1 OVERVIEW

1.1 Project Description and History

Southwest Marine, Inc. (SWM) is planning to reconfigure a portion of its shipyard area, currently occupied by three abandoned marine railways, by constructing a new section of sheetpile bulkhead. Material will then be placed in the area behind the sheetpile bulkhead to create additional upland yard space for the facility. Figure 1 identifies the general location of the proposed bulkhead extension and yard improvement project (henceforth, project) relative to SWM's shipyard and facilities. Figures 2 and 3 present detailed plan and cross-sectional views of the bulkhead improvement area and proposed construction activities. The project will be performed in two phases; the general sequence of construction is illustrated as a typical cross-section on Figure 2.

Phase 1 of the project will be accomplished by removing marine structures from the area and installing a new section of sheetpile bulkhead across the face of the abandoned railways. SWM has received a 401 Water Quality Certification (WQC; File No.03C-065) from the California Regional Water Quality Control Board, San Diego Region (SDRWQCB) for Phase 1 activities. All other permits have been received, including an approved mitigation plan, a Phase 1 Water Quality Monitoring Plan (WQ Plan), and a provisional U.S. Army Corps of Engineers (Corps) permit.

After completion of Phase 1, Phase 2 construction activities will commence and involve relocating and isolating existing impacted sediments within the project site. First, impacted sediments immediately inside the new bulkhead alignment will be relocated to an area farther back (shoreward) within the yard improvement area (as shown on Figure 3). Second, the excavated area and the remainder of the bulkhead-enclosed area will be backfilled with imported, clean, granular fill to the elevation of the surrounding grade (approximately +12 feet Mean Lower Low Water [MLLW]). After adequate settlement, the area will be paved to support yard operations.

In support of obtaining a 401 WQC for Phase 2 construction activities, SWM met with the SDRWQCB on November 12, 2004 to finalize additional data collection and evaluation requirements. This Site Investigation and Characterization Report (Report) presents the required information and evaluations. The provisional Corps permit for the overall project is contingent on receipt of the 401 WQC for Phase 2 construction activities, so receipt of the Phase 2 WQC, and subsequently, the Corps permit, will allow construction to commence.

In order to maintain projected facility use requirements, SWM desires to incorporate Phase 1 construction into the early 2005 construction season, requiring completion of the bulkhead wall before April 15 (start of least tern season). Maintaining this schedule will require the following interim steps:

- Submittal of this Report to the SDRWQCB – **January 12, 2005**
- SDRWQCB review and public comment (expected two month duration) – complete by **March 13, 2005**
- Receipt of the Phase 2 WQC from the SDRWQCB – **March 16, 2005**
- Receipt of the Corps permit – **March 21, 2005**
- Start construction of bulkhead wall – **March 30, 2005**
- Completion of bulkhead wall construction – **April 14, 2005**

1.2 Purpose of this Report

This Report was prepared for the SDRWQCB to support SWM's application for a 401 WQC from the SDRWQCB for Phase 2 construction activities. This Report provides information specifically requested by the SDRWQCB in their evaluation of the proposed project, as documented in a letter dated September 14, 2004, and as discussed during a meeting on November 12, 2004. This Report supplements previous submittals to the SDRWQCB, as indicated below.

In August 2004, SWM submitted to the SDRWQCB a Data Evaluation Report (DER) for Phase 2 Activities (Anchor 2004a), that provided information supporting issuance of a 401 WQC and Waste Discharge Requirements (WDR) for Phase 2 of the work. Specifically, the DER included a detailed evaluation of the long-term potential for impacts to the surface waters of San Diego Bay associated with the placement of imported fill over impacted sediments behind the sheetpile wall. The DER documented the results of analytical testing of two groundwater samples obtained from chemically impacted sediments in the project area, and presented modeling results of tidally influenced groundwater flow and resulting potential water quality impacts from the project. The DER also included a revised WQ Plan to address both Phase 1 and Phase 2 activities.

After reviewing the DER, the SDRWQCB issued a letter dated September 14, 2004, in which the SDRWQCB requested additional site investigation and characterization activities to better define the lateral and vertical extent of waste impacts at the site, and further evaluation of mechanisms of waste transport through soil and groundwater. This letter also required SWM to submit the proposed methods and approach for this investigation in a Site Investigation Workplan (Workplan) prior to initiating field activities. SWM prepared and submitted the requested Workplan in November 2004.

SWM subsequently met with SDRWQCB staff on November 12, 2004 to discuss comments on the Workplan. At this meeting, the SDRWQCB requested the following modifications to the Workplan, necessary for SWM to receive a 401 WQC:

- Additional soil sampling from the underlying Bay Point Formation from each planned sediment core sample location
- Subdivision of sediment cores into a maximum of 2 foot intervals for chemical analyses, rather than compositing all sediment into a single sample from each core

The requested changes were made to the Workplan, and SWM carried out the field investigation program in late November and early December of 2004. The September 14, 2004 letter from the SDRWQCB required that the results of the investigation be documented in a Site Investigation and Characterization Report. (The field investigation program and related chemical analyses are described in further detail in Section 3 of this Report.) This document fulfills the SDRWQCB's request and has been prepared in accordance with the requirements documented in the September 14 letter.

During discussions in 2004, the SDRWQCB expressed to SWM their intent to consider this site, and its impacted sediments, as an inactive landfill subject to the requirements of the SDRWQCB's Order No. 97-11 and its Addendum No. 1 (SDRWQCB 1997 and 2000), which govern waste discharge and post-closure requirements for closure of inactive site landfills. This site characterization and this Report demonstrate that the proposed project will fulfill the requirements of Order No. 97-11. Specifically, this investigation identifies the nature and extent of existing site waste which will be contained on-site by project construction, and evaluates the ability of the proposed project to meet waste containment requirements (landfill closure, as referenced by Order No. 97-11), and hence its overall protectiveness of site surface water and groundwater.

1.3 Structure of this Report

This Report addresses the study objectives and concerns documented in the SDRWQCB letter dated September 14, 2004. The study objectives include the following specific elements, listed with the corresponding section where they are addressed in this Report:

- Site Conceptual Model – updated based on the results of the investigation (documented in Section 5.5)
- Source Characterization – results of an investigation of all potential sources of waste constituent discharges to the soil, groundwater, and stormwater conveyance systems, based on historical records of operations, site reconnaissance, and previous and current studies (documented in Section 5.4)
- Geologic Characterization – subsurface materials at the site, including the hydrogeologic characteristics and identification of geologic features that may affect groundwater flow and contaminant migration, are presented (documented in Section 5.1)
- Groundwater Flow Characterization – the magnitude and direction of groundwater flow at the site, in both the horizontal and vertical directions, for all water bearing units potentially affected by the waste constituents (documented in Section 5.2)
- Waste Constituent Characterization – characterization of the lateral and vertical extent of waste constituents in soil, sediment, and groundwater to existing "background" conditions (documented in Section 5.3, and in Tables 1 through 5).
- Fate and Transport – assessment of the movements, dispositions, and transformations of waste constituents within and between environmental media, such as soil, surface water, groundwater, and biota (documented in Section 6, and in Tables 7 through 9)
- Description of Field Methodologies used for the investigation and characterization study (documented in Section 3.2)
- Chemical Analyses – description of the analytical methods used for each environmental medium, adequate to identify the full range of waste constituents that may occur (documented in Section 4)

- Sample Locations and Numbers – the locations, type, and number of samples identified and shown on a site map and cross-sections; sufficient to identify the nature of waste constituent sources, to define the distribution of waste constituents in the subsurface, and to provide data for fate and transport evaluation, risk assessment, remedy selection, and remedial design, if necessary (documented in Section 3.1 and 3.2.1)

2 SUMMARY OF PREVIOUSLY AVAILABLE INFORMATION

2.1 Site Layout and History

SWM's San Diego shipyard is located on the eastern shore of San Diego Bay, approximately 1 mile south of the Coronado Bridge. The shipyard has been leased by SWM from the San Diego Unified Port District since 1979, during which time SWM has provided ship repair, alteration, and overhaul services for various commercial and government customers (the Navy being a prominent example).

The bulkhead extension project area under consideration will be constructed across the mouth of an intertidal embayment around the landward end of Pier 1. The embayments are occupied by abandoned shipway marine railways: Ways 1 on the northwest side of Pier 1, and Ways 2 and 3 on the southeast side (see Figure 2).

A history of the SWM property area is summarized and documented in Woodward-Clyde (1995), Exponent (2003), and the San Diego Unified Port District (2004). The subject site has been used for industrial operations since the early 20th century, when the current shoreline was created by filling between 1906 and 1914. The property area was subsequently used by San Diego Marine Construction Corporation for marine vessel construction, repair, and maintenance. Historical evidence (San Diego Unified Port District 2004) indicates that marine railways were present in the project area since approximately the beginning of San Diego Marine Construction Corporation's use of the site. From this time through to the mid-1970s, sandblast and paint wastes were discharged directly to the Bay from upland and drydock areas.

Between 1952 and 1974, a pair of wastewater settling ponds were present on the adjacent San Diego Gas and Electric (SDG&E) property for separation of oil and water from the SDG&E power plant. These ponds may have contributed machine oils, hydraulic fluid, and possibly polychlorinated biphenyls (PCBs) to the subsurface (San Diego Unified Port District 2004) The approximate locations and extents of these previously existing settling ponds are shown on Figure 2.

During the 1980s and 1990s, the three marine railways in the project area generally accommodated about one to seven vessels annually for repair and maintenance, with abrasive sandblasting activities common (SWM 2004). The railways were abandoned in 1992 (Ways 1) and 1997 (Ways 2 and 3). Comprehensive pollution prevention programs and best management practices have been in place since the mid-1980s, preventing releases of contaminants from construction activities or from stormwater runoff (E^x^ponent 2003).

2.2 Geology and Groundwater

Prior to the field investigation documented in this Report, the main source of information on sediment conditions at the site was the result of a detailed site sediment investigation conducted by SWM and the adjoining NASSCO shipyard in 2002 and 2003 to determine the existence and extent of potential chemical contamination associated with historical operations at the shipyards. This investigation, documented by E^x^ponent (2003) in the report entitled, "NASSCO and Southwest Marine Detailed Sediment Investigation," was conducted in response to SDRWQCB Resolution Nos. 2001-02 and 2001-03 and subsequent Water Code Section 13267 letters issued to the shipyards. The investigation involved a series of surface and core samples taken from site sediments throughout both shipyards' leasehold areas and beyond. Figures 1 and 2 identify the locations of cores and sediment surface samples taken during the 2002/2003 investigation.

Information on subsurface geology and groundwater characteristics was provided by the site sediment investigation prepared by E^x^ponent (2003) described above, and by a series of soil probes and borings advanced for geotechnical design of the bulkhead (Christian-Wheeler 2002).

These data sources indicate that the site is underlain by the following sequence of soil/sediment types:

- Upland areas are underlain by fill materials originally placed when the site land was constructed in the early 20th century. More recent sand fill areas within landward portions of the original railway embayment (Figure 2) were created during a 1998 remedial action undertaken by SWM under SDRWQCB oversight.
- Three to 11 feet of soft, geologically recent, surface sediments were observed throughout the offshore areas by E^x^ponent (2003) and by Christian-Wheeler (2002). These surface sediments consist of interbedded silts, clayey silts, and sandy silts, and contain the elevated chemical concentrations observed in the study.

- The offshore surface sediments and upland fill materials are underlain by the firmer Bay Point Formation, which is Quaternary in age and consists of intermixed, medium dense to dense sands and silty sands, and stiff to hard silty to sandy clays.

Groundwater at the site is tidally influenced, responding to the tidal action of San Diego Bay. The ground surface elevation at the site is approximately 12 feet MLLW, while tidal levels fluctuate roughly between elevations -1 and 7 feet MLLW. Borings conducted by Christian-Wheeler (2002) indicated groundwater at depths of 8.5 to 10 feet below ground surface (bgs) in upland areas. Work conducted by ENV America on the neighboring SDG&E parcel indicated groundwater at approximately 15 feet bgs in upland areas (ENV America 2002).

2.3 Waste Characterization of Existing Sediments

Sediments along and in the vicinity of the planned bulkhead are best represented by cores SW04 and SW08, which represent sediments in close proximity to the alignment of the bulkhead (Figure 2). Sediment chemistry from various depth intervals in these cores are summarized in Table 1. Impacted sediments were identified in both cores to a depth of about 4 feet (although core SW04 could not be penetrated beyond this depth because refusal was reached, so deeper materials could not be sampled at this location).

The primary constituents of concern (COCs) in the impacted sediments include elevated metals, PCBs, and polycyclic aromatic hydrocarbons (PAHs). It is likely that these chemicals exist as sorbed phases on clays and carbon-rich particulate matter in the fine-grained sediments, thus limiting their bioavailability. This is supported by bioassay testing and microbial analysis by E^{x}ponent (2003), which indicate that the sediments do not exhibit significant toxicity.

In 1998, under the SDRWQCB's oversight, SWM dredged chemically impacted sediments from the landward (northeastern) portions of this embayment, and replaced the dredged material with clean sand fill. Pursuant to Order No. 98-38, SWM was required to remove sediments to depths sufficient to reach mandated sediment cleanup levels for copper (810 mg/kg), lead (231 mg/kg), mercury (4.2 mg/kg), zinc (820 mg/kg), and PCBs (0.95 mg/kg). Figure 2 identifies the areas where sediments were removed and clean sand fill placed (shown on the figure as "Sand Fill Areas"), and Figure 3 shows a typical section through the sand fill in cross-section. Confirmation grab samples of surface sediments were obtained at regularly spaced intervals after dredging these areas to confirm that all sediments exceeding the relevant cleanup standards were removed. The locations of the confirmation surface samples are shown on Figure 2. The analytical results from these samples are summarized in Table 2, and demonstrate that sediments remaining below the sand fill have bulk concentrations well below the cleanup levels mandated by Order 98-38 (SWM 1998). Table 2 also compares the confirmation sediment concentrations to reference background concentration levels (Exponent 2002; see further discussion of background concentrations in Section 4.1).

As part of SWM's DER for Phase 2 activities (Anchor 2004a), a pair of temporary well points were installed within the upper 3 feet of site sediments near the alignment of the planned bulkhead wall. Porewater samples were obtained from each well point and analyzed for metals, PAHs, and PCBs. The locations of these two well point samples are shown on Figure 2, and the chemistry results are documented in Table 3.

The well point samples detected dissolved metals (arsenic, cadmium, chromium, lead, nickel, selenium, silver, and zinc) and PCBs. PAHs were not detected in the well point samples. These concentrations were used to predict porewater concentrations entering surface waters from the completed bulkhead project, accounting for tidal mixing behind the bulkhead wall. Results of this evaluation were presented in the previous DER and indicate that porewater expressed from the project footprint will have chemical concentrations below chronic water quality criteria upon entry into site surface waters, and are not expected to impact ambient surface water quality.

2.4 Data Gaps

This previously available site information has been supplemented by the current site investigation and characterization program requested by the SDRWQCB and presented in this Report. At the request of the SDRWQCB, the site investigation has been designed to address the following data gaps:

- Characterize lateral and horizontal extent of waste constituents within and below the chemically impacted surface sediments.

- Evaluate the presence and extent (if any) of chemical impacts to upland fill soils outside the perimeter of the project area and in the underlying Bay Point Formation.
- Document the groundwater flow regime and gradient in the immediate project area and adjacent areas.

3 SAMPLING PROGRAM

3.1 Overview of Sampling Design

This site investigation provides additional vertical and lateral characterization of COCs in the soil, sediment, and groundwater at the SWM bulkhead extension/yard improvement area. All field and laboratory work has been performed in accordance with the methods and procedures described in the Workplan and accompanying Quality Assurance Project Plan (QAPP; Anchor 2004b), while incorporating additional requirements requested by the SDRWQCB during a meeting with SWM representatives on November 12, 2004.

Continuous core samples were collected at three stations (labeled 1, 2, and 3 on Figure 2) to sample the upland fill and underlying Bay Point Formation. Composite samples from the Bay Point Formation at Stations 1 and 2 were analyzed for total organic carbon (TOC), metals, PCBs, and PAHs (Table 4). Samples from distinct geologic layers within the overlying material were also collected and archived for future analysis, if needed. At Station 3, samples were also collected from distinct geologic layers within the upland fill and the Bay Point Formation. The Bay Point Formation sample from Station 3 was archived and the upland fill samples were analyzed for TOC, metals, PCBs, and PAHs (Table 3).

Two additional core samples were collected near the previous well point sample locations (July 2004), and are labeled Stations 4 and 5 on Figure 2. Composite samples were collected from distinct geologic layers (determined visually), or every 2 feet if the material appeared homogeneous, for the sediment overlying the Bay Point Formation. These samples were analyzed for metals, PCBs, and PAHs. In addition, the upper 2 feet of the Bay Point Formation was also collected for sediment characterization analyses at Stations 4 and 5.

To determine the spatial extent of the chemical concentrations and the hydrologic characteristics of the site groundwater regime, a pair of nested temporary monitoring wells (piezometers) were installed at sample Stations 1, 2, and 3 (Figure 2). Groundwater was sampled from both the Bay Point Formation (well number 1 in each pair) and from the overlying upland fill and surface sediments (well number 2 in each pair). Each groundwater sample was analyzed for metals, PCBs, and PAHs (Table 5).

Logs of all cores and diagrams depicting the monitoring well installations are provided in Appendix A. Note that the logs indicate "gaps" for some depth intervals, resulting from the fact that incomplete sediment recovery was obtained for some of the cores.

Groundwater elevations were also measured during ebb, low, flood, and high tidal conditions to document hydrologic gradients for the upland fill, surface sediments, and underlying Bay Point Formation.

3.2 Field Methodologies

Detailed methods for sample collection, handling, and shipping are described in the Workplan (Anchor 2004b), and summarized in this section. Procedures for the following tasks are included:

- Locations of sampling stations
- Collecting and compositing sediment core samples
- Collecting groundwater samples and groundwater elevation measurements
- Sample packaging, handling, and shipping procedures
- Completing standard forms to document the collection effort and field conditions

3.2.1 Sample Locations and Numbers

Five sample locations are shown on Figure 2. Monitoring well and core locations were assigned designations corresponding to their station number (i.e., monitoring wells MW-1.1 and MW-1.2 at Station 1; sediment core SW-4 at Station 4, etc). In the monitoring well designations, the first number indicates the sample station and the second number identifies whether it is the deeper well (1) or the shallower well (2).

At three stations (Stations 1, 2, and 3), a continuous core sample was taken and two monitoring wells installed. Stations 1 and 2 (continuous cores SW-1 and SW-2 and wells MW-1.1, MW-1.2, MW-2.1, and MW-2.2) are located in the sand fill areas near the railways' shoreward terminus where impacted sediments were previously removed. Station 3 (continuous core SW-3 and wells MW-3.1 and MW-3.2) is located in the paved uplands area immediately east of the project area. Stations 4 and 5 (cores only; labeled SW-4 and SW-5) were co-located as close as possible to previous well point stations (WP-1 and WP-2) sampled in July 2004. Station 4 (core SW-4) is within surface sediments between Marine Railway Number 2 and Number 3. Station 5 (core SW-5) is located to the east of Pier 1 within the existing ship cradles.

Station locations were chosen relative to existing conditions in the field and as close as possible to locations described in the Workplan. Stations 1 and 2 were located by measuring the distance across the sand fill areas and placing the stations equidistant from either side of the enclosed area. Station 3 was moved slightly upland from the original location to avoid utility lines underneath the pavement. Stations 4 and 5 were placed as close as possible to the previous well point stations described above. Due to restrictions with the coring equipment, Station 4 was relocated between marine railways 2 and 3 at the water's edge at low tide, moving the original location slightly shoreward. Station 5, also restricted due to the coring equipment, was relocated slightly seaward of the original location to provide a safe and stable platform for the equipment and field crew. All of the station locations were measured in the field relative to existing landmarks, and are shown to scale on Figure 2.

3.2.2 Sample Collection

3.2.2.1 Direct-Push Continuous Cores

Continuous soil cores were collected from each station using a direct-push sampling rig, to a target depth of at least 4 feet into the Bay Point Formation or until refusal. Five foot acetate core liners were decontaminated immediately prior to use following the procedures outlined in the QAPP (Anchor 2004b). Care was taken during sampling to avoid contact of the sample tube with potentially contaminated surfaces. Push core equipment (i.e. sample tubes and extension rods) was steam cleaned prior to use and between stations.

Each core was split open vertically, photographed, and geologically characterized into a core log. In cases of incomplete recovery, the top of the recovered sediment was assumed to correlate to the top of the cored interval. The core was sectioned into two distinct geologic layers, the upland fill or surface sediment layer, and the underlying Bay Point Formation. At sampling Stations 1 and 2, a composite sample was collected from the Bay Point Formation layer and analyzed for TOC, trace metals, PCBs, and PAHs. Samples from the overlying material were archived.

At Station 3, two composite samples were collected that represented distinct geologic layers of the upland fill material. A sample was also collected from the underlying Bay Point Formation and archived.

At Stations 4 and 5, composite samples were collected from four distinct layers that were visually determined from the overlying sediment along with a composite sample from the upper 2 feet of the Bay Point Formation. Each composite sample was split into 50-gram glass containers for laboratory analysis of TOC, trace metals, PCBs, and PAHs.

At all stations, sampling information, including sample identifier, sample location, date and time of sampling, requested analysis, and sampler name, was recorded on a chain-of-custody form and on the sampling jar label. Following collection, samples were placed immediately on ice in a cooler and taken to Federal Express for delivery to CRG Laboratory the next business day by 10:30 a.m. Chain-of-custody forms were filled out as the samples were placed in the coolers and were kept with the samples in Ziplock bags at all times. The coolers were tracked the next business day using the Federal Express tracking numbers to ensure arrival at the lab.

3.2.2.2 Groundwater

Upon completion of the continuous-push cores at Stations 1, 2, and 3, two temporary monitoring wells were installed at each station. One well was installed into the same location the core sample was taken from and the other was installed approximately 1 meter from the first. Both were installed using direct-push methods. The monitoring wells consisted of 0.75 inch pre-packed well screens as per the typical detail shown on Figure 4. One screen was set approximately 1 foot below the upper boundary of the Bay Point Formation materials, and the other was placed in the overlying fill material just above the underlying Bay Point Formation materials. This process was used to determine vertical and horizontal groundwater gradients in each material type.

Groundwater elevations were measured in each monitoring well during ebb, low, flood, and high tidal conditions to characterize hydrologic gradients for the upland fill, surface sediments, and underlying Bay Point Formation. Groundwater elevations were measured using a decontaminated, electronic well probe and tape measure lowered into each well and recorded on a data sheet. The maximum tidal exchange in San Diego Bay for the day of the water level monitoring (December 6, 2004) was 3.2 feet.

Groundwater samples were collected from each well and analyzed for salinity, total dissolved solids (TDS), PAHs, dissolved metals, and PCBs. Groundwater samples were collected 24 hours after each of the wells were installed using a peristaltic pump with disposable tubing. To ensure maximum potential for groundwater inclusion, all sampling was conducted as close to low tide as possible, particularly in the wells located near the shore. Wells were purged of at least three well volumes of groundwater prior to collecting samples, which were collected by discharging water from the peristaltic pump directly into the laboratory-provided sample jars. All samples collected for dissolved metals analyses were filtered with a 0.45 µm in-line filter prior to placement in the sampling bottles. Sampling information, including sample identifier, sample location, date and time of sampling, requested analysis, and sampler name, was recorded on a chain-of-custody form and on the sampling jar label. Following collection, samples were placed immediately in a cooler on ice and delivered to the laboratory as described above.

3.2.3 Sample Processing and Record Keeping

All sample handling, labeling, packaging, documentation, chain-of-custody forms, and shipping were accomplished and recorded in full accordance with the procedures detailed in the Workplan and associated QAPP (Anchor 2004b). Sample station duplicates were obtained and analyzed as described in the QAPP to ensure project quality control objectives were met.

Results of chemical analyses, and validation of the chemistry data, are presented in the next section.

3.2.4 Field Quality Control Sample Procedures

The following quality control samples were collected in the field and analyzed in the testing laboratory with the other samples:

- Station Location Duplicates – Field duplicate samples are collected to assess the variability of chemical concentrations at the station location and provide a measure of the total analytical bias (field and laboratory variance). One field duplicate was collected from core SW-5 at depth interval 5 feet to 6 feet 5 inches and monitoring well MW 2.2, which was located in the overlying surface sediments.

3.2.5 Field Documentation and Chain-of-Custody Forms

A field log book was maintained throughout the study to document daily field activities and field observations. Core logs were produced for each continuous-push core collected. Photo documentation of each core was collected and identified in the field book with sample identification and photograph number. Repositioned station locations were noted during field sampling to update the station location map after sampling was completed.

Sample labels were completed for each sample, and included station identification, date, and time, sampling personnel, preservative, and analysis required. All labels were completed using indelible ink and covered with clear tape to prevent smearing.

Chain-of-custody forms were completed at the end of each sampling day to trace samples from collection to final disposition. The chain-of-custody form included sample identification, collection date and time, matrix, analysis requested, number of containers, and preservative. Chain-of-custody forms were completed in triplicate with one copy retained in the field notebook.

4 CHEMICAL ANALYSES

4.1 Soil/Sediment Chemistry

A total of 14 soil/sediment samples were analyzed for chemical constituents from the five sampling stations (Figure 2), and represent upland fill, overlying sediment, and Bay Point Formation material. Table 4 presents the sediment chemistry results for metals, PAHs, and PCBs measured in each of the soil/sediment samples.

For comparison purposes, and to comply with SDRWQCB guidance, chemical concentrations measured in this study have been compared to "background" chemical concentrations. In this Report, reference pool sediment concentrations as determined by Exponent in their 2003 study are considered to be reasonably representative of background conditions, and are included in the first column of Table 4 for comparison purposes.

Metal concentrations measured in the upland fill material at core SW-3 and the Bay Point Formation material in cores 1 and 2 were all below background concentrations (Table 4). Metal concentrations were consistently measured above background concentrations in the upper surface sediment layers in cores SW-4 and SW-5, but were below detection limits in underlying sediment and Bay Point Formation samples. Elevated metal concentrations were identified to a depth of 5 feet 9 inches in core SW-4, and to 2 feet in core SW-5. Particularly high concentrations were noted in these samples for copper, lead, and zinc, with maximum concentrations of 6,950 mg/kg, 955 mg/kg, and 6,630 mg/kg, respectively.

Total PCB concentrations were detected above reference concentrations in the same surface sediment layers containing elevated metals concentrations. The maximum total PCB concentration measured was 5,198 µg/kg in core SW-4, between depths of 2 feet1 inch and 3 feet 6 inches; this is above the reference concentration of 170 µg/kg. Elevated total PCB concentrations were identified to the same depths in these cores as for metals (to 5 feet 9 inches in core SW-4, and to 2 feet in core SW-5).

PAHs were also detected in the same samples where metals and total PCBs were elevated (Table 4); however, reference values do not exist for PAHs so no comparison is provided.

4.2 Groundwater Chemistry

Three pairs of temporary monitoring wells, at Stations 1, 2, and 3, were sampled for groundwater within the project area (Figure 2). The results of the groundwater chemistry analyses are shown in Table 5 along with California Toxic Rule (CTR) water quality criteria for comparison. These results show that low concentrations of dissolved metals were detected in all six wells. However, only nickel exceeded the CTR criteria in well MW-2.1 (screened in the Bay Point Formation) and copper and nickel exceeded the criteria in well MW-3.1 (also screened in the Bay Point Formation).

All other detected concentrations were below the CTR criteria. Low concentrations of some PAHs were also reported in all six wells, however, several were below the analytical detection limits. PCBs were detected only in well MW-1.1 (screened in the Bay Point Formation), with the total PCB concentration of 0.067 µg/L exceeding the CTR criteria of 0.03 µg/L.

4.3 Data Validation

Data validation and review were performed on the seven water samples and 14 sediment samples submitted to Anchor by CRG Marine Laboratories of Torrance, California. The two matrices are reported in separate data validation reports, attached to this Report in Appendix B.

5 SITE CHARACTERIZATION

A site conceptual model is a representation of the site's potential chemical sources, effected media, potential pathways to exposure, and receptors.

5.1 Geological Characterization

Figure 2 depicts a typical cross-section through the site and the geological layers observed in the field investigation. Geologic logs from the soil borings taken as part of this investigation are shown in Appendix A. These logs confirm earlier conclusions about the geology of the site discussed in Section 2.2. The following details specific to the proposed project area supplement and/or verify the information summarized in Section 2.2 :

- Up to 6.5 feet of recent sand fill was observed in cores SW-1 and SW-2, representing backfilling of areas remediated by SWM in 1998.
- Fill materials and sediments overlying the Bay Point Formation in the upland area (core SW-3) are approximately 15 feet thick.
- Eleven to 18 feet of soft, geologically recent, surface sediments were observed in the offshore areas (cores SW-4 and SW-5). These surface sediments were dominated by gray silty sands.
- The offshore surface sediments and upland fill materials are underlain by the firmer Bay Point Formation at all sampling stations.

5.2 Groundwater Flow Characterization

Water levels were measured in each monitoring well under ebb, low, flood, and high tide conditions to determine the magnitude and direction of groundwater flow at the site. Table 6 provides a summary of the water level information. In general, saturated conditions were observed approximately 7 feet bgs in upland areas of the project area, typical of tidally influenced conditions.

The water level information from upland and offshore monitoring wells was used to generate piezometric surface maps for the project area for shallow and deep geologic units. Examples of these maps at low tide and high tide conditions are shown in Figures 5 through Figure 8.

The following provides a summary of the findings from the water level monitoring:

- The maximum observed groundwater gradient was 0.0047, and occurred during low tide with flow in a South/Southwest direction. This direction is essentially orthogonal to the uplands shoreline areas with flow towards the Bay. Gradient and flow were consistent for formational and fill materials.
- A complete reversal of flow during high tide was not observed during the monitoring described here, but the gradient essentially fell to a value of zero for groundwater flow from land to the Bay during high tide. It is likely there is a complete reversal of gradient during extreme tides.
- The vertical gradient between formation and fill materials was very low and reversed from net downward at low tide to net upward during high tide.

Because of the tidal action at the site, there is a small net flow of water emanating from upland areas to San Diego Bay through sediments bordering the site. The data from the monitoring wells show there is not a significant difference in the flow characteristics of groundwater in upper formational sediments and recent sediments. These data indicate the system can be functionally treated as one water bearing unit.

5.3 Waste Constituent Characterization

Concentrations of COCs in sediments, soil, and groundwater are summarized here for the upland fill, surface sediment, and Bay Point Formation, to describe both the vertical and spatial extent of COCs in each. This information supplements the results of confirmational sampling that was done following SWM's 1998 sediment removal project (described in Section 2.3).

Distinct spatial gradients of sediment chemical concentrations were found both vertically and horizontally in the improvement area. Figures 9 and 10 illustrate, in plan view and in cross-sectional view, the distribution of chemically impacted sediments and groundwater at the project site. The general observed trends include:

- Concentrations of constituents measured in groundwater samples were generally below CTR concentrations in both the upland fill and Bay Point Formation wells.
- The horizontal distribution of COCs above relevant criteria was confined to the seaward portions of the project area, in the upper near-surface sediment at Stations 4 and 5 (Figures 9 and 10).

- The vertical distribution of COCs above relevant criteria was confined to the upper near-surface sediment at Stations 4 and 5 (Figures 9 and 10).

The few COCs that were measured in groundwater at concentrations marginally above CTR values (nickel, copper, and total PCBs) were from the Bay Point Formation (wells MW-2.1 and MW-3.1; Table 5). Groundwater samples from the wells located in upper fill material did not have any elevated concentrations of COCs.

The horizontal distribution of elevated COCs in the project area was confined to the seaward sediment samples at Stations 4 and 5 (cores SW-4 and SW-5; refer to Figure 9). These stations represent the western extent of the project area both north and south of Pier 1 (Figure 2). Concentrations measured in these sediment cores are consistent with results found by E^{x}ponent in 2003 at core SW08 (Table 1), which also detected elevated COC concentrations in this area. The upland sampling station, Station 3, did not have elevated COCs in the upland fill material (Table 4). In the sand fill area where Stations 1 and 2 are located, SWM's 1998 cleanup measures removed sediment with elevated COCs to depths ranging from 3.5 to 12 feet; the excavated areas were subsequently filled with clean sand fill material (as described in Section 2.3).

Elevated COC concentrations are confined to the upper surface sediment layers at Stations 4 and 5 (Figure 10). Concentrations of metals and total PCBs are above background concentrations (as defined by E^{x}ponent 2003), above a depth of 5 feet 9 inches at Station 4 and above a depth of 2 feet at Station 5 (Table 4). The sediment layers below these depths extending down to the Bay Point Formation material do not show elevated COC concentrations. The upland fill material at Station 3 also did not have elevated concentrations of COCs, nor did Stations 1 and 2, as previously described. Bay Point Formation material had low concentrations of metals and generally no detected organics at all the sampling stations. The metal concentrations detected likely represent natural background levels.

5.4 Source Characterization

Cores taken during the E^{x}ponent (2003) site investigation in 2002 and 2003, and those taken during this study, indicate that chemical concentrations were generally highest in the surface sediment and decreased with depth. Elevated chemical concentrations in soil and sediment are seen to be concentrated in shallow, near-surface sediment layers (Figures 9 and 10), as follows:

- To a depth of 4 feet in cores SW04 and SW08 taken in 2002/2003 (Exponent 2003)
- To depths ranging from 3.5 to 12 feet excavated and sampled during SWM's remediation of the landward portions of the site (SWM 1998)
- To depths of 5 feet 9 inches and 2 feet in cores SW-4 and SW-5 sampled during this study

In each case, underlying sediments have been shown to be free of chemical concentrations above background concentrations. This is consistent with the fact that the surface sediments were deposited in recent industrial times in the vicinity of the marine railway. The nature of the elevated chemical concentrations (metals and PCBs) is consistent with past industrial uses of the marine railways (repair, maintenance, and sandblasting). Therefore, the potential sources of waste constituent discharges at the project site appear to be, overall, primarily confined to historical ship repair and maintenance activities.

There does not appear to be chemical impacts to shallow porewater from the sediment bulk chemistry observed in this investigation. As is discussed in Section 5.3, more chemical detections were noted in the deeper monitoring wells screened in the Bay Point Formation, than from the shallower wells screened in overlying sediment. The concentrations of some metals observed in wells screened in the Bay Point Formation likely reflect ambient conditions.

SWM has controlled all stormwater runoff from the site since the mid-1980's, routing all surface water runoff into a site stormwater collection and treatment system. As a result, site groundwater chemistry is unaffected by site surface water influences. This is supported by the relatively low concentrations of chemicals observed in shallow monitoring wells during this study.

5.5 Site Conceptual Model

Since the surface sediments are laterally bounded by timber and steel bulkhead walls that form the perimeter of the project area, near-surface sediments with elevated chemical concentrations in the project area are not continuous with adjacent upland soils. Neither the 2002/2003 site investigation nor the 1998 remedial action involved samples taken from upland areas immediately around the bulkhead extension project area. Samples taken from Station 3 for this study indicate that the upland fill materials are free of significant chemical impacts to sediment and to groundwater.

Based on groundwater measurements made as part of this study, groundwater at the site moves in a generally horizontal direction from the uplands toward the Bay. Within and adjacent to the project site, groundwater is influenced both by overall regional gradients and by tidal action.

The potential receptor of concern for this project is the surface waters of San Diego Bay. The primary route for possible water-quality impacts is potential contaminant release from sediments behind the bulkhead, as a result of groundwater seepage through and under the sheetpile, via a sediment to groundwater to surface (Bay) water pathway. Porewater, driven by tidal flushing and groundwater gradients, could move through, around, or under the sheetpile bulkhead, thereby coming in contact with the surface water. Infiltration and percolation of surface water will be relatively insignificant because the site will be paved.

Construction of the project will provide both horizontal and vertical isolation and confinement of the existing contaminated sediments underlying the area, restricting the potential for contaminants to leach into the surrounding environment. Vertical confinement will be provided by placement of up to 15 feet of fill and an impervious asphalt surface. Horizontal confinement will be provided by the installation of sheetpiling across the front of the former shipways to a depth of about 20 to 25 feet below existing mudline and about 8 to 10 feet into the relatively impermeable Bay Point Formation, which underlies the more recent surface sediments. The presence of the sheetpile wall as a relatively impervious barrier to water flow will significantly restrict flow of aqueous contaminants into receiving waters.

To provide for additional protection, the project has been designed with a clean, imported sand buffer between impacted sediments and the bulkhead wall (Figure 3). Impacted sediments along the interior of the bulkhead will be relocated to the interior of the project site footprint and replaced with imported, clean, granular fill sand. This sand buffer will both increase the distance the porewater must move and will increase tidal attenuation, adsorption, and partitioning of the migrating water within the sand as it approaches the bulkhead and surface waters of San Diego Bay.

Modeling of tidal attenuation presented in the DER for Phase 2 activities (Anchor 2004a) indicates that the overall effect of the project's design features (sheetpile bulkhead and clean sand buffer) will be to decrease concentrations in the groundwater/porewater at least 400-fold before surface waters are reached. Based on this evaluation, porewater expressed from the project site via the sediment-groundwater-surface water pathway is predicted to have chemical concentrations well below chronic WQC upon entry into site surface waters, and thus is not expected to impact ambient surface water quality.

As requested by the SDRWQCB, additional modeling has been performed using the results of this site investigation program and the updated Site Conceptual Model, to supplement and verify the conclusions cited above from the previous DER. The methods, assumptions, and results of this additional modeling are presented in the next section.

6 FATE AND TRANSPORT

Consistent with SDRWQCB requirements as documented in the letter dated September 14, 2004, this section presents a rigorous and updated evaluation of the sediment to groundwater to surface water chemical transport pathway, thus providing an assessment of the movements, dispositions, and transformations of waste constituents in soil, sediment, and groundwater within and between environmental media (soil, sediment, groundwater, surface water, and potentially biota).

Information collected during the current site investigation was combined with data collected during previous site investigations and the Site Conceptual Model (Section 5.5), to determine the fate and transport of waste constituents using a standard flow and partitioning model (Reible 1998, promulgated by the Corps). The end result of this modeling was to quantify potential water quality impacts to surface waters, to update the Site Conceptual Model (Sections 5.4 and 5.5), and to update conclusions cited in the DER (Anchor 2004a).

6.1 Modeling Approach

One-dimensional chemical transport modeling (Reible 1998) was used to conservatively assess the long-term effectiveness of the sheetpile wall as a horizontal barrier, in conjunction with clean fill placed behind the wall, to mitigate the potential transport of chemicals via the sediment-groundwater-surface water pathway to the surface waters of San Diego Bay. Reible's (1998) modeling approach is described in an appendix to nationally recognized Corps guidance on the design of sediment caps: *Guidance for Subaqueous Dredged Material Capping* (Palermo et al. 1998). Results predicted from this conservative modeling approach have then been evaluated against actual groundwater concentrations to assess the overall protectiveness of the project.

The model described by Equation B32 of Reible (1998) was executed in Microsoft Excel. This model describes advective/diffusive transport of a dissolved chemical through a homogeneous porous media, such as clean quarried sand or dredged material. The output of the model is expressed as the concentration of the COCs in porewater at specified times as it exits the project limits and enters surrounding surface waters. The model conservatively assumes no biodegradation of the chemical takes place over time.

For this assessment, copper, lead, zinc, and total PCBs were selected as COC's for modeling due to their relatively high concentrations in the project area. Although groundwater samples indicated virtually no significant chemical impacts to site groundwater at Stations 1, 2, and 3, theoretical porewater concentrations for each constituent were conservatively calculated using bulk sediment concentrations (defined as the 95 percent upper confidence limit [UPL] from all samples), divided by appropriate adsorption distribution coefficients (K_{oc} for PCBs; K_d for metals), and calculated for the medium through which groundwater would move (i.e., fill placed behind the sheetpile bulkhead). The partitioning coefficient (K_{oc}) for PCBs was calculated using the measured organic carbon content of site sediments. A range of K_ds were considered from low literature-derived values to high, site-specific values estimated from Exponent's previous work (2003; Table 7). A conservative estimate of K_d was chosen from the low end of the range and used to calculate initial porewater concentrations. The model was used to predict porewater concentrations for each COC at a point 10 cm behind the sheetpile wall, at 100, 250, and 500 year intervals after bulkhead construction.

6.2 Parameters and Assumptions

Table 8 presents the input parameters required by the model and the input values used for each COC. The model assumes a homogeneous layer of clean fill placed behind the bulkhead and over the impacted sediments within the project area. Two different types of fill materials were assessed to estimate their overall effectiveness for restricting COC migration through the different materials. The first clean fill material analyzed was a clean quarried sand with a low TOC fraction. This low TOC fraction does not allow for PCBs to adsorb to cap material and is, therefore, theoretically not as effective at controlling any PCB migration. The second clean fill material analyzed was dredge material with a higher TOC fraction, which more effectively controls PCB migration. Using K_ds, any modeled metals migration will not be affected by the differing TOC levels in these potential fill materials.

The horizontal advection of groundwater through sediment and overlying materials is a key factor in the rate of chemical migration and, therefore, is a particularly significant parameter for this model. As a result, field measurements of groundwater flow and gradient (documented in Section 5.2) were used in defining this parameter. The advection rate was calculated from Darcy's law which used the hydraulic gradient (calculated using site specific data), the hydraulic conductivity, and the effective porosity of the isolating material. For this modeling, conservative estimates of both hydraulic conductivity and effective porosity were used.

Values for all other model input parameters were obtained from standard sources noted in Table 8, including values for cap porosity, specific gravity of cap material, cap material organic carbon content, partition coefficients for PCBs, and molecular diffusion coefficients for PCBs in water.

6.3 Results

Results of cap effectiveness modeling are presented in Table 9 in terms of mg/L of COCs in isolated material porewater. The results are compared to CTR surface water criteria. Table 9 shows the dissolved concentrations of the selected COCs in porewater expressed from the project area 25, 50, and 100 years after the project is complete. All modeled COCs are well below CTR criteria after 100 years (and for several centuries beyond in most cases). Expressed dissolved concentrations of total PCBs are below CTR criteria when quarried sand material is used as backfill, and are seen to be at even lower concentrations when a fill material with higher TOC content – such as dredged Bay sediment – is used for construction.

In summary, the modeling results demonstrate that the use of either fill material would be effective over the long term in isolating COCs from San Diego Bay waters. Notably, actual water quality impacts would be significantly less even than those predicted by the model, because measured concentrations of COCs in site groundwater (as documented in Tables 3 and 5) are lower than those that were input to the model.

Thus, the highly conservative modeling approach presented here shows no significant impacts to surface water quality, and verifies that the planned project will be fully protective of water quality.

7 CONCLUSIONS

This study addresses questions and requirements documented by the SDRWQCB in their letter dated September 14, 2004 (as well as input obtained during SWM's meeting with the SDRWQCB on November 12, 2004), necessary to support a 401 WQC for Phase 2 activities.

Additional coring and groundwater sampling at the site, in conjunction with past sampling events, indicate that significant chemical impacts to site sediments are confined to near-surface sediments surrounding the now defunct marine railways. The nature of chemical impacts to site sediments (namely, high metals and PCB concentrations in the upper several feet) are consistent with past industrial uses of these railways (i.e., repair, maintenance, sandblasting).

An upland sampling station (continuous core SW-3 and monitoring wells MW-3.1 and 3.2) did not show significant impacts to subsurface materials. Walls bounding the project site on the north and south separate the marine railway area from adjacent upland fills.

Chemical impacts to groundwater appears to be largely restricted to shallow depths, corresponding to the highest chemical detections in site sediment.

A standard groundwater flow and chemical partitioning model was used to predict potential long-term effects to water quality in the adjacent waters of San Diego Bay. Conservative input parameters were used, as were conservative upper 95 percent limits of measured sediment concentrations. Even with "worst case" assumptions made for model inputs, the modeling results indicate that chemical breakthrough of site COCs is not expected for time durations on the order of well over 100 years, which is consistent with typical cap design projects in San Diego and elsewhere. This model does not account for tidal mixing, which (as discussed in the DER; Anchor 2004a) would reduce water quality impacts by additional orders of magnitude.

Altogether, this study indicates that the proposed project will be fully protective of adjacent surface waters after construction, and that chemical concentrations will not exceed existing surface water quality criteria along the bulkhead wall after construction.

As an added measure, and to meet post-closure maintenance requirements for inactive nonhazardous waste landfills (SDRWQCB, 1997 and 2000), long-term monitoring of groundwater quality will be instituted at this site. The long-term water quality monitoring plan for the site is presented in the Data Evaluation Report (Anchor 2004a).

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TABLES

Table 1
Bulk Sediment Chemistry - Sediment Cores SW04 and SW08

Analyte of Concern	Exponent Final Reference Pool Sediment 95% UPL	SW04 8/7/2001 0-2 cm	SW04 9/10/2002 0-2 cm	SW04 8/27/2002 0-2 ft	SW04 8/27/2002 2-4.1 ft	SW04 Depth Averaged	SW08 8/8/2001 0-2 cm	SW08 8/28/2002 0-2 ft	SW08 8/28/2002 0-2 ft	SW08 6/28/2002 2-4 ft	SW08 8/28/2002 4-6 ft	SW08 8/28/2002 6-6.5 ft	SW08 Depth Averaged
Conventionals													
Fines content (%)		31.8	-	-	-	31.8	68.8	-	-	-	-		68.8
TOC (% dry)		1.59	-	0.91	1.8	1.37	3.35	1.5	-	1.1	0.12	-	0.93
Metals (mg/kg)													
Arsenic	9	**95.5**	-	**67.7**	**107**	**89.65**	**25.5**	**26.6**	-	**13.2**	4.9	-	**15.12**
Cadmium	0.29	**2.35**	-	**0.79**	**3.17**	**2.05**	**0.67**	**1.13**	-	**0.86**	0.07	-	**0.69**
Chromium	57	**64.7**	-	**25.5**	**97.2**	**63.36**	**77.8**	**110**	-	**109**	7.4	-	**76.00**
Copper	120	**1880**	-	**370**	**2170**	**1325.60**	**1030**	**1540**	-	**1480**	49	-	**1029.94**
Lead	48	**482**	-	**154**	**413**	**295.73**	**248**	**343**	-	**341**	10.6	-	**233.26**
Mercury	0.56	**1.19**	-	1.14	**7.4**	**4.36**	**2.53**	**4.97**	-	**5.95**	0.3	-	**3.75**
Nickel	17	**20.1**	-	8.3	**40**	**24.87**	**22.7**	16.8	-	9.1	2.6	-	9.71
Selenium	0.72	**1.2**	-	**1.2 U**	**3.1**	**2.19**	**1 U**	**1.6 U**	-	**1.4 U**	1.2 U	-	**1.6 U**
Silver	1	**1.72**	-	0.59	**1.4**	**1.04**	**1.38**	**1.04**	-	0.49	0.03	-	0.53
Zinc	210	**4550**	-	**669**	**1450**	**1158.31**	**859**	**1410**	-	**786**	33.7	-	**749.46**
PCB (µg/kg)													
Aroclor 1016		190 U	-	150 U	1500 U	1500 U	330 U	1900 U	950 U	1400 U	130 U	12 U	1900 U
Aroclor 1221		370 U	-	290 U	2900 U	2900 U	650 U	3800 U	1900 U	2800 U	250 U	24 U	3800 U
Aroclor 1232		190 U	-	150 U	1500 U	1500 U	330 U	1900 U	950 U	1400 U	130 U	12 U	1900 U
Aroclor 1242		190 U	-	150 U	1500 U	1500 U	330 U	1900 U	950 U	1400 U	130 U	12 U	1900 U
Aroclor 1248		190 U	-	1300	16000	8664	990	9300	12000	15000	1100	12 U	8223
Aroclor 1254		2400	-	1200	13000	7153	2400	7000	8700	12000	600	12 U	6303
Aroclor 1260		600	-	610	6500	3570	640	4100	4400	6600	290	12 U	3427
Total PCBs	170	**3000**		**3110**	**35500**	**19387**	**4030**	**20400**	**25100**	**33600**	**1990**	0	**17954**
PAHs (µg/kg)													
2-Methylnaphthalene		31	-	10	460	240	32	18	-	50	6.1 U	-	25
Acenaphthene		110	-	22	3100	1594	83	54	-	110	6.1 U	-	57
Acenaphthylene		120	-	47	190	122	280	100	-	84	6.1 U	-	66
Anthracene		710	-	150	2400	1312	1500	360	-	360	10	-	258
Benz(a)anthracene		1100	-	370	3400	1937	2300	770	-	950	17	-	601
Benzo(a)pyrene		1500	-	1100	5800	3527	2900	2600	-	3000	85	-	1918
Benzo(b)fluoranthene		1600	-	950	5800	3456	3500	2900	-	3000	88	-	2025
Benzo(ghi)perylene		640	-	630	2100	1393	1300	970	-	1000	26	-	677
Benzo(k)fluoranthene		1300	-	790	5200	3065	2400	2600	-	2900	85	-	1880
Chrysene		1800	-	580	4500	2615	4900	1200	-	1200	38	-	862
Dibenzo(a,h)anthracene		230	-	120	650	395	450	310	-	370	8.4	-	233
Fluoranthene		2100	-	700	10000	5485	3500	1000	-	1200	25	-	776
Fluorene		180	-	34	1500	785	220	77	-	120	6.1 U	-	70
Indeno[1,2,3-cd]pyrene		880	-	750	2600	1711	1800	1400	-	1300	34	-	927
Naphthalene		38	-	20	3800	1949	38	19	-	58	6.1 U	-	28
Phenanthrene		1100	-	260	5000	2699	1300	490	-	620	13	-	387
Pyrene		2000	-	1400	18000	9906	2600	6000	-	8400	51	-	4826
Total PAHs		15439	-	7933	74500	42191	29103	20868	-	24722	510.9	-	15617

Notes:
U = analyte not detected at the indicated detection limit
From E^{x}ponent (2003)

Table 2
Chemical Concentrations Measured in 1998 Confirmatory Sampling Event

Parameter	1998 Sediment Cleanup Criteria (per Order 98-58)	Exponent Final Reference Pool Sediment 95% UPL	A1 8/17/1998 10 ft	A2 8/17/1998 6 ft	A3 8/13/1998 6 ft	B1 8/19/1998 6 ft	B2 8/10/1998 3.5 ft	B3 8/17/1998 5.5 ft	C1 8/19/1998 5.5 ft	C2 8/24/1998 4 ft	C3 8/31/1998 [illegible] ft	D1 8/21/1998 [illegible] ft	D2 8/24/1998 6 ft	D3 8/27/1998 5 ft
Metals (mg/kg)														
Copper	810	120	8.0	6	85	3.1	59	3.7	1.4	22	49	0 U	1.5	**650**
Lead	231	48	0 U	12	9.7	0 U	7.9	0 U	0 U	6.8	39	0 U	0 U	0 U
Mercury (total)	4.2	0.56	0 U	0 U	0.27	0 U	0 U	0 U	0 U	0 U	**0.97**	0.07	0 U	0 U
Zinc	820	210	14	16	**520**	17	51	**340**	8.4	31	47	11	7.7	**450**
PCBs (µg/kg)														
Total PCBs	~~0.95~~ 950	170	0 U	0 U	**914**	68	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U

Parameter	1998 Sediment Cleanup Criteria (per Order 98-58)	Exponent Final Reference Pool Sediment 95% UPL	E1 8/17/1998 12 ft	E2 8/18/1998 12 ft	E3 8/13/1998 6 ft	F1 8/20/1998 9.5 ft	F2 8/20/1998 10 ft	F3 8/19/1998 6.5 ft	G1 8/24/1998 [illegible] ft	G2 8/24/1998 7.5 ft	G3 8/17/1998 8 ft	H1 8/26/1998 5.5 ft	H2 8/26/1998 6.5 ft	H3 8/14/1998 5.5 ft	I1 8/31/1998 [illegible] ft	I2 8/31/1998 5 ft	I3 8/14/1998 5.5 ft
Metals (mg/kg)																	
Copper	810	120	47	67	**510**	24	12	7.9	6.5	**144**	61	0 U	29	59	625	56	10
Lead	231	48	6.2	20	**78**	8.1	0 U	9.1	0 U	42	26	0 U	10	11	8.2	0 U	0 U
Mercury (total)	4.2	0.56	0 U	0.38	0.44	0 U	0 U	0.4	0.41	**0.97**	0.1	0 U	**0.68**	**0.66**	**4.14**	**0.66**	0.28
Zinc	820	210	76	91	61	48	27	18	17	87	25	9.6	8.3	**620**	**270**	**290**	54
PCBs (µg/kg)																	
Total PCBs	~~0.95~~ 950	170	125	**207**	**810**	0 U	0 U	**196**	0 U	**530**	0 U	0 U	0 U	0 U	0 U	0 U	0 U

Bold values exceed reference sediment concentrations
U = analyte not detected at the indicated detection limit

Table 3
Chemical Concentrations Measured in Well Point Samples

Chemical	Well Point 1 ASW-WP1 µg/L (Dissolved)	Well Point 2 ASW-WP2 µg/L (Dissolved)	Ambient Concentrations Measured in Site Surface Water ASW-SW1 Ambient^1	Ambient^2	Water Quality Criteria in µg/L (Dissolved)^3 Acute	Chronic
Conventionals						
Total Suspended Solids (mg/L)	24	120	15			
Salinity (ppt)	33	30	33			
Fines content (%)				-		
TOC (% dry)				-		
Metals (mg/kg or µg/L)						
Arsenic	1.03	14.4	1.35	8.8 J	69	36
Cadmium	0.215	0.33	0.1	1.2 U	42	9.3
Chromium^4	1.18	2.06	0.99	2.1 J	1100	50
Copper	2.005	0.98	5.42	5	4.8	3.1
Lead	0.32	0.36	0.07	0.55 J	210	8.1
Mercury	0.1 U	.01 U	.01 U	0.1 U	0.4	0.04
Nickel	1.545	0.98	1.05	5 U	74	8.2
Selenium	0.035	0.01	0.02	11	290	71
Silver	0.36	0.33	0.27	1.2 U	1.9	-
Zinc	7.22	18.8	9.03	18	90	81
Butyltins (µg/kg)						
Tributyltin				15.43		
PCB (µg/kg or µg/L)						
Aroclor 1016	0.15 U^5	0.15 U^5	1 U	0.5 U		
Aroclor 1221	0.10 U	0.10 U	1 U	0.5 U		
Aroclor 1232	0.10 U	0.10 U	1 U	0.5 U		
Aroclor 1242	0.10 U	0.10 U	1 U	0.5 U		
Aroclor 1248	1.3	0.63	1 U	0.5 U		
Aroclor 1254	0.10 U	0.10 U	1 U	0.5 U		
Aroclor 1260	1.1	0.63	0.1 U	0.5 U		
Aroclor 1262	0.10 U	0.10 U				
Aroclor 1268	0.024 U	0.024 U				
Total PCBs^8	2.7^6	1.6^6	1 U	-	10^7	0.03^7
PAHs (µg/kg or µg/L)						
2-Methylnaphthalene	1.0 U	1.0 U	1.0 U	-		
Acenaphthene	1.0 U	1.0 U	1.0 U	1 U		
Acenaphthylene	1.0 U	1.0 U	1.0 U	5 U		
Anthracene	1.0 U	1.0 U	1.0 U	5 U		
Benz(a)anthracene	1.0 U	1.0 U	1.0 U	5 U		
Benzo(a)pyrene	1.0 U	1.0 U	1.0 U	5 U		
Benzo(b)fluoranthene	1.0 U	1.0 U	1.0 U	5 U		

Table 3
Chemical Concentrations Measured in Well Point Samples

Chemical	Well Point 1 ASW-WP1 µg/L (Dissolved)	Well Point 2 ASW-WP2 µg/L (Dissolved)	Ambient Concentrations Measured in Site Surface Water		Water Quality Criteria in µg/L (Dissolved)[3]	
			ASW-SW1 Ambient[1]	Ambient[2]	Acute	Chronic
Benzo(ghi)perylene	1.0 U	1.0 U	1.0 U	5 U		
Benzo(k)fluoranthene	1.0 U	1.0 U	1.0 U	5 U		
Chrysene	1.0 U	1.0 U	1.0 U	5 U		
Dibenzo(a,h)anthracene	1.0 U	1.0 U	1.0 U	5 U		
Fluoranthene	1.0 U	1.0 U	1.0 U	1 U		
Fluorene	1.0 U	1.0 U	1.0 U	5 U		
Indeno[1,2,3-cd]pyrene	1.0 U	1.0 U	1.0 U	5 U		
Naphthalene	1.0 U	1.0 U	1.0 U	1 U		
Phenanthrene	1.0 U	1.0 U	1.0 U	5 U		
Pyrene	1.0 U	1.0 U	1.0 U	5 U		
Total PAHs[8]	1.0 U	1.0 U	1.0 U	-	300[7]	

Notes:

U = analyte not detected at the indicated detection limit

J = estimated value

- = not measured or not applicable

[1] Dissolved San Diego Bay reference samples taken 7/2/2004 concurrent with Well Point sampling, 200 feet west of proposed bulkhead location.

[2] San Diego Bay reference samples taken 3/26/2002 as part of SWM Water Quality Monitoring Program, 300 feet west of SWM Pier 3.

[3] From U.S. EPA water quality standards (2000).

[4] Hexavalent Chromium for well point and 2004 ambient surface water data.

[5] Maximum detection limit for PCBs in well point samples was 0.10 to 0.25 µg/L. Reporting limit for PCBs in well point samples was 1 µg/L.

[6] Sums were calculated using one-half the detection limit for those compounds that were not detected.

[7] Ambient Marine Water Quality Criteria for PCBs and total PAHs are from EPA and NOAA Screening Quick Reference Tables, September 1999.

[8] Water concentrations for Total PCBs and Total PAHs were calculated by summing the values of the individual Aroclors and PAHs, respectively.

Table 4
Sediment Chemistry Results

Parameter	Exponent Final Reference Pool Sediment 95% UPL	Core SW-1	Core SW-2	Core SW-3		Core SW-4					Core SW-5				
		Bay Point Formation 15' - 17'10"	Bay Point Formation 18' - 20'	Upland Fill 5' - 7'9"	Upland Fill 12'2" - 14'2"	Surface Sediment 0' - 2'1"	Surface Sediment 2'1" - 3'6"	Surface Sediment 5' - 6'9"	Surface Sediment 6'9" - 8'10"	Bay Point Formation 15' - 16'	Surface Sediment 2" - 2'	Surface Sediment 2' - 2'11"	Surface Sediment 5' - 6'5"	Surface Sediment 6'5" - 7'5"	Bay Point Formation 10' - 12'9"
Total Organic Carbon (percent)															
		0.01	0.02	0.22	0.13	1.48	0.29	0.21	0.01	0.03	0.46	0.04	0.06	0.03	0.02
Metals (mg/kg)															
Arsenic	9	3.65	1.15	3.46	3.9	**154**	**35.4**	**65.8**	1.42	1.56	**177**	3.57	3.13	2.62	6.42
Cadmium	0.29	0.05 J	0.04 J	0.05 J	0.07	**3.13**	**0.73**	**1.13**	0.05 J	0.04 J	**2.83**	0.08	0.08	0.08	0.06
Chromium	57	3.6	12.3	6.46	3.89	**173**	**138**	**75.2**	3.22	22.4	**192**	8.7	5.4	21.4	4.73
Copper	120	1.75	5.57	4.76	11.3	**2540**	**981**	**1040**	2.4	12.6	**6950**	12.7	5.85	14.1	4.52
Lead	48	0.81	2.1	5.39	4.04	**868**	**352**	**326**	0.73	3.75	**955**	21.4	5.25	3.98	1.04
Mercury (total)	0.56	0.03 J	0.01 U	0.05 J	0.03 J	**0.89 J**	**2.4 J**	**0.7 J**	0.01 J	0.03 J	**0.91 J**	0.24 J	0.1 J	0.01 U	0.01 U
Nickel	17	2.06	6.22	2.29	1.74	**25.9**	10.6	12	2.02	10.1	**28.1**	3.7	2.1	8.17	3.58
Selenium	0.72	0.13	0.15	0.3	0.09	**2.91**	**0.95**	**1.24**	0.68	0.25	**3.52**	0.1	0.09	0.05 J	0.8
Silver	1	0.05 U	0.05 U	0.05 U	0.05 U	**1.77 J**	0.55 J	0.76 J	0.05 U	0.18 J	**2.1 J**	0.28 J	0.15 J	0.04 J	0.05 U
Zinc	210	23.9 J	23.9 J	17.8 J	13.7 J	**8630 J**	**1560 J**	**2250 J**	6.18 J	42.1 J	**4470 J**	28.8 J	19.3 J	49.3 J	9.77 J
PAHs (µg/kg)															
1-Methylnaphthalene		5 U	5 U	5 U	2.30 J	29.90	22.30	20.40	5 U	5 U	5 U	5 U	5.00 U	5.00 U	5 U
1-Methylphenanthrene		5 U	5 U	5 U	2.80 J	102	15.50	34.10	5 U	5 U	5 U	1.20 J	5.00 U	5.00 U	5 U
2,3,5-Trimethylnaphthalene		5 U	5 U	5 U	2.40 J	44.50	13.30	12.90	5 U	5 U	5 U	5 U	5.00 U	5.00 U	5 U
2,6-Dimethylnaphthalene		5 U	5 U	5 U	1.0 J	34.60	22.70	19.0	5 U	5 U	5 U	5 U	5.00 U	5.00 U	5 U
2-Methylnaphthalene		5 U	5 U	5 U	1.70 J	38.40	32.80	29.40	5 U	1.0 J	5 U	1.10 J	5.00 U	5.00 U	5 U
Acenaphthene		5 U	5 U	5 U	22.90	5 U	62.90	66.50	5 U	5 U	5 U	5 U	5.00 U	5.00 U	5 U
Acenaphthylene		5 U	5 U	5 U	6.80	35.70	31.90	17.60	5 U	5 U	5 U	1.40 J	1.20 J	5.00 U	5 U
Anthracene		5 U	5 U	5 U	13.90	5 U	5 U	5 U	5 U	5 U	5 U	2.70 J	2.20 J	5.00 U	5 U
Benz(a)anthracene		5 U	2.30 J	1.10 J	46.30	5 U	5 U	5 U	5 U	5 U	5 U	4.40 J	7.20 J	5.00 U	5 U
Benzo(a)pyrene		5 U	5 U	1.50 J	103	5 U	5 U	5 U	5 U	5 U	5 U	6.70	16.90 J	5.00 U	5 U
Benzo(b)fluoranthene		5 U	5 U	1.40 J	81.80	5 U	5 U	5 U	5 U	5 U	5 U	5.10	16.40 J	5.00 U	5 U
Benzo(e)pyrene		5 U	5 U	1.30 J	67.90	5 U	5 U	5 U	5 U	5 U	5 U	4.0 J	9.70 J	5.00 U	5 U
Benzo(ghi)perylene		5 U	5 U	1.40 J	101.0	5 U	5 U	5 U	5 U	5 U	5 U	5.40	14.00 J	5.00 U	5 U
Benzo(k)fluoranthene		5 U	5 U	1.20 J	77.40	5 U	5 U	5 U	5 U	5 U	5 U	4.80 J	15.30 J	5.00 U	5 U
Biphenyl		5 U	5 U	5 U	1.80 J	15.60	13.10	10.60	5 U	5 U	5 U	5 U	5.00 U	5.00 U	5 U
Chrysene		5 U	1.40 J	1.30 J	62.30	5 U	5 U	5 U	5 U	5 U	5 U	6.10	8.00	5.00 U	5 U
Dibenzo(a,h)anthracene		5 U	5 U	5 U	11.50	5 U	5 U	5 U	5 U	5 U	5 U	5 U	1.50 J	5.00 U	5 U
Fluoranthene		5 U	1.20 J	2.60 J	168	5 U	5 U	5 U	5 U	1.20 J	5 U	7.90	16.10	5.00 U	5 U
Fluorene		5 U	5 U	5 U	2.10 J	5 U	58.10	5 U	5 U	5 U	5 U	5 U	5.00 U	5.00 U	5 U
Indeno[1,2,3-cd]pyrene		5 U	5 U	5 U	89.60	5 U	5 U	5 U	5 U	5 U	5 U	4.30 J	11.90 J	5.00 U	5 U
Naphthalene		5 U	5 U	5 U	14.90	39.10	31.30	31.70	5 U	1.20 J	5 U	1.10 J	5.00 U	5.00 U	5 U
Perylene		5 U	5 U	5 U	28.30	5 U	5 U	5 U	5 U	5 U	5 U	3.20 J	4.40 J	5.00 U	5 U
Phenanthrene		1.10 J	1.30 J	1.60 J	14.70	5 U	5 U	5 U	5 U	1.40 J	5 U	4.70 J	5.00	5.00 U	5 U
Pyrene		1.30 J	10.90	8.20	178	5 U	5 U	5 U	6.50	1.30 J	5 U	130	29.60	5.00 U	5 U
Total PAHs		2.40 J	17.02	21.60	1102.50	339.80	303.90	242.20	6.50	6.10	0	194.10	159.40	0.00	0
PCBs (µg/kg)															
Aroclor 1016		20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20.00 U	20.00 U	20.00 U
Aroclor 1221		20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20.00 U	20.00 U	20.00 U
Aroclor 1232		20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20.00 U	20.00 U	20.00 U
Aroclor 1242		20 U	20 U	20 U	20 U	379	2410	459	20 U	20 U	452	20 U	20.00 U	20.00 U	20.00 U
Aroclor 1248		20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20.00 U	20.00 U	20.00 U
Aroclor 1254		20 U	20 U	20 U	20 U	1270	2260	1100	20 U	20 U	851.0	20 U	20.00 U	20.00 U	20.00 U
Aroclor 1260		20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20.00 U	20.00 U	20.00 U
Total PCBs (U=0)	170	0	0	0	0	**1759**	**5198.10**	**1894.80**	0	0	**1310.80**	0	0	0.00	0.00

U = analyte not detected at the indicated detection limit
J = estimated value
Bold values exceed reference sediment concentrations
UPL = upper prediction limit

Table 5
Groundwater Chemistry Results

Parameter	California Toxic Rule Water Quality Criteria	Station 1		Station 2		Station 3	
		MW-1.1 Bay Point Formation 18-23 feet	**MW-1.2 Upland Fill 10-15 feet**	**MW-2.1 Bay Point Formation 22-27 feet**	**MW-2.2 Upland Fill 15-20 feet**	**MW-3.1 Bay Point Formation 18-23 feet**	**MW-3.2 Upland Fill 12-17 feet**
Conventionals							
Salinity (PSU)		16.0	12.0	25.0	9.7	3.0	< 2.0
Total dissolved solids (mg/L)		599	803	12,570	6,010	274	60
Metals (µg/L)							
Arsenic	36	1.67	1.01	3.70	0.50	5.20	23.20
Cadmium	9.3	0.01 U	0.01 U	0.03	0.01	0.01 U	0.01 U
Chromium		0.71	0.47	0.95	0.46	7.77	2.22
Copper	3.1	0.38	0.18	0.91	0.009 E	**3.34**	0.97
Lead	8.1	0.03	0.02	0.05	0.01	0.50 U	0.38 E
Mercury (total)		0.006 E	0.01 U	0.01 U	0.006 E	0.10 U	0.10 U
Nickel	8.2	24.5	6.19	**11.2**	1.58	**8.25**	4.73
Selenium	71	0.13	0.22	0.01 U	0.01 U	3.85	1
Silver		0.04	0.05	0.07	0.06	0.20 U	0.20 U
Zinc	81	6.88	4.57	4.86	1.88	8.84	3.52
PAHs (µg/L)							
1-Methylnaphthalene		0.015	0.006	0.005 U	0.005 U	0.006	0.011
1-Methylphenanthrene		0.057	0.035	0.005 U	0.005 U	0.012	0.028
2,3,5-Trimethylnaphthalene		0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
2,6-Dimethylnaphthalene		0.010	0.010	0.005 U	0.005 U	0.006	0.005
2-Methylnaphthalene		0.016	0.012	0.005 U	0.01	0.009	0.015
Acenaphthene		1.19	0.051	0.005 U	0.01	0.030	0.116
Acenaphthylene		0.005 U	0.005 U	0.005 U	0.005 U	0.005	0.049
Anthracene		0.057	0.018	0.060	0.12	0.038	0.111
Benz(a)anthracene		0.028	0.005 U	0.005 U	0.15	0.008	0.276
Benzo(a)pyrene		0.010	0.010	0.005 U	0.005 U	0.005 U	0.485
Benzo(b)fluoranthene		0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.422
Benzo(e)pyrene		0.008	0.008	0.005 U	0.005 U	0.005 U	0.286
Benzo(ghi)perylene		0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.432
Benzo(k)fluoranthene		0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.344
Biphenyl		0.006	0.005 U	0.005 U	0.01	0.005 U	0.011
Chrysene		0.022	0.005 U	0.005 U	0.09	0.012	0.313
Dibenzo(a,h)anthracene		0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.086
Fluoranthene		0.452	0.039	0.08	1.14	0.088	1.020
Fluorene		0.053	0.007	0.005 U	0.005 U	0.005 U	0.015
Indeno[1,2,3-cd]pyrene		0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.504
Naphthalene		0.024	0.010	0.005 U	0.02	0.01	0.040
Perylene		0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.192
Phenanthrene		0.113	0.032	0.005 U	0.03	0.024	0.056
Pyrene		0.382	0.039	2.76	2.97	0.185	1.640
PCBs (µg/L)							
Aroclor 1016		0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U
Aroclor 1221		0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U
Aroclor 1232		0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U
Aroclor 1242		0.1	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U
Aroclor 1248		0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U
Aroclor 1254		0.0233	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U
Aroclor 1260		0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U
Total PCBs (U=0)	0.03	**0.1233**	0	0	0	0	0

Notes:
U = analyte not detected at the indicated detection limit
E = estimated value
Bold values exceed water quality criteria

Table 6
Summary of Measured Water Levels

	Water Level (MLLW)			
	Ebb Tide	**Low Tide**	**Flood Tide**	**High Tide**
Deep Piezometers				
Station 1	4.05	3.57	3.94	4.21
Station 2	3.99	3.46	3.88	4.53
Station 3	4.31	4.13	4.21	4.36
Shallow Piezometers				
Station 1	4.08	3.6	3.97	4.24
Station 2	4.16	3.65	4.03	4.36
Station 3	4.44	4.21	4.22	4.31

Table 7
Summary of Modeling Parametric Analyses

Parameter	Kd (L/kg)	Co (mg/L)	Information Source
Copper	20,452	0.037	Calculated from E^{x}ponent sediment partitioning equations (2003).
	85	8.78	Calculated from sediment 95 percent UCL and Kd's from Aziz et al. 2001.
Lead	15402	0.01	Calculated from E^{x}ponent sediment partitioning equations (2003).
	1150	0.16	Calculated from sediment 95 percent UCL and Kd's from Aziz et al. 2001.
Zinc	20067	0.04	Calculated from E^{x}ponent sediment partitioning equations (2003).
	140	5.8	Calculated from sediment 95 percent UCL and Kd's from Aziz et al. 2001.
PCBs	60.2	0.023	(TOC = 0.001) weighted average of Aroclors 1254 and 1242 Koc (RAIS 2004).
	602	0.002	(TOC = 0.01) weighted average of Aroclors 1254 and 1242 Koc (RAIS 2004).
	820	0.001692	(TOC = 0.001) using total PCB Koc (RAIS 2004).
	8200	0.000169	(TOC = 0.01) using total PCB Koc (RAIS 2004).

TOC - Total Organic Carbon

Table 8
Fate and Transport Modeling Input Parameters

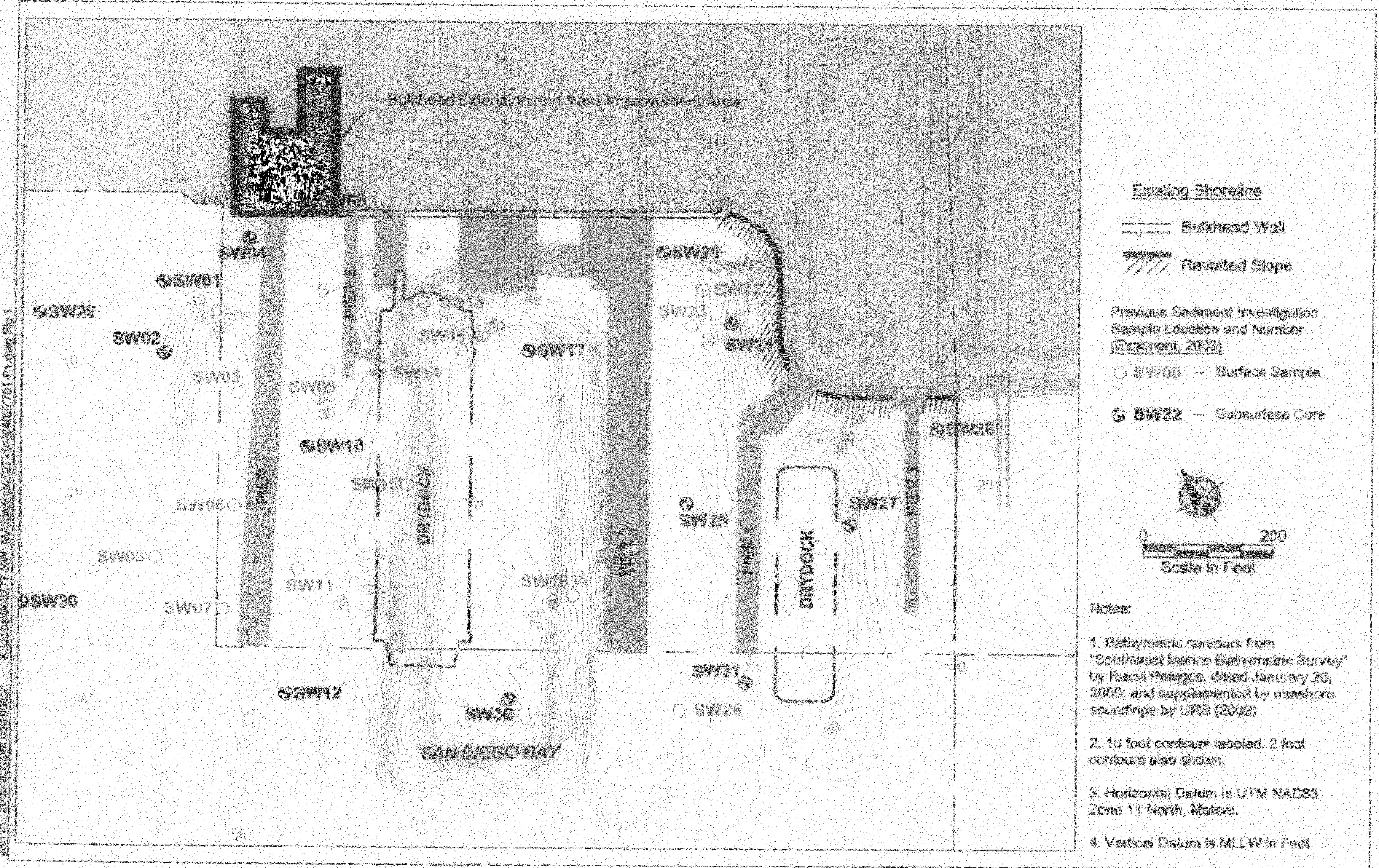
Parameter	Units	Constituents Modeled					Information Source
		Copper	Lead	Zinc	Total PCBs	Total PCBs	
Controlling Cap Layer	NA	Sand	Sand	Sand	Sand	Sediment	Possible cap alternatives.
Cap Layer Thickness	cm	90	90	90	90	90	Assumed effective thickness was 100 cm less 10 cm at bioturbation.
Cap Material Porosity	unitless	0.4	0.4	0.4	0.4	0.4	Typical values for placed sand and clean sediment that may be used.
Specific Gravity of Cap	g/cm^3	2.5	2.5	2.5	2.5	2.5	Typical values for these materials.
In Situ Bulk Density Cap	g/cm^3	1.5	1.5	1.5	1.5	1.5	Calculated from porosity and specific gravity per page B24 of Reible (1998).
Cap TOC Content	fraction	0.001	0.001	0.001	0.001	0.01	Typical values for these materials.
PCB K_{oc}	L/kg_{OC}				60,200	60,200	Weighted average of Aroclors found in sediment (1242 and1254; RAIS 2004).
Cap K_d	L/kg	100	1,200	200	60.2	602	PCB $K_d = K_{oc}$ * TOC; Copper, Lead, and Zinc Kds from Aziz et al. 2001.
Groundwater Seepage Velocity	cm/yr	17.79	17.79	17.79	17.79	17.79	$Vx = Q/(n_e*A)$, where Q = discharge and A = cross-sectional area. Or: $Vx = (Kdh)/(n_e dl)$ Assume K = 0.00003 cm/sec, ne = 0.25, dh/dl = 0.0047.
Diffusion Coefficient	cm^2/yr	225	267	222	190	190	Conservatively high value from range of diffusion coefficients for PCBs (RAIS 2004); For metals D = (RT/F2)(lambda/charge of the ion).
Porewater Concentration in Underlying Sediments	mg/L	7.47E+00	1.52E-01	4.07E+00	2.305E-02	2.305E-03	95 percent UCL porewater concentration calculated from bulk chemistry cores.

Koc - Organic Carbon Partitioning Coefficient
Kd - Calculated partitioning equilibrium coefficient
TOC - Total Organic Carbon

Table 9
Fate and Transport Modeling Results

Chemical	Years after Construction (mg/L)			California Toxics Rule WQ Criteria (mg/L)	Years until predicted breakthrough
	100	250	500		
Copper	0	0	0	3.10E-03	660
Lead	0	0	0	8.10E-03	12,400
Zinc	0	0	0	8.10E-02	1,670
Total PCBs (clean sediment cap)	0	0	0	3.00E-05	2,280
Total PCBs (quarry sand cap)	0	0	3.9409E-11	3.00E-05	184

FIGURES



Notes:

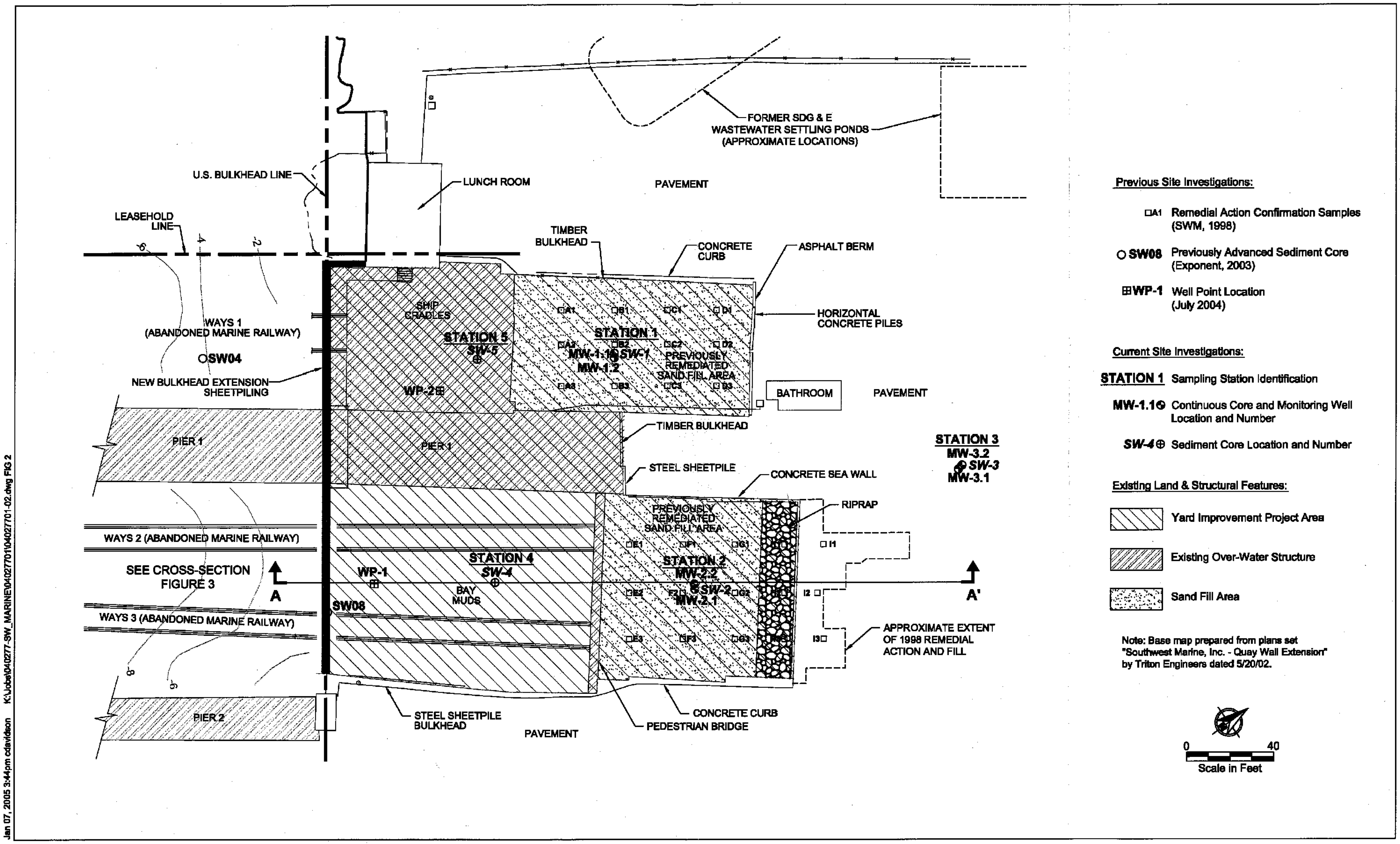
1. Bathymetric contours from "Southwest Marine Bathymetric Survey" by Racal Pelagos, dated January 25, 2000, and supplemented by nearshore soundings by URS (2002)

2. 10 foot contours labeled. 2 foot contours also shown.

3. Horizontal Datum is UTM NAD83 Zone 11 North, Meters.

4. Vertical Datum is MLLW in Feet

Figure 1
Project Location Plan
Southwest Marine Bulkhead Extension and Yard Improvement



Previous Site Investigations:

☐A1 Remedial Action Confirmation Samples (SWM, 1998)

○ **SW08** Previously Advanced Sediment Core (Exponent, 2003)

⊞**WP-1** Well Point Location (July 2004)

Current Site Investigations:

STATION 1 Sampling Station Identification

MW-1.1⊖ Continuous Core and Monitoring Well Location and Number

SW-4⊕ Sediment Core Location and Number

Existing Land & Structural Features:

▨ Yard Improvement Project Area

▨ Existing Over-Water Structure

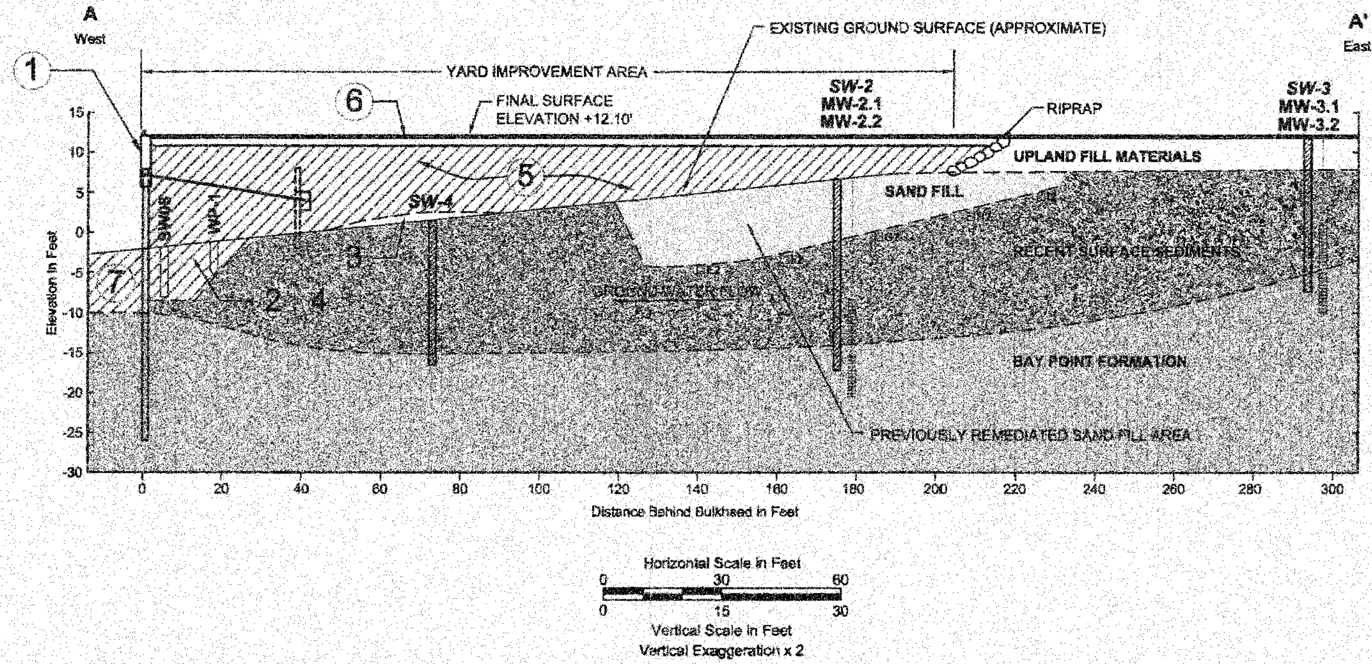
▨ Sand Fill Area

Note: Base map prepared from plans set "Southwest Marine, Inc. - Quay Wall Extension" by Triton Engineers dated 5/20/02.

Jan 07, 2005 3:44pm cdavidson K:\Jobs\040277-SW_MARINE\04027701\04027701-02.dwg FIG 2

ANCHOR ENVIRONMENTAL, L.L.C.

Figure 2
Project Site Plan and Sampling and Well Locations
Southwest Marine Bulkhead Extension and Yard Improvement



Project Construction Sequence
(refer to circled numbers on cross section above)

① Sheetpile Bulkhead Installed
② Chemically Impacted Sediments to be Excavated from Vicinity of Installed Bulkhead
③ Excavated Sediments Relocated to Interior of Yard Improvement Area
④ Excavation Backfilled with Clean Imported Sand Buffer
⑤ Yard Improvement Area Backfilled With Compacted Import Fill
⑥ Aggregate Base and Asphalt Placed Over Entire Yard Improvement Area
⑦ Sheetpile Wall Designed for Future Potential Removal of Sediments Outside Wall

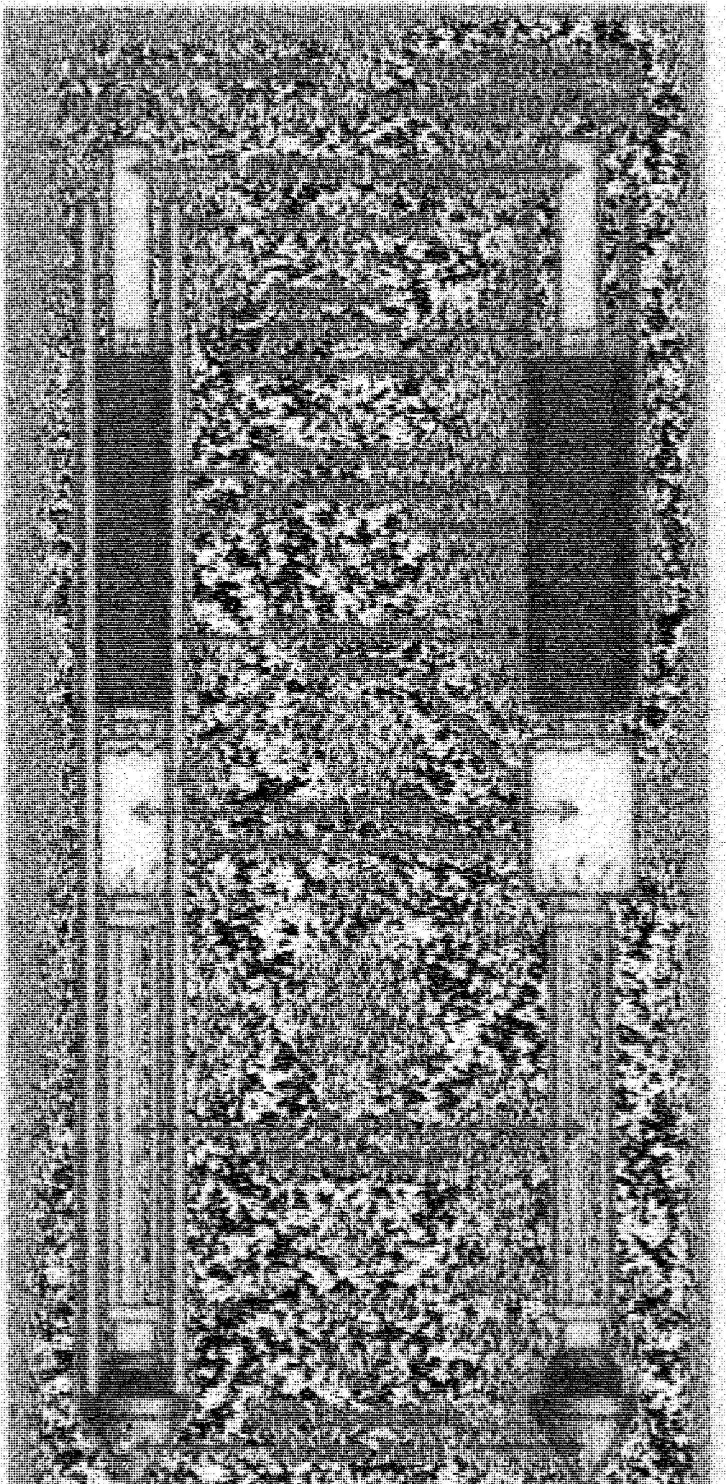
Symbol	Description
▯ SW08	Previously Advanced Sediment Core (Exponent, 2003)
▨ SW-4	Sediment Core
▨ SW-2 MW-2.1	Continuous Core and Monitoring Well
☐ E2	Remedial Action Confirmation Sample (SWM, 1998)
▨	Clean Backfill

Note:
Structural features and existing ground surface based on plans set "Southwest Marine, Inc. - Quay Wall Extension" by Triton Engineers Dated 5/20/02.

Jan 07, 2005 4:04pm cdavidson K:\Jobs\040277-SW_MARINE\04027701\04027701-03.dwg FIG 3

ANCHOR ENVIRONMENTAL, L.L.C.

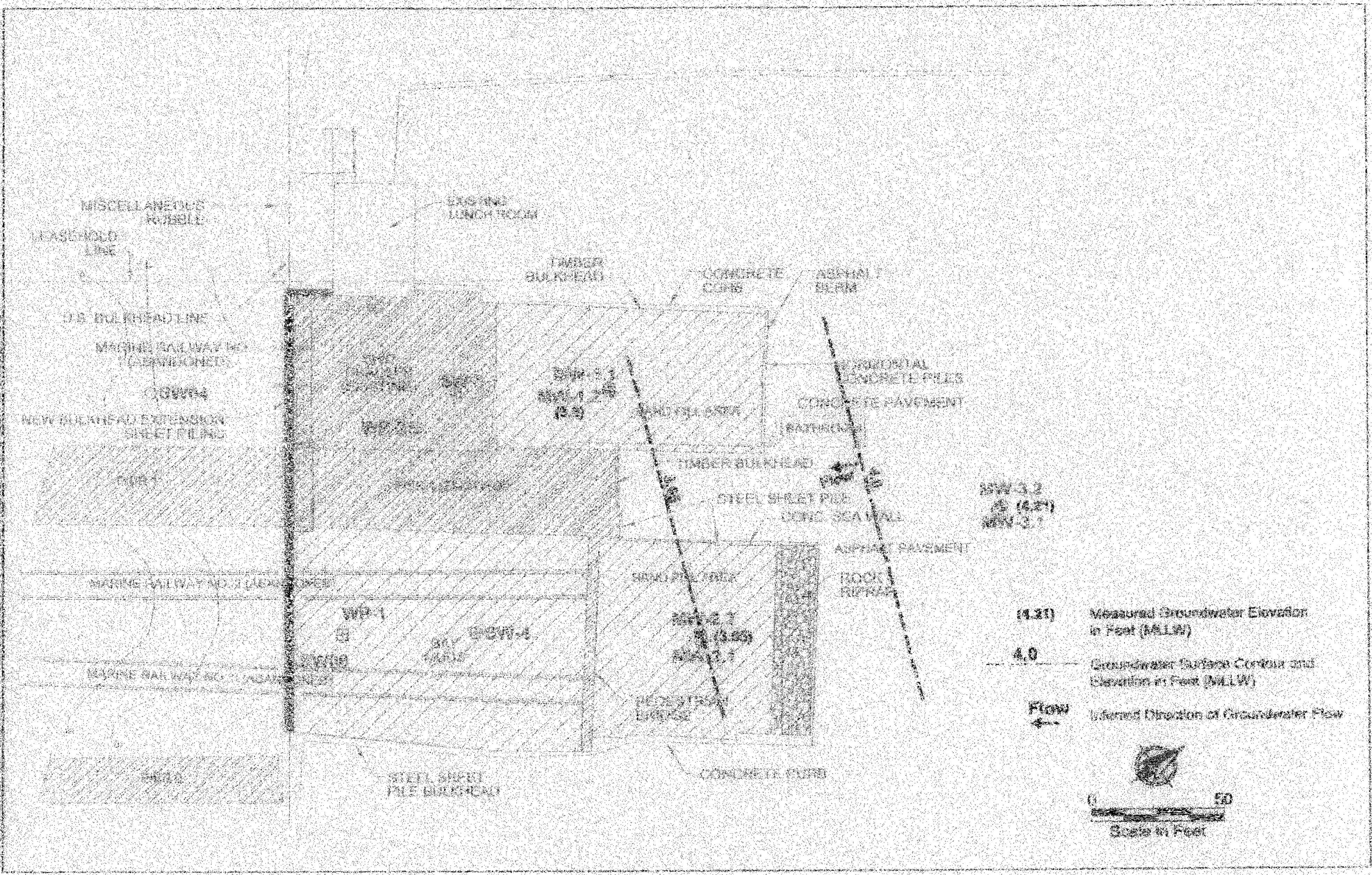
Figure 3
Cross-Section A-A' and Sequence of Planned Construction Events
Southwest Marine Bulkhead Extension and Yard Improvement



1/10/08 OVD K:\Jobs\040271-SW Marine\04027101\[illegible]4.cdr

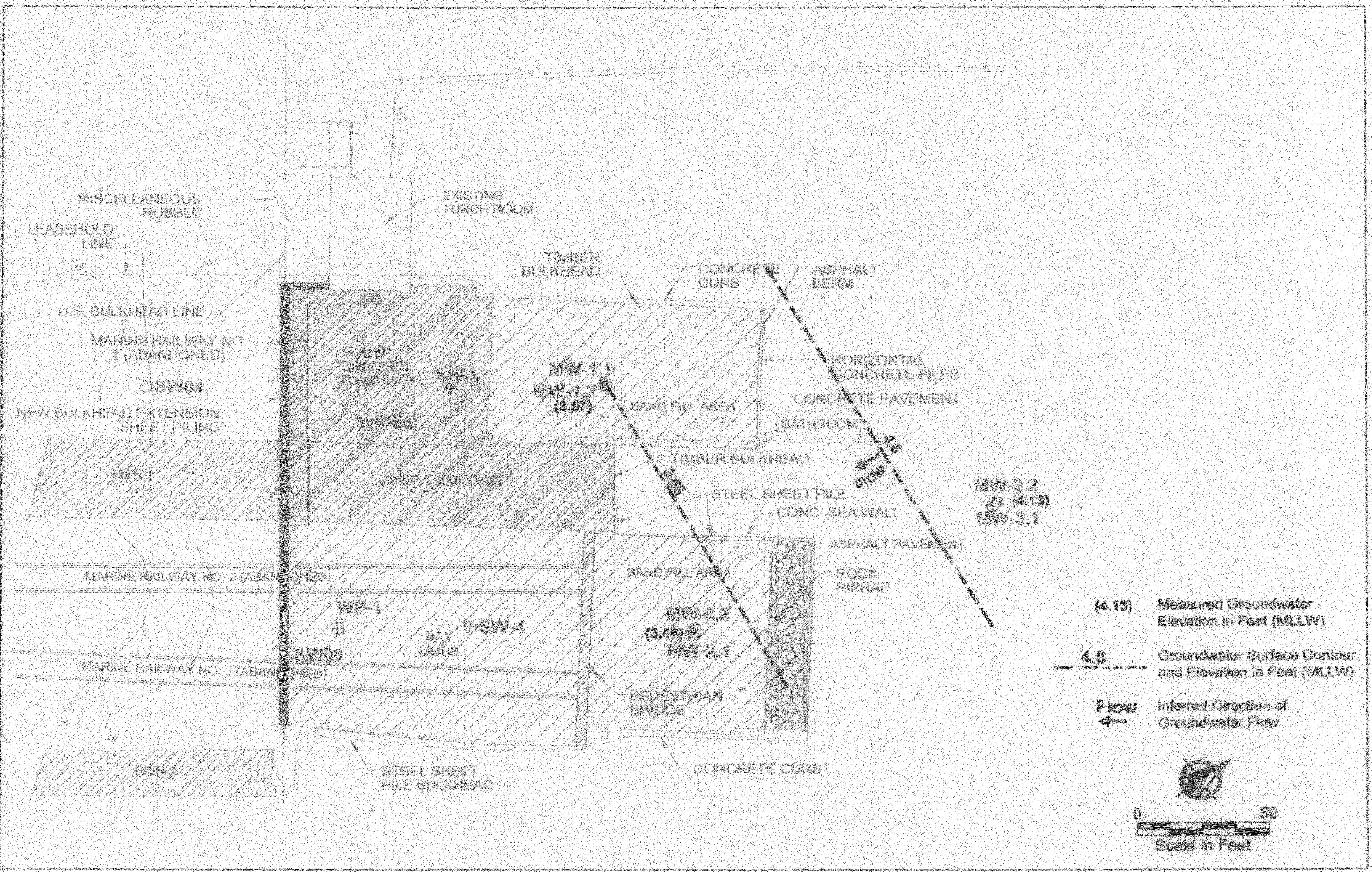
ANCHOR ENVIRONMENTAL, L.L.C.

Figure 4
Typical Detail - Prepacked Well Screen
Southwest Marine Bulkhead Extension and Yard Improvement



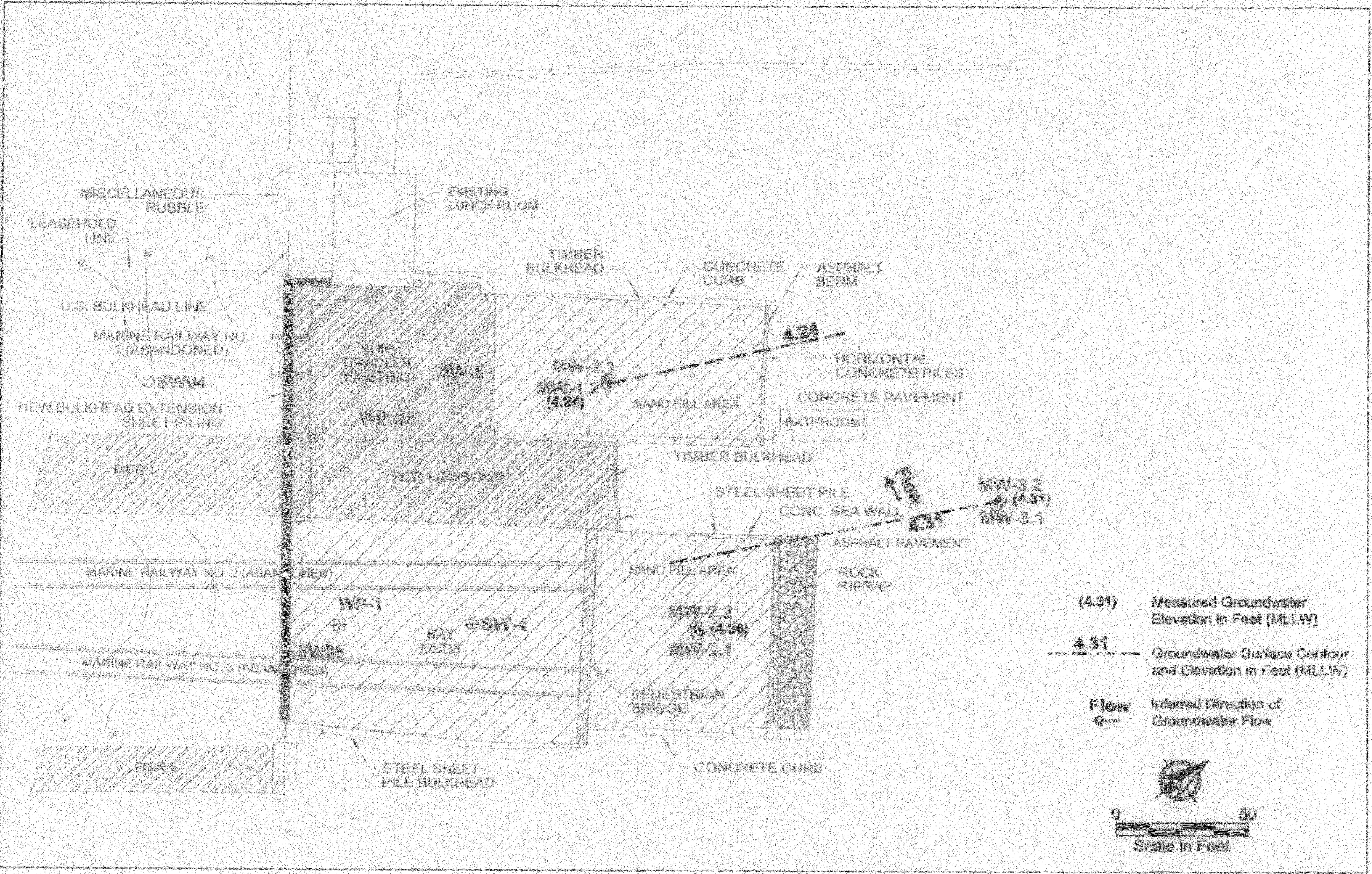
ANCHOR ENVIRONMENTAL, L.L.C.

Figure 5
Low Tide Piezometric Surface
Shallow Monitoring Wells (Recent Sediments)
Southwest Marine Bulkhead Extension and Yard Improvement



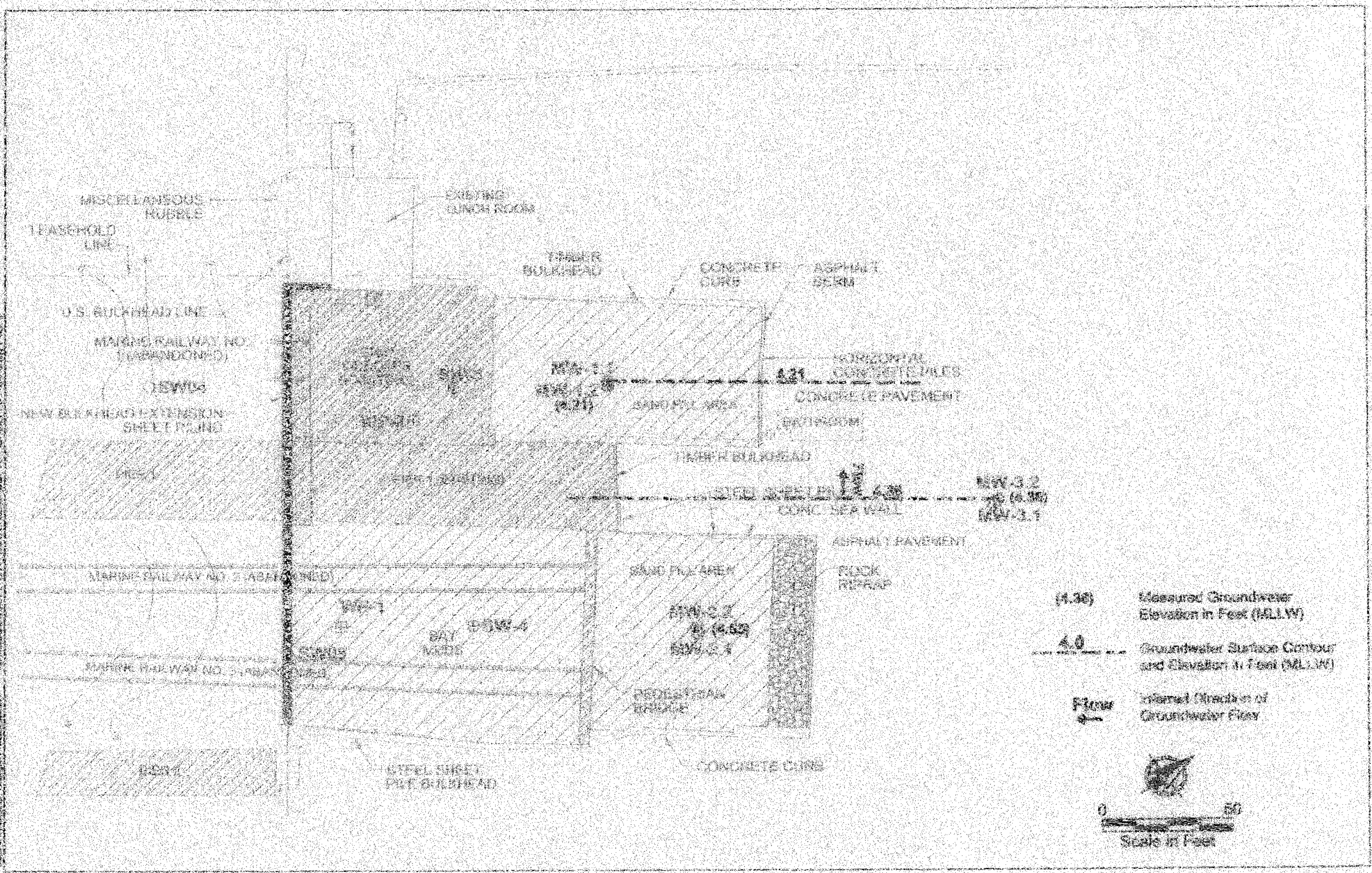
ANCHOR ENVIRONMENTAL, L.L.C.

Figure 6
Low Tide Piezometric Surface
Deep Monitoring Wells (Bay Point Formation)
Southwest Marine Bulkhead Extension and Yard Improvement



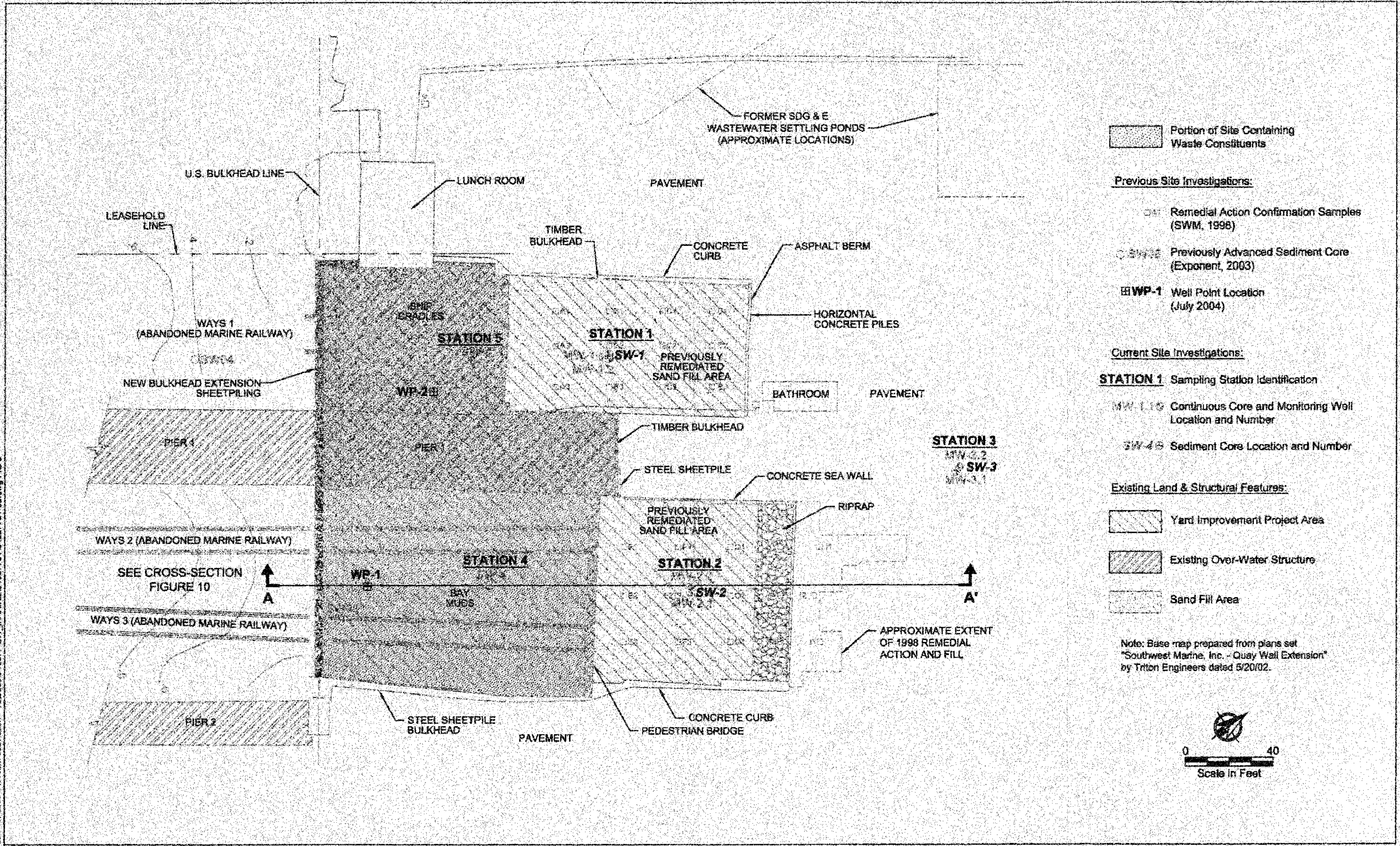
ANCHOR ENVIRONMENTAL, L.L.C.

Figure 7
High Tide Piezometric Surface
Shallow Monitoring Wells (Recent Sediments)
Southwest Marine Bulkhead Extension and Yard Improvement



ANCHOR

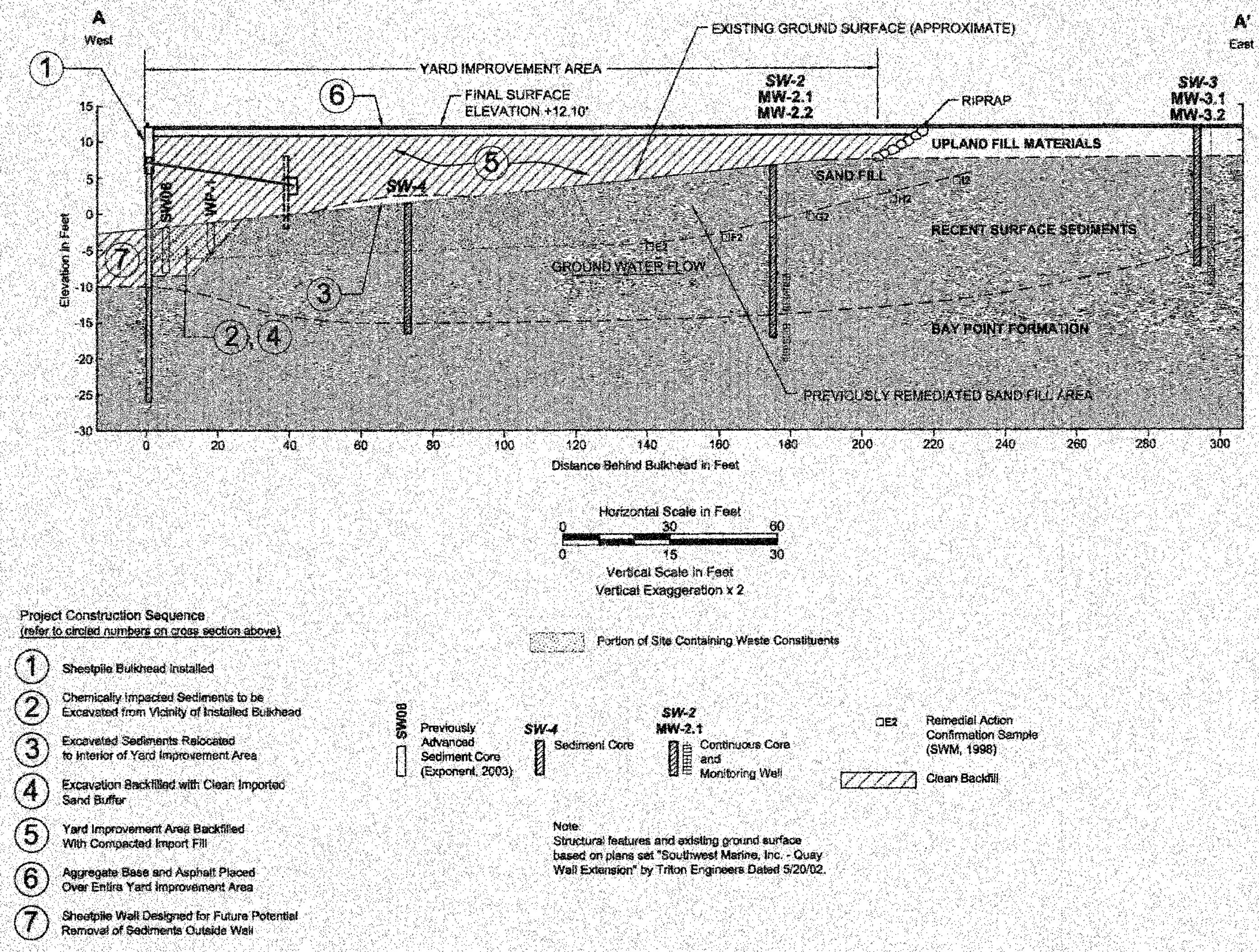
Figure 8
High Tide Piezometric Surface
Deep Monitoring Wells (Bay Point Formation)
Southwest Marine Bulkhead Extension and Yard Improvement



Jan 10, 2005 11:40am ccavidson K:\Jobs\040277-SW_MARINE\04027701\04027701-05.dwg FIG 9

ANCHOR ENVIRONMENTAL, L.L.C.

Figure 9
Distribution of Waste Constituents - Plan View
Southwest Marine Bulkhead Extension and Yard Improvement



Project Construction Sequence
(refer to circled numbers on cross section above)

① Sheetpile Bulkhead Installed
② Chemically Impacted Sediments to be Excavated from Vicinity of Installed Bulkhead
③ Excavated Sediments Relocated to Interior of Yard Improvement Area
④ Excavation Backfilled with Clean Imported Sand Buffer
⑤ Yard Improvement Area Backfilled With Compacted Import Fill
⑥ Aggregate Base and Asphalt Placed Over Entire Yard Improvement Area
⑦ Sheetpile Wall Designed for Future Potential Removal of Sediments Outside Wall

Note:
Structural features and existing ground surface based on plans set "Southwest Marine, Inc. - Quay Wall Extension" by Triton Engineers Dated 5/20/02.

Jan 10, 2005 11:41am cdavidson K:\Jobs\040277-SW_MARINE\04027701\04027701-08.dwg FIG 10

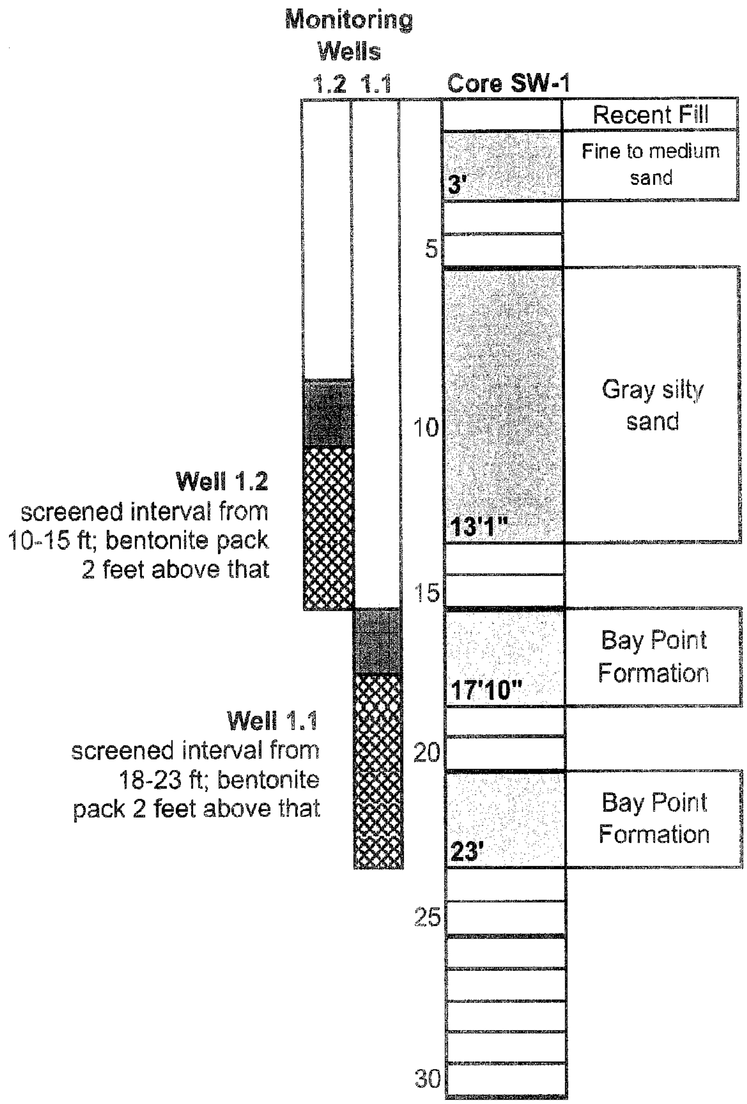
ANCHOR ENVIRONMENTAL, L.L.C.

Figure 10
Distribution of Waste Constituents - Cross-Section View
Southwest Marine Bulkhead Extension and Yard Improvement

APPENDIX A

CORING AND WELL INSTALLATION LOGS

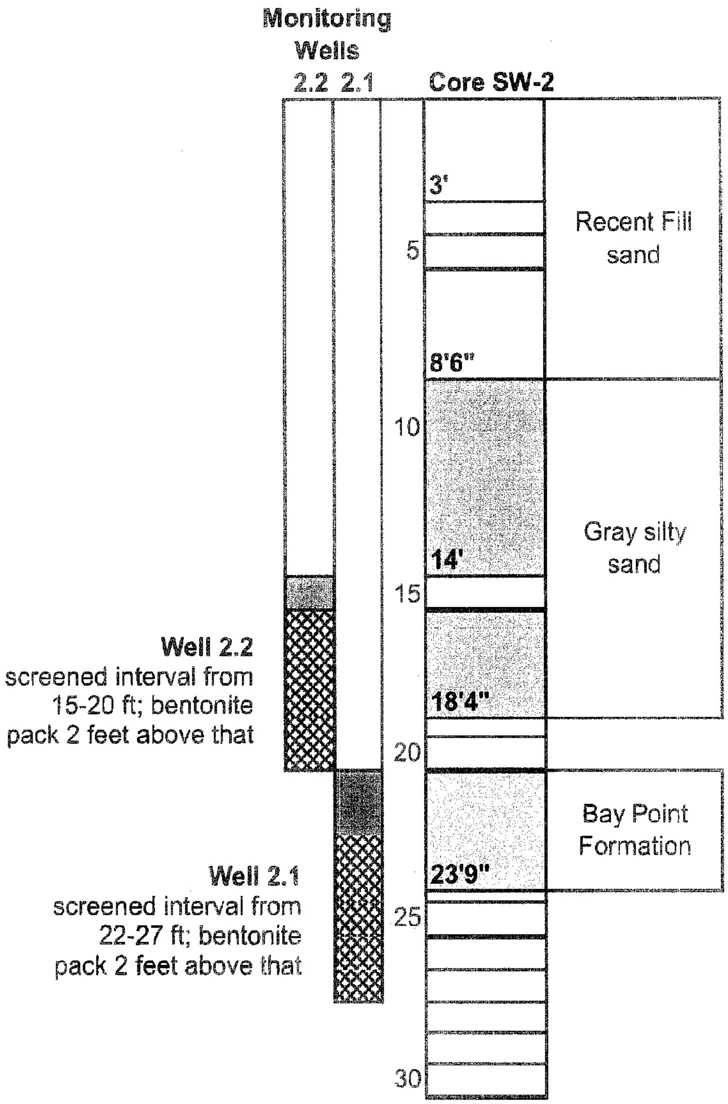
BULKHEAD EXTENSION AND YARD IMPROVEMENT PROJECT
PHASE 2 ACTIVITIES



1/10/04 CVD K:\Jobs\040277-SW_Marine\04027701\CORES.cdr

ANCHOR ENVIRONMENTAL, L.L.C.

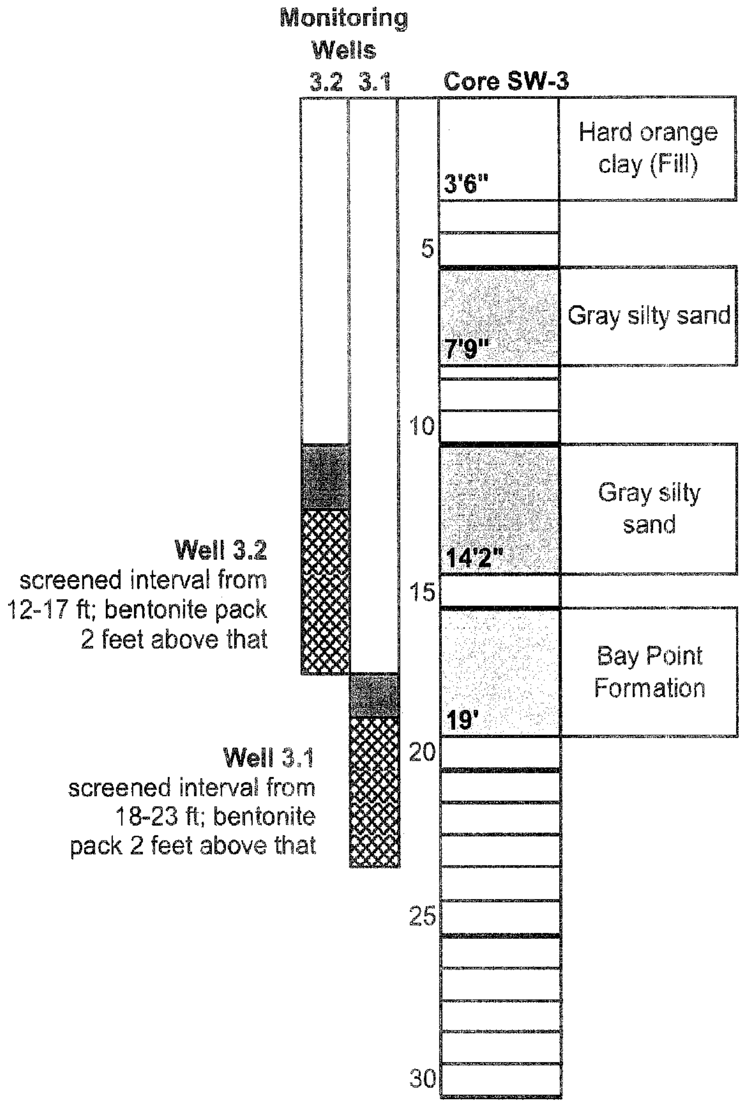
Figure A-1
Monitoring Wells MW-1.1 and MW-1.2
Southwest Marine Bulkhead Extension and Yard Improvement



1/10/04 CVD K:\Jobs\040277-SW_Marine\04027701\CORES.cdr

ANCHOR ENVIRONMENTAL, L.L.C.

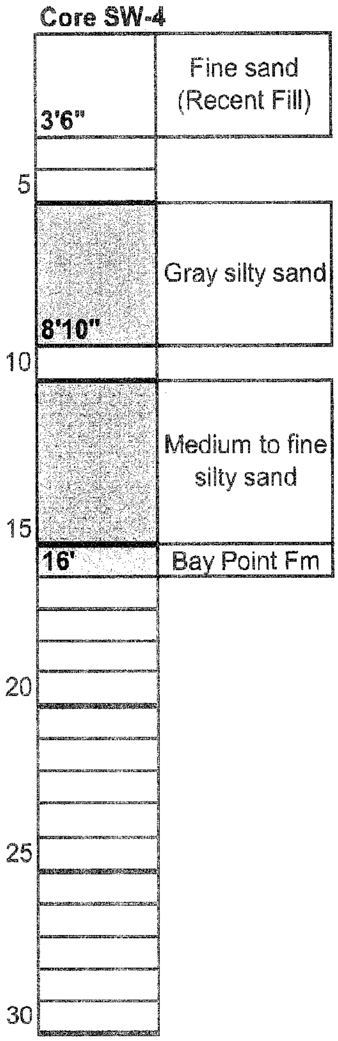
Figure A-2
Monitoring Wells MW-2.1 and MW-2.2
Southwest Marine Bulkhead Extension and Yard Improvement



1/10/04 CVD K:\Jobs\040277-SW_Marine\04027701\CORES.cdr

Figure A-3
Monitoring Wells MW-3.1 and MW-3.2
Southwest Marine Bulkhead Extension and Yard Improvement

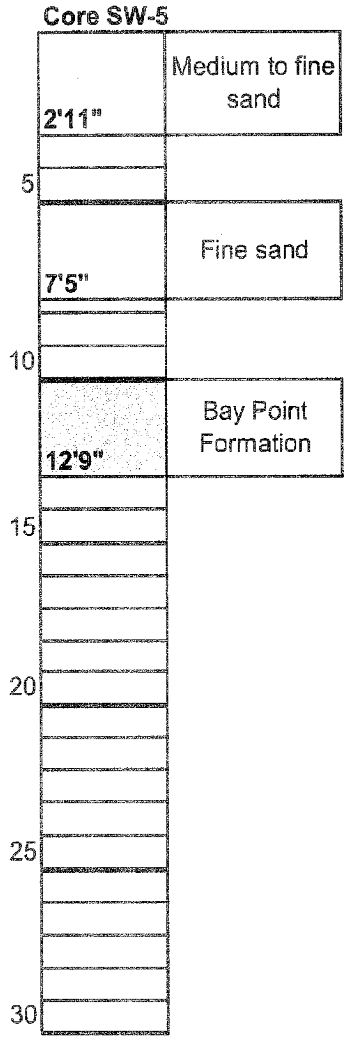
ANCHOR ENVIRONMENTAL, L.L.C.



1/10/04 CVD K:\Jobs\040277-SW_Marine\04027701\CORES.cdr

ANCHOR
ENVIRONMENTAL, L.L.C.

Figure A-4
Sediment Core SW-4
Southwest Marine Bulkhead Extension and Yard Improvement



1/10/04 CVD K:\Jobs\040277-SW Marine\04027701\CORES.cdr

Figure A-5
Sediment Core SW-5
Southwest Marine Bulkhead Extension and Yard Improvement

ANCHOR ENVIRONMENTAL, L.L.C.

APPENDIX B

DATA VALIDATION REVIEW REPORTS

BULKHEAD EXTENSION AND YARD IMPROVEMENT PROJECT
PHASE 2 ACTIVITIES

DATA VALIDATION REVIEW REPORT FOR GROUNDWATER SAMPLES

SOUTHWEST MARINE BULKHEAD EXTENSION

Prepared for
SW Marine, Inc.
2205 E. Belt Street
San Diego, California 92113

Prepared by
Anchor Environmental, L.L.C.
1423 Third Avenue, Suite 300
Seattle, Washington 98101

January 2005

This report summarizes the review of analytical results for seven water samples collected on December 3, 2004 at the Southwest Marine site in San Diego, California. Samples were collected by Anchor Environmental, LLC and submitted to CRG Marine Laboratories, Inc. (CRG) in Torrance, California. Samples were analyzed for total dissolved solids (TDS) by SM 2450-C, Chromium (CR) +6 by SM3500-CR, salinity by SM 2510, metals by United States Environmental Protection Agency (USEPA) Method 1640 or 200.8, polychlorinated biphenyls (PCBs) and congeners by USEPA Method 625, and polycyclic aromatic hydrocarbons (PAHs) by USEPA Method 625. CRG project ID P24152 and P24153c were reviewed.

Sample ID	Location	Lab ID	Matrix	Analysis Requested
SWM-Well 2-27-22	Station 2, MW-2.1	21498	Water	TDS, CR+6, salinity, metals, PCB, congeners, and PAH
SWM-Well 2-15-20	Station 2, MW-2.2	21499	Water	TDS, CR+6, salinity, metals, PCB, congeners, and PAH
SWM-Well 2-15-20 DUP	"	21500	Water	TDS, CR+6, salinity, metals, PCB, congeners, and PAH
SWM-Well 3-18-23	Station 3, MW-3.1	21388	Water	TDS, CR+6, salinity, metals, PCB, congeners, and PAH
SWM-Well 3-12-17	Station 3, MW-3.2	21389	Water	TDS, CR+6, salinity, metals, PCB, congeners, and PAH
SWM-Well 1-18-23	Station 1, MW-1.1	21386	Water	TDS, CR+6, salinity, metals, PCB, congeners, and PAH
SWM-Well 1-10-5	Station 1, MW-1.2	21387	Water	TDS, CR+6, salinity, metals, PCB, congeners, and PAH

DATA VALIDATION AND QUALIFICATIONS

The following comments refer to the laboratory's performance in meeting the quality assurance/quality control (QA/QC) guidelines outlined in the data quality objective section of the Quality Assurance Project Plan (QAPP; Anchor 2004). Laboratory results were reviewed following USEPA guidelines (USEPA 1999 and 2004). Unless noted in this report, laboratory results for the samples listed above were within QC criteria.

Laboratory Data Package and Field Documentation

Field documentation was checked for completeness and accuracy. The following was noted by CRG at the time of sample receipt: the samples were received in good condition and were consistent with the accompanying Chain-of-Custody form as documented on the Sample Receipt Form.

Holding Times and Sample Preservation

Samples were appropriately preserved and analyses were conducted within holding times. No data were qualified.

LABORATORY METHOD BLANKS

Laboratory method blanks were analyzed at the required frequencies. No analytes were detected in the laboratory method blanks.

FIELD QUALITY CONTROL

Field Duplicates

One field duplicate pairs was collected: SWM Well 2-15-20/SWM Well 2-15-20-DUP. The field duplicate pairs were comparable. No data were qualified due to these results.

SURROGATE RECOVERIES

There were no surrogate recoveries reported for the PCB or congener analyses. The surrogate recoveries for the semivolatile organics (PAH) analyses were performed at the required frequencies. Surrogate recoveries were within the QAPP-specified control limits, except for the following:

- d8-Naphthalene in samples SWM-Well 1-18-23, SWM-Well 1-10-15, SWM-Well 3-18-23, SWM-Well 3-12-17, and the method blank. The recoveries for the surrogate were below the QAPP-specified control limit. As the method allows for up to one surrogate to be outside the control limit for each sample, no data were qualified based on the surrogate recoveries.

MATRIX SPIKE (MS) AND MATRIX SPIKE DUPLICATE

Matrix spike (MS) and matrix spike duplicate (MSD) samples, were analyzed at the required frequency for the inorganic analyses. The following exceptions were noted:

- The inorganic MS and MSD percent recoveries (%Rs) were within the QAPP-specified control limits, except for hexavalent chromium MS on sample SWM-Well 3-12-17. As the MSD was within the QAPP-specified control limits no data were qualified.
- There were no MS or MSD analyzed for the organic analyses: PCBs, congeners, or PAH.

LABORATORY CONTROL SAMPLE, LCS DUPLICATE, AND SAMPLE REPLICATES

Laboratory control samples (LCS) for the inorganics were analyzed at the required frequencies. All LCS and LCS Duplicate (LCSD) %Rs were within QAPP-specified control limits, with the following exceptions:

- Trace metals recoveries for Antimony, iron, and manganese were outside the QAPP-specified control limits low in Method USEPA 1640 LCS. Iron and manganese were also outside the QAPP-specified control limit for Relative Percent Difference (RPD) in the LCSD. All associated data were flagged with the "J" flag for estimated.
- Cadmium RPD was above the QAPP-specified control limit in both the sample replicate (SWM-Well 2-27-22) and the dissolved LCS control limit.
- Titanium was above the sample replicate RPD control limit in sample SWM-Well 2-27-22.
- Selenium and mercury were not reported in the dissolved LCS or in the sample replicate analysis.
- Antimony and beryllium were above the RPD limit in the sample replicates for sample SWM-Well 1-18-23. Data associated with these recoveries will be qualified with the "J" flag to indicate the values reported are estimates.
- Aluminum and cadmium in the LCS and LCSD were above the QAPP-specified control limit for RPDs in USEPA method 1640 analyzed on December 13, 2004. Associated sample data will be qualified with the "J" flag to indicate the values reported are estimates.
- There were no laboratory control samples analyzed for the PCB, congener, or PAH analyses.

METHOD REPORTING LIMITS

Sample results were reported using the QAPP method reporting limits. Reporting limits were acceptable unless noted below:

- Samples SWM-Well 3-18-23 and SWM-Well 3-12-17 were analyzed using USEPA Method 200.8 rather than USEPA Method 1640. This resulted in a reporting limit of ten times the QAPP requirement.

OVERALL ASSESSMENT

The inorganic data are judged to be acceptable for their intended use. Due to the lack of surrogates for the PCB and congener analyses, it was difficult to access whether this data met minimal acceptance criteria. This compounded with the lack of any precision or accuracy data for the PCB, congener, or PAH data qualifies the data as estimated.

PRECISION, ACCURACY, AND COMPLETENESS

Precision:	All precision goals were not met.
Accuracy:	All accuracy goals were not met.
Completeness:	Completeness was 100 percent for all inorganic data, these data are useable as qualified. For the organic data, completeness cannot be determined.

REFERENCES

Anchor, 2004. Site Investigation Workplan, for 401 Water Quality Certification, Southwest Marine Bulkhead Extension and Yard Improvement Phase 2 Activities. Includes Quality Assurance Project Plan (QAPP). November 2004.

USEPA. 2004. USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. EPA 540/R-94/013. February.

USEPA. 1999. USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. EPA 540/R-99/008. October.

DATA VALIDATION REVIEW REPORT FOR SEDIMENT SAMPLES

SOUTHWEST MARINE BULKHEAD EXTENSION

Prepared for
SW Marine, Inc.
2205 E. Belt Street
San Diego, California 92113

Prepared by
Anchor Environmental, L.L.C.
1423 Third Avenue, Suite 300
Seattle, Washington 98101

January 2005

This report summarizes the review of analytical results for 14 sediment samples collected on November 29 and December 2, 2004, at the Southwest Marine site in San Diego, California. Samples were collected by Anchor Environmental, LLC and submitted to CRG Marine Laboratories, Inc. (CRG) in Torrance, California. Samples were analyzed for total organic carbon (TOC), trace metals by United States Environmental Protection Agency (USEPA) Method 6020, polychlorinated biphenyls (PCBs) and congeners by USEPA Method 8270C, and polycyclic aromatic hydrocarbons (PAHs) by USEPA Method 8270C. CRG project ID P24152b was reviewed.

Sample ID	Location	Lab ID	Matrix	Analysis Requested
SWM-Core 2-18-20	Station 2, core SW-2	21439	Sediment	TOC, Metals, PCB, congeners, and PAH
SWM-Core 1-17.2-20	Station 1, core SW-1	21440	Sediment	TOC, Metals, PCB, congeners, and PAH
SWM-Core 3-13-15	Station 3, core SW-3	21441	Sediment	TOC, Metals, PCB, congeners, and PAH
SWM-Core 3-5-10	“	21442	Sediment	TOC, Metals, PCB, congeners, and PAH
SWM-Core 4-6.11-10	Station 4, core SW-4	21443	Sediment	TOC, Metals, PCB, congeners, and PAH
SWM-Core 4-0-2	“	21444	Sediment	TOC, Metals, PCB, congeners, and PAH
SWM-Core 4-19-20	“	21445	Sediment	TOC, Metals, PCB, congeners, and PAH
SWM-Core 4-6.2-6.11	“	21446	Sediment	TOC, Metals, PCB, congeners, and PAH
SWM-Core 4-2-3.4	“	21447	Sediment	TOC, Metals, PCB, congeners, and PAH
SWM-Core 5-2.1-2.3	Station 5, core SW-5	21448	Sediment	TOC, Metals, PCB, congeners, and PAH
SWM-Core 5-2.3-4.1	“	21449	Sediment	TOC, Metals, PCB, congeners, and PAH
SWM-Core 5-4.1-5.0	“	21450	Sediment	TOC, Metals, PCB, congeners, and PAH
SWM-Core 5-7.7-9	“	21451	Sediment	TOC, Metals, PCB, congeners, and PAH
SWM-Core 5-9-10	“	21452	Sediment	TOC, Metals, PCB, congeners, and PAH
SWM-Core 5-12.3-15	“	21470	Sediment	TOC, Metals, PCB, congeners, and PAH

DATA VALIDATION AND QUALIFICATIONS

The following comments refer to the laboratory's performance in meeting the quality assurance/quality control (QA/QC) guidelines outlined in the data quality objective section of the Quality Assurance Project Plan (QAPP; Anchor 2004). Laboratory results were reviewed following USEPA guidelines (USEPA 1999 and 2004). Unless noted in this report, laboratory results for the samples listed above were within QC criteria.

Laboratory Data Package and Field Documentation

Field documentation was checked for completeness and accuracy. The following were noted by CRG at the time of sample receipt: the samples were received in good condition and were consistent with the accompanying Chain-of-Custody forms as documented on the Sample Receipt Form.

Holding Times and Sample Preservation

Samples were appropriately preserved and analyses were conducted within holding times. No data were qualified.

LABORATORY METHOD BLANKS

Laboratory method blanks were analyzed at the required frequencies. No analytes were detected in the laboratory method blanks.

FIELD QUALITY CONTROL

Field Duplicates

No field duplicates were taken with this data set.

SURROGATE RECOVERIES

There were no surrogate recoveries reported for the PCB or congener analyses. The surrogate recoveries for the semivolatile organics (PAH) analyses were performed at the required frequencies. Surrogate recoveries were within the QAPP-specified control limits, except for the following:

- d8-Naphthalene in the method blank, samples SWM-Core 5-7.7-9, SWM-Core 5-12.3-15, and SWM-Core 1-17.2-20 (matrix spike [MS]). The recovery for the surrogates were below the QAPP-specified control limit. As the method allows for up to one surrogate to be outside the control limit for each sample, no data were qualified based on the surrogate recoveries.

- Surrogates d8-Naphthalene and d12-perylene in sample SWM-Core 5-9-10. The recovery for the surrogates were below the QAPP-specified control limit. As the sample was non-detect for all analytes of interest, no data qualifications were made.

MATRIX SPIKE AND MATRIX SPIKE DUPLICATE

MS and matrix spike duplicate (MSD) samples, were analyzed at the required frequency for the inorganic analyses. The following exceptions were noted:

- The MS and MSD for sample SWM-Core 5-12.3-15 has numerous analytes outside the QAPP-specified control limits of 75 to 125 percent recovery (%R) in the PAH analysis. All relative percent difference (RPDs) were within the QAPP-specified control limits. Since the second MS and MSD set were within QAPP-specified control limits, the low recoveries were attributed to matrix effects rather than poor laboratory performance. No data were qualified based on these recoveries.
- The MS RPD for strontium and titanium were outside the QAPP-specified control limit. Results associated with these MSs were qualified with a "J" to indicate the values associated with this data are estimates.
- The MSD recovery for sample SWM-Core 5-12.3-15 has PCB congener PCB189 below the QAPP-specified control limit. Since this was the only congener that fell below the QC criteria, no data qualifications were made based on this recovery. All associated RPDs were within the control limits.

SAMPLE REPLICATES

- A sample replicate was performed on sample SWM-Core 5-2.3-4.1. The resulting RPDs for manganese, silver, and vanadium were above the QAPP-specified control limits.
- The sample replicate for SWM-Core 5-12.3-15 was missing data for mercury analysis.
- The sample replicate for SWM-Core 5-12.3-15 for PCB analysis does not match that of the original analysis. The replicate appears to have been done on sample SWM-Core 4-0-2 based on the congener results. The replicate data for this sample should not be used in any evaluation until further clarification can be ascertained.

LABORATORY CONTROL SAMPLE AND LCS DUPLICATE

Laboratory control samples (LCS) for the inorganics were analyzed at the required frequencies. All LCS and LCS Duplicate (LCSD) %Rs were within QAPP-specified control limits, with the following exceptions:

- Trace metals recoveries for Antimony, iron, strontium, and zinc were outside the QAPP-specified control limits low in the LCS and LCSD. Titanium recovery was also outside the QAPP-specified control limit in the LCSD. All associated data were qualified with the "J" flag for estimated.
- There were no laboratory control samples analyzed for the PCB, congener or PAH analyses.

METHOD REPORTING LIMITS

Sample results were reported using the QAPP method reporting limits. Reporting limits were acceptable.

OVERALL ASSESSMENT

The data are judged to be acceptable for their intended use. Due to the lack of surrogates for the PCB and congener analyses, it was difficult to access whether this data met all acceptance criteria. Since the resulting precision and accuracy data met the criteria, assessment was based on these recoveries.

PRECISION, ACCURACY, AND COMPLETENESS

For the organic analyses precision and accuracy were judged from the matrix spike data.

Precision:	All precision goals were met.
Accuracy:	All accuracy goals were met.
Completeness:	As the TOC data had not been submitted at the time of publication, completeness was not evaluated for it at this time.

REFERENCES

Anchor, 2004. Site Investigation Workplan, for 401 Water Quality Certification, Southwest Marine Bulkhead Extension and Yard Improvement Phase 2 Activities. Includes Quality Assurance Project Plan (QAPP). November 2004.

USEPA. 2004. USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. EPA 540/R-94/013. February.

USEPA. 1999. USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. EPA 540/R-99/008. October.

APPENDIX C

FATE AND TRANSPORT MODELING RESULTS

Modeling Results for Copper

Inputs Copper

Symbol	Value	Units	Comments	
O	0.4	unitless	Porosity of cap sediments	Drever, 1988. Well sorted sand or gravel range 25 - 50%
SG	2.5	g/cm3	Specific gravity of cap sediments	
Pb	1.50	g/cm3	Bulk sediment density of cap sediments (per page B24)	Bulk density = Specific gravity X porosity
Koc		L/kgOC	Organic carbon partitioning coefficient	
TOC	0.001	fraction	Cap Total Organic Carbon Content	
Kd	100	L/kg	Cap adsorption distribution coefficient	
Rf	376	unitless	Retardation factor calculated per Eq. B3	Retardation factor = 1+ (dry bulk mass density of soil/volumetric moisture content of the soil)*Kd – Reible equation is not consistent with Drever or Fetter.
L	90	cm	Effective cap depth (total cap minus bioturbation depth)	Assumes a 100cm thick cap and 10 cm for bioturbation
U	17.786304	cm/yr	Seepage velocity (not Darcy velocity)	Vx = Q/(n_e*A), where Q = discharge and A = cross-sectional area. Or: Vx = (k*dh*)/(n_e*dl*) Assume K = 0.00003 cm/sec, ne = 0.25, dh/dl = 0.0047
Do	225	cm2/yr	Molecular diffusion for chemical of interest in water	For metals D = (RT/F^2)(lambda/charge of the ion) RT/F^2 = 2.66E-07
Deff	66	cm2/yr	Effective diffusion through cap	Per Millington and Quirk, 1961. (Reible assumption)
D	84	cm2/yr	Diffusion/Dispersion combined coefficient	
Co	7.469	mg/L	Porewater conc. of underlying sediments	- 95% UCL for copper in sediments = 746.9 mg/Kg / 20452 L/Kg
TS	5	years	Desired time step for results	
Criteria	mg/L	3.10E-03		

Model Calculation and Results

Years Time(t)	Fac1	EF	Fac2	Comb	mg/L Conc. (Cpw)	mg/kg Conc. Seds
5	-	1.84E+08	-	-	-	-
10	-	1.84E+08	-	-	-	-
15	0.00E+00	1.84E+08	0.00E+00	0.00E+00	0.00E+00	0.00E+00
20	0.00E+00	1.84E+08	0.00E+00	0.00E+00	0.00E+00	0.00E+00
25	0.00E+00	1.84E+08	0.00E+00	0.00E+00	0.00E+00	0.00E+00
30	0.00E+00	1.84E+08	0.00E+00	0.00E+00	0.00E+00	0.00E+00
35	0.00E+00	1.84E+08	0.00E+00	0.00E+00	0.00E+00	0.00E+00
40	0.00E+00	1.84E+08	0.00E+00	0.00E+00	0.00E+00	0.00E+00
45	0.00E+00	1.84E+08	0.00E+00	0.00E+00	0.00E+00	0.00E+00
50	0.00E+00	1.84E+08	0.00E+00	0.00E+00	0.00E+00	0.00E+00
55	0.00E+00	1.84E+08	0.00E+00	0.00E+00	0.00E+00	0.00E+00
60	0.00E+00	1.84E+08	0.00E+00	0.00E+00	0.00E+00	0.00E+00
65	0.00E+00	1.84E+08	0.00E+00	0.00E+00	0.00E+00	0.00E+00
70	0.00E+00	1.84E+08	0.00E+00	0.00E+00	0.00E+00	0.00E+00
75	0.00E+00	1.84E+08	0.00E+00	0.00E+00	0.00E+00	0.00E+00
80	0.00E+00	1.84E+08	0.00E+00	0.00E+00	0.00E+00	0.00E+00
85	0.00E+00	1.84E+08	0.00E+00	0.00E+00	0.00E+00	0.00E+00
90	0.00E+00	1.84E+08	0.00E+00	0.00E+00	0.00E+00	0.00E+00
95	0.00E+00	1.84E+08	0.00E+00	0.00E+00	0.00E+00	0.00E+00
100	0.00E+00	1.84E+08	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Modeling Reults for Lead

Inputs **lead**

Symbol	Value	Units	Comments	
O	0.4	unitless	Porosity of cap sediments	Drever, 1988. Well sorted sand or gravel range 25 - 50%
SG	2.5	g/cm3	Specific gravity of cap sediments	
Pb	1.50	g/cm3	Bulk sediment density of cap sediments (per page B24)	Bulk density = Specific gravity X porosity
Koc		L/kgOC	Organic carbon partitioning coefficient	
TOC	0.001	fraction	Cap Total Organic Carbon Content	
Kd	1200	L/kg	Cap adsorption distribution coefficient	
Rf	4501	unitless	Retardation factor calculated per Eq. B3	Retardation factor = 1+ (dry bulk mass density of soil/volumetric moisture content of the soil)*Kd -- Reible equation is not consistent with Drever or Fetter.
L	90	cm	Effective cap depth (total cap minus bioturbation depth)	Assumes a 100cm thick cap and 10 cm for bioturbation
U	17.786304	cm/yr	Seepage velocity (not Darcy velocity)	Vx = Q/(n_e*A), where Q = discharge and A = cross-sectional area. Or: Vx = $(k\,dh)/(n_e\,dl)$ Assume K = 0.0003 cm/sec, ne = 0.25, dh/dl = 0.0047
Do	267	cm2/yr	Molecular diffusion for chemical of interest in water	For metals D = (RT/F^2)(lambda/charge of the ion) RT/F^2 = 2.66E-07
Deff	79	cm2/yr	Effective diffusion through cap	Per Millington and Quirk, 1961. (Reible assumption)
D	96	cm2/yr	Diffusion/Dispersion combined coefficient	
Co	1.58E-01	mg/L	Porewater conc. of underlying sediments	
TS	25	years	Desired time step for results	
Criteria	mg/L	8.10E-03		

Model Calculation and Results

Years Time (t)	Fac1	EF	Fac2	Comb	mg/L Conc. (Cpw)	mg/kg Conc. Seds
25	-	1.60E+07	-	-	-	-
50	-	1.60E+07	-	-	-	-
75	-	1.60E+07	-	-	-	-
100	-	1.60E+07	-	-	-	-
125	-	1.60E+07	-	-	-	-
150	0.00E+00	1.60E+07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
175	0.00E+00	1.60E+07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
200	0.00E+00	1.60E+07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
225	0.00E+00	1.60E+07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
250	0.00E+00	1.60E+07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
275	0.00E+00	1.60E+07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
300	0.00E+00	1.60E+07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
325	0.00E+00	1.60E+07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
350	0.00E+00	1.60E+07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
375	0.00E+00	1.60E+07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
400	0.00E+00	1.60E+07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
425	0.00E+00	1.60E+07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
450	0.00E+00	1.60E+07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
475	0.00E+00	1.60E+07	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Modeling Results for Zinc

Inputs Zinc

Symbol	Value	Units	Comments	
O	0.4	unitless	Porosity of cap sediments	Drever, 1988. Well sorted sand or gravel range 25 - 50%
SG	2.5	g/cm3	Specific gravity of cap sediments	
Pb	1.50	g/cm3	Bulk sediment density of cap sediments (per page B24)	Bulk density = Specific gravity X porosity
Koc		L/kgOC	Organic carbon partitioning coefficient	
TOC	0.001	fraction	Cap Total Organic Carbon Content	
Kd	200	L/kg	Cap adsorption distribution coefficient	
Rf	751	unitless	Retardation factor calculated per Eq. B3	Retardation factor = 1+ (dry bulk mass density of soil/volumetric moisture content of the soil)*Kd -- Reible equation is not consistent with Drever or Fetter.
L	81.4	cm	Effective cap depth (total cap minus bioturbation depth)	Assumes a 100cm thick cap and 10 cm for bioturbation
U	17.786304	cm/yr	Seepage velocity (not Darcy velocity)	Vx = Q/(n_e*A), where Q = discharge and A = cross-sectional area. Or: Vx = (*kdh*)/(n_e*dl*) Assume K = 0.0003 cm/sec, ne = 0.25, dh/dl = 0.0047
Do	222	cm2/yr	Molecular diffusion for chemical of interest in water	For metals D = (RT/F^2)(lambda/charge of the ion) RT/F^2 = 2.66E-07
Deff	65	cm2/yr	Effective diffusion through cap	Per Millington and Quirk, 1961. (Reible assumption)
D	83	cm2/yr	Diffusion/Dispersion combined coefficient	
Co	4.1	mg/L	Porewater conc. of underlying sediments	
TS	5	years	Desired time step for results	
Criteria	mg/L	8.10E-02		

Model Calculation and Results

Years Time (t)	Fac1	EF	Fac2	Comb	mg/L Conc. (Cpw)	mg/kg Conc. Seds
5	-	3.67E+07	-	-	-	-
10	-	3.67E+07	-	-	-	-
15	-	3.67E+07	-	-	-	-
20	0.00E+00	3.67E+07	-	-	-	-
25	0.00E+00	3.67E+07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
30	0.00E+00	3.67E+07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
35	0.00E+00	3.67E+07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
40	0.00E+00	3.67E+07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
45	0.00E+00	3.67E+07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
50	0.00E+00	3.67E+07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
55	0.00E+00	3.67E+07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
60	0.00E+00	3.67E+07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
65	0.00E+00	3.67E+07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
70	0.00E+00	3.67E+07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
75	0.00E+00	3.67E+07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
80	0.00E+00	3.67E+07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
85	0.00E+00	3.67E+07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
90	0.00E+00	3.67E+07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
95	0.00E+00	3.67E+07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
100	0.00E+00	3.67E+07	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Modeling Results for PCBs (quarry sand)

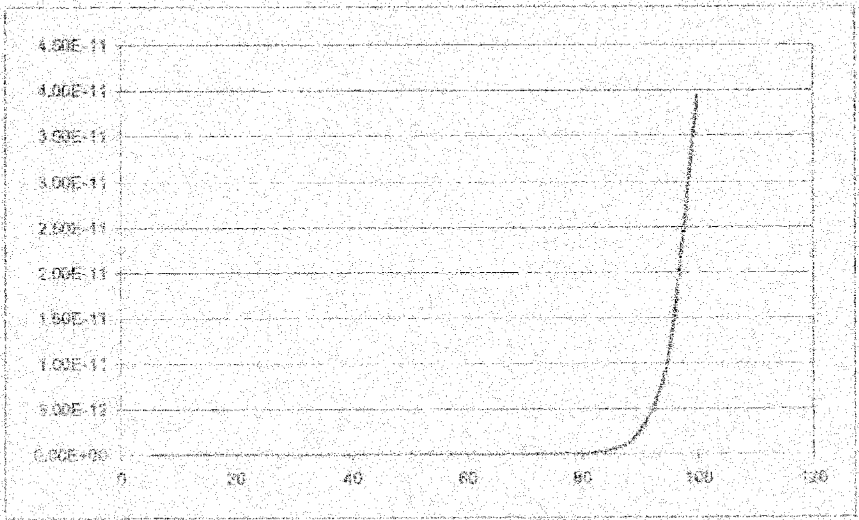
Inputs

PCBs (quarry sand cap)

Symbol	Value	Units	Comments
[illegible]	0.4	unitless	Porosity of cap sediments
Gs	2.6	g/cm3	Specific gravity of cap sand
Pb	1.60	g/cm3	Bulk sediment density of cap sediments (per page 2?4)
Koc	60,205	L/kgOC	Organic carbon partitioning coefficient
TOC	0.001	fraction	Cap Total Organic Carbon Content
Kd	60.2	L/kg	Cap adsorption distribution coefficient
Rf	91	unitless	Retardation factor calculated per Eq. B3
L	90	cm	Effective cap depth (total cap minus bioturbation depth)
U	17.786304	cm/yr	Seepage velocity (not Darcy velocity)
Dw	150	cm2/yr	Molecular diffusion of chemical of interest in water
Deff	56	cm2/yr	Effective diffusion through cap
D	74	cm2/yr	Diffusion/Dispersion combined coefficient
Co	[illegible]	mg/L	PW conc. of underlying sediments
TS	5	years	Desired time step for results
Criteria	3.00E-05	mg/L	Porewater criteria at top of isolation cap

Model Calculation and Results

Years (time t)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
5	0.00E+00	2.64E+09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
10	0.00E+00	2.64E+09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
15	0.00E+00	2.64E+09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
20	0.00E+00	2.64E+09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
25	0.00E+00	2.64E+09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
30	0.00E+00	2.64E+09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
35	0.00E+00	2.64E+09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
40	0.00E+00	2.64E+09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
45	0.00E+00	2.64E+09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
50	0.00E+00	2.64E+09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
55	1.11E-16	2.64E+09	0.00E+00	1.11E-16	1.28E-19	7.70E-18
60	2.44E-15	2.64E+09	0.00E+00	2.44E-15	2.81E-18	1.69E-16
65	5.01E-14	2.64E+09	0.00E+00	5.01E-14	6.58E-17	4.03E-15
70	8.86E-13	2.64E+09	0.00E+00	8.86E-13	1.02E-15	6.15E-14
75	9.39E-12	2.64E+09	0.00E+00	9.39E-12	1.08E-14	6.49E-13
80	7.34E-11	2.64E+09	0.00E+00	7.34E-11	8.49E-14	5.09E-12
85	4.50E-10	2.64E+09	0.00E+00	4.50E-10	5.18E-13	3.12E-11
90	2.24E-09	2.64E+09	0.00E+00	2.24E-09	2.59E-12	1.55E-10
95	9.43E-09	2.64E+09	0.00E+00	9.43E-09	1.09E-11	6.54E-10
100	3.42E-08	2.64E+09	0.00E+00	3.42E-08	3.94E-11	2.37E-09



Modeling Results for PCBs (clean sediment)

Inputs **PCBs (clean sediment cap)**

Symbol	Value	Units	Comments
O	0.4	unitless	Porosity of cap sediments
SG	2.5	g/cm3	Specific gravity of cap sand
Pb	1.50	g/cm3	Bulk sediment density of cap sediments (per page B24)
Koc	60,200	L/kgOC	Organic carbon partitioning coefficient
TOC	0.010	fraction	Cap Total Organic Carbon Content
Kd	602	L/kg	Cap adsorption distribution coefficient
Rf	903	unitless	Retardation factor calculated per Eq. B3
L	90	cm	Effective cap depth (total cap minus bioturbation depth)
U	17.786304	cm/yr	Seepage velocity (not Darcy velocity)
Do	190	cm2/yr	Molecular diffusion for chemical of interest in water
Deff	56	cm2/yr	Effective diffusion through cap
D	74	cm2/yr	Diffusion/Dispersion combined coefficient
Co	2.31E-03	mg/L	PW conc. of underlying sediments
TS	5	years	Desired time step for results
Criteria	3.00E-05	mg/L	Porewater criteria at top of isolation cap

Model Calculation and Results

Years Time (t)	Fac1	EF	Fac2	Comb	mg/L Conc. (Cpw)	mg/kg Conc. Seds
5	-	2.64E+09	-	-	-	-
10	-	2.64E+09	-	-	-	-
15	-	2.64E+09	-	-	-	-
20	-	2.64E+09	-	-	-	-
25	-	2.64E+09	-	-	-	-
30	-	2.64E+09	-	-	-	-
35	0.00E+00	2.64E+09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
40	0.00E+00	2.64E+09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
45	0.00E+00	2.64E+09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
50	0.00E+00	2.64E+09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
55	0.00E+00	2.64E+09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
60	0.00E+00	2.64E+09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
65	0.00E+00	2.64E+09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
70	0.00E+00	2.64E+09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
75	0.00E+00	2.64E+09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
80	0.00E+00	2.64E+09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
85	0.00E+00	2.64E+09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
90	0.00E+00	2.64E+09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
95	0.00E+00	2.64E+09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
100	0.00E+00	2.64E+09	0.00E+00	0.00E+00	0.00E+00	0.00E+00

SITE INVESTIGATION WORKPLAN
FOR
401 WATER QUALITY CERTIFICATION

SOUTHWEST MARINE
BULKHEAD EXTENSION AND YARD IMPROVEMENT
PHASE 2 ACTIVITIES

Submitted to

California Regional Water Quality Control Board
San Diego Region

Submitted by

Southwest Marine, Inc.
2205 East Belt Street
San Diego, California 92113

Prepared by

Anchor Environmental, CA LP.
3914 Murphy Canyon Road
San Diego, California 92123

November 2004

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Table of Contents

List of Tables

List of Figures

List of Appendices

1 OVERVIEW

Southwest Marine, Inc. (SWM) is planning to reconfigure a portion of its shipyard area, currently occupied by three abandoned marine railways by constructing a new section of sheetpile bulkhead. Material will be placed in the area behind the sheetpile bulkhead to create additional upland yard space for the facility. Figure 1 identifies the general location of the proposed bulkhead extension and yard improvement project (henceforth, "the project") relative to SWM's shipyard and facilities. Figures 2 and 3 present detailed plan and cross-sectional views of the bulkhead improvement area and proposed construction activities.

Phase 1 of the project will be accomplished by removing marine structures from the area and installing a new section of sheetpile bulkhead across the face of the abandoned railways. SWM has received a 401 Water Quality Certification (WQC; File No.03C-065) from the California Regional Water Quality Control Board, San Diego Region (RWQCB) for Phase 1 activities. All other permits have been received[1], including an approved mitigation plan and a Phase 1 Water Quality Monitoring Program (WQ Plan).

After completion of Phase 1, a subsequent series of Phase 2 construction activities will involve existing impacted sediments within the project site. First, impacted sediments immediately inside the new bulkhead alignment will be relocated to an area farther back (shoreward) within the yard improvement area (as shown on Figure 3). Second, the excavated area and the remainder of the bulkhead-enclosed area will be backfilled with imported, clean, granular fill to the elevation of the surrounding grade (approximately +12 feet Mean Lower Low Water [MLLW]). After adequate settlement, the area will be paved to support yard operations.

In August 2004, SWM submitted to the RWQCB a Data Evaluation Report for Phase 2 Activites (Anchor 2004), which provided information supporting issuance of a 401 WQC and Waste Discharge Requirements (WDR) for Phase 2 of the work. Specifically, the Data Evaluation Report included a detailed evaluation of the long-term potential for impacts to the surface waters of San Diego Bay associated with the placement of imported fill over impacted sediments behind the sheetpile wall, and a revised WQ Plan to address both Phase 1 and Phase 2 activities.

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[1] A Provisional U.S. Army Corps of Engineers permit will be finalized upon receipt of WQC for Phase 2.

After reviewing the Data Evaluation Report, the RWQCB issued a letter dated September 14, 2004, in which additional site investigation and characterization was requested in order to better define the lateral and vertical extents of waste impacts at the site, and the mechanisms of waste transport through soil and groundwater. This letter also required SWM to submit a Workplan for the site investigation. This document is the Workplan, and was prepared in accordance with the requirements documented in the RWQCB's September 14 letter.

This Workplan addresses the following objectives:

1. Summarize existing information on site history, waste characterization, geology, and groundwater
2. Present the site conceptual model and potential impacts to sediments and water quality
3. Identify existing data gaps
4. Present sampling and analysis activities necessary to address these data gaps
5. Discuss data evaluation steps.

2 SUMMARY OF EXISTING INFORMATION

2.1 Site History and Layout

SWM's San Diego shipyard is located on the eastern shore of San Diego Bay, approximately 1 mile south of the Coronado Bridge. The shipyard has been used primarily for ship repair activities since the early 19th century, and under SWM ownership since 1979. Comprehensive pollution prevention programs and best management practices have been in place for approximately 20 years.

The bulkhead extension under consideration will be constructed across the mouth of an intertidal embayment around the landward end of Pier 1. The embayments are occupied by abandoned shipway marine railways: railway Number 1 on the northwest side of Pier 1, and railways Numbers 2 and 3 on the southeast side.

2.2 Geology and Groundwater

Much of our current understanding of sediment conditions at the site is the result of a detailed site sediment investigation conducted by SWM and NASSCO in 2002 and 2003 to determine the existence and extent of potential chemical contamination associated with historical operations at the shipyards. This investigation, conducted and documented by E^{x}ponent (2003) in the report entitled NASSCO and Southwest Marine Detailed Sediment Investigation, was conducted in response to RWQCB Resolutions No. 2001-02 and 2001-03 and subsequent Water Code Section 13267 letters issued to the shipyards. The investigation involved a series of surface and core samples taken from site sediments throughout both shipyards' leasehold areas and beyond. Figures 1 and 2 identify the locations of cores and sediment surface samples taken during the 2002/2003 investigation.

Information on subsurface geology and groundwater characteristics was provided by the site sediment investigation by E^{x}ponent (2003) described above, and by a series of soil probes and borings advanced for geotechnical design of the bulkhead (Christian-Wheeler 2002). The site is underlain by the following sequence of soil/sediment types:

- Upland areas are underlain by fill materials originally placed when the site land was constructed in the early 20th century. More recent sand fill areas (Figure 2) were created during a 1998 remedial action undertaken by SWM within the project area, under RWQCB oversight.

- Three to 11 feet of soft geologically recent surface sediments were observed throughout the offshore areas by Exponent (2003) and by Christian-Wheeler (2002). These surface sediments consist of interbedded silts, clayey silts, and sandy silts, and contain the elevated chemical concentrations observed in the study.
- The offshore surface sediments and upland fill materials are underlain by the firmer Bay Point Formation , which is Quaternary in age and consists of intermixed medium dense to dense sands and silty sands, and stiff to hard silty to sandy clays.

Groundwater at the site responds to the tidal action of San Diego Bay. The ground surface elevation at the site is approximately 12 feet MLLW, while tidal levels fluctuate roughly between elevations -1 and 7 feet MLLW. Borings conducted by Christian-Wheeler (2002) indicated groundwater at depths of 8.5 to 10 feet below ground surface (bgs). Work conducted by ENV America on the neighboring San Diego Gas & Electric (SDG&E) parcel indicated groundwater at approximately 15 feet bgs (ENV America 2002).

2.3 Waste Characterization of Existing Sediments

Sediments along and in the vicinity of the planned bulkhead are best represented by cores SW04 and SW08, since these cores were located in close proximity to the alignment of the bulkhead (Figure 2). Sediment chemistry from various depth intervals in these cores are summarized in Table 1.

The primary constituents of concern (COCs) in the impacted sediments include metals, polychlorinated biphenyls (PCBs), and polycyclic aromatic hydrocarbons (PAHs). It is likely that these chemicals exist as sorbed phases on clays and carbon-rich particulate matter in the fine-grained sediments. Bioassay testing by Exponent (2003) indicated that the sediments do not exhibit significant toxicity.

In 1998, under the RWQCB's oversight, SWM dredged chemically impacted sediments from the landward (northeastern) portions of this embayment, and replaced the dredged material with clean sand fill. Figure 2 identifies the areas where sediments were removed and clean sand fill placed. Confirmation samples were obtained at regularly spaced intervals by SWM after dredging these areas to confirm that all sediments exceeding the relevant cleanup standards had been removed. Analytical results from these samples are sufficient to characterize sediments remaining below the sand fill, and will be reviewed as part of the site investigation described in this Workplan.

As part of SWM's Data Evaluation Report for Phase 2 activities (Anchor 2004), a pair of temporary well points were installed within the site sediments near the alignment of the planned bulkhead wall. Porewater samples were obtained from each well point and analyzed for metals, PAHs, and PCBs. The locations of these two well point samples are shown on Figure 2, and the chemistry results documented in Table 2.

3 SITE CONCEPTUAL MODEL

A site conceptual model is a representation of the site's potential chemical sources, affected media, potential pathways to exposure, and receptors.

3.1 Current Site Conceptual Model

Cores taken during the Exponent (2003) site investigation in 2002 and 2003 indicated that chemical concentrations were generally highest in the surface sediment and decreased with depth. This is consistent with the fact that the surface sediments were deposited in recent industrial times, as opposed to the underlying Quaternary-age Bay Point Formation. It is expected that chemical concentrations in the Bay Point Formation are significantly lower than those in the younger surface sediments.

SWM's 1998 remedial action in the landward portions of the project area provided additional evidence that chemical concentrations decrease with depth in the surface sediments. Cleanup goals for that project were met by removing the upper sediments, and subsequent confirmatory samples verified that underlying sediments did not exceed the established cleanup criteria.

Neither the 2002/2003 site investigation not the 1998 remedial action involved samples taken from upland areas immediately around the bulkhead extension project area. Therefore, chemical concentrations in the upland fill materials are not known at this time. The chemically impacted offshore surface sediments are not continuous with the upland soils, since the surface sediments are laterally bounded by timber and steel bulkhead walls forming the perimeter of the project area.

Based on studies of groundwater at similar sites fringing San Diego Bay, groundwater at the site is expected to move in a generally horizontal direction from the uplands toward the Bay. Within and adjacent to the project site, groundwater will be influenced both by overall regional gradients and by tidal action.

The potential receptor of concern for this project is the surface waters of San Diego Bay. The primary route for possible water-quality impacts is potential contaminant release from sediments behind the bulkhead, as a result of groundwater seepage through and under the sheetpile. Porewater, driven by tidal flushing and groundwater gradients, could move through, around, or under the sheetpile bulkhead, thereby coming in contact with the surface water. Infiltration and percolation of surface water will be relatively insignificant because the site will be paved.

Construction of the project will provide both horizontal and vertical isolation and confinement of the existing contaminated sediments underlying the area, restricting the potential for contaminants to leach into the surrounding environment. Vertical confinement will be provided by placement of up to 15 feet of clean imported fill and an impervious asphalt surface. Horizontal confinement will be provided by the installation of sheetpiling across the front of the former shipways to a depth of about 20 to 25 feet below existing mudline and about 8 to 10 feet into the relatively impermeable Bay Point Formation, which underlies the more recent surface sediments. The presence of the sheetpile wall as a relatively impervious barrier to water flow will significantly restrict flow of aqueous contaminants into receiving waters.

To provide for additional protection, the project has been designed with a clean imported sand buffer between impacted sediments and the bulkhead wall (Figure 3). Impacted sediments along the interior of the bulkhead will be relocated to the interior of the project footprint and replaced with imported, clean, granular fill sand. This sand buffer will both increase the distance the porewater must move and will increase tidal attenuation, adsorption, and partitioning of the migrating water within the sand as it approaches the bulkhead and surface waters of San Diego Bay.

Modeling of tidal attenuation presented in the Data Evaluation Report for Phase 2 activities (Anchor 2004) indicates that the overall effect of the project's design features (sheetpile bulkhead and clean sand buffer) will be to decrease concentrations in the groundwater/porewater by a factor of at least 400 before surface waters are reached. Porewater expressed from the project footprint is predicted to have chemical concentrations well below chronic WQC upon entry into site surface waters, and thus is not expected to impact ambient surface water quality.

3.2 Data Gaps

This Site Conceptual Model will be further developed and modified by the site investigation presented in the next section of this Workplan. The site investigation scope has been designed to address existing data gaps, as follows:

- Lateral and horizontal extent of waste constituents within and below the chemically impacted surface sediments.
- Presence and extent (if any) of chemical impacts to upland fill soils outside the perimeter of the project area, and the underlying Bay Point Formation.
- Groundwater flow regime and gradient in the project area and immediately adjacent to it.

4 SAMPLING PROGRAM

4.1 Overview of Sampling Design

The site investigation will provide additional vertical and lateral characterization of COCs in the soil, sediment, and groundwater at the SWM bulkhead extension/yard improvement area.

Continuous core samples will be collected at three stations (labeled 1, 2, and 3 on Figure 2) to sample the upland fill and underlying Bay Point Formation. Composite samples from the Bay Point Formation at stations 1 and 2 will be analyzed for TOC, metals, PCBs, and PAHs (Table 3) to determine the chemical and physical properties within the layer. At station 3, a composite sample will be obtained from the upland fill layer.

Two additional piston cores will be taken from surface sediments at the former well point locations sampled in July 2004. These sample locations are labeled 4 and 5 on Figure 2. A composite sample from each core will also be analyzed for metals, PCBs, and PAHs for sediment characterization.

To determine the spatial extent of the chemical and hydrologic characteristics of groundwater, two piezometers will be installed at continuous core sample stations 1, 2, and 3 (Figure 2). Groundwater will be sampled from the upland fill or surface sediments (depending on the location of the sample station), and from the underlying Bay Point Formation, and analyzed for metals, PCBs, and PAHs (Table 4).

Groundwater levels will also be measured under different tidal conditions to characterize hydrologic gradients for the upland fill, surface sediments, and underlying Bay Point Formation.

4.2 Field Sampling Plan

Detailed procedures for sample collection, handling, and shipping are described in this section. Procedures for the following tasks are included:

- Locations of sampling stations
- Collecting and compositing sediment push core and piston core samples
- Collecting groundwater samples and groundwater elevation measurements

- Sample packaging, handling, and shipping procedures
- Completing standard forms to document the collection effort and field conditions

4.2.1 Station Locations

Five station locations are shown in Figure 2. At three stations, Stations 1, 2, and 3, a continuous core sample will be taken and two temporary groundwater wells installed. Stations 1 and 2 are located in the sand-fill areas near the railways' shoreward terminus where impacted sediments were previously removed. Station 3 is located in the paved uplands area immediately east of the project area. Stations 4 and 5 are co-located with previous well point stations sampled in July 2004. Station 4 is within surface sediments between Marine Railway Number 2 and Number 3. Station 5 is located to the east of Pier 1 within the existing ship cradles. If a core cannot be advanced at Station 5, then this station will be relocated to a nearby location (possibly south of the existing Pier 1) where the sediments can be successfully penetrated.

Depending on conditions encountered in the field, the exact locations of the stations will be determined in the field by the field team leader. If riprap or other debris impedes the sampling equipment, the station will be relocated as close to the original station location as possible.

4.2.2 Sample Collection

4.2.2.1 Direct Push Continuous Cores

Three continuous soil cores will be collected from Stations 1, 2, and 3 using a direct-push sampling rig, to a target depth of at least 4 feet into the Bay Point Formation or until refusal. Four foot acetate core liners will be decontaminated immediately prior to use following the procedures outlined in the Quality Assurance Project Plan (QAPP). Care will be taken during sampling to avoid contact of the sample tube with potentially contaminated surfaces. Extra sample tubes will be available during sample operations for uninterrupted sampling in the event of potential core tube breakage or contamination. Core tubes suspected to have been accidentally contaminated will not be used.

Each core will be split open vertically, photographed, and geologically characterized into a core log. The core will then be sectioned into two distinct layers, the upland fill or surface sediment layer, and the underlying Bay Point Formation. At sampling stations 1 and 2, a composite sample will be collected from the Bay Point Formation layer and analyzed for total organic carbon (TOC), trace metals, PCBs, and PAHs. At station 3, a composite sample will be collected from the upland fill layer. Each composite sample will be split into four 50-gram glass containers for laboratory analysis. Constituents, analysis methods, containers and holding times are depicted in Table 3. Sampling information, including sample identifier, sample location, date and time of sampling, requested analysis, and sampler name, will be recorded on a chain of custody form and on the sampling jar label. Following collection, samples will be placed in a cooler with ice pending delivery to the laboratory.

4.2.2.2 *Fixed-Piston Sediment Cores*

A piston corer fitted with polycarbonate tubing (7.6-cm inner diameter [id]) will be used to collect surface sediment cores from Stations 4 and 5. All cores will be driven by hand until refusal is reached, which is expected to be on the order of 5 to 7 feet based on previous cores advanced by Exponent (2003).

The core tubes will be decontaminated immediately prior to use following the procedures outlined in the QAPP. Care will be taken during sampling to avoid contact of the sample tube with potentially contaminated surfaces. Extra sample tubes will be available during sample operations for uninterrupted sampling in the event of a potential core tube breakage or contamination. Core tubes suspected to have been accidentally contaminated will not be used.

The piston depth will be set at approximately 20 cm above the surveyed sediment-water interface, and driven into the sediment with drive rods. Penetration and recovery will be assessed using Velcro® on the outside of the core tube. The piston corer will be retrieved slowly and steadily to avoid agitating the sample. Prior to lifting the core tube out of the water, a plug will be inserted into the bottom of the core tube to prevent sediment from slipping out of the bottom. During deployment and retrieval of the coring device, care will be taken to ensure that the end of the core tube does not become contaminated. After retrieval, each core will be split open vertically, photographed, and geologically characterized into a core log. Each core will then be composited into one sample and split into three 50-gram glass containers for analytical testing of metals, PCBs, and PAHs. Sampling information, including sample identifier, sample location, date and time of sampling, requested analysis, and sampler name, will be recorded on a chain-of-custody form and on the sampling jar label. Following collection, samples will be placed in a cooler with ice pending delivery to the laboratory.

4.2.2.3 Groundwater

Upon completion of the continuous-push cores at Stations 1, 2, and 3, each boring will be converted into a .75- inch temporary groundwater well. This will involve installing direct-push geoprobes in paired piezometer nests at each of the three sampling locations. The paired piezometer nests consist of one 5-foot prepacked screen to be installed from (approximately) 20 to 15 feet, with a second 5-foot screen placed in the same vicinity from (approximately) 15 to 10 feet. One well will collect groundwater from within the Bay Point Formation layer, the second from the overlying upland fill/surface sediment layer.

Groundwater samples will be collected from each of the newly installed monitoring wells after 24 hours to allow the wells to equilibrate, using a peristaltic pump with disposable tubing. Sampling for COCs will be conducted as close to low tide as possible, particularly in the wells located near the shore. Wells will be purged of at least three well volumes of groundwater prior to sampling. Following the removal of each well volume from the monitoring wells, specific conductance and pH of the water will be measured. The results of these measurements, in addition to the volume of groundwater removed, will be recorded on the sampling log. Groundwater samples will be collected by discharging water from the peristaltic pump directly into the laboratory-provided sample jars described in Table 4. All samples collected for dissolved metals analysis will be filtered with a 0.45 µm in-line filter prior to placement in a sampling bottle. Sampling information, including sample identifier, sample location, date and time of sampling, requested analysis, and sampler name, will be recorded on a chain-of-custody form and on the sampling jar label. Following collection, samples will be placed in a cooler with ice pending delivery to the laboratory.

Groundwater levels will also be measured in each piezometer on four different occasions over two days to characterize hydrologic gradients for the upland fill, surface sediments, and underlying Bay Point Formation under different tidal conditions. Groundwater levels will be measured using a decontaminated, electronic well probe and tape measure lowered into each well and recorded on a data sheet.

4.2.3 Sample Handling, Packaging, and Shipping

All sample containers will be provided by the testing laboratory and prepared in accordance with United States Environmental Protection Agency guidelines (USEPA 1986) prior to field operations. Sample containers for chemical analysis will be kept closed and stored in a box or cooler until they are used. As they are collected, samples will be labeled, recorded on a field data log sheet, and placed as soon as possible on ice in a cooler at 4± 2°C.

Samples for all chemical analyses will be shipped on ice (4± 2°C) to the testing laboratory and will be stored at this temperature until analysis. Samples in glass containers will be packed in bubble wrap to prevent breakage and chain-of-custody forms will be placed in Ziploc® bags taped to the inside cooler lid. Samples will be shipped overnight to the testing laboratory and signed in at the laboratory upon receipt. A copy of the signed chain-of-custody form will be returned by the testing laboratory along with the analysis results.

4.2.4 Field Quality Control Sample Procedures

The following quality control samples will be collected in the field and analyzed in the testing laboratory with the other samples:

- Field Sampling Duplicates – Field duplicate samples are collected to assess the variability of chemical concentrations at the station location and provide a measure of the total analytical bias (field and laboratory variance). One field duplicate will be taken from one continuous-push core and one groundwater well.

- Equipment Rinsate Blank – A rinsate blank will be collected from the groundwater sampling equipment (tubing) to identify possible contamination from the sampling environment. The rinsate blank will consist of running distilled/deionized water over the sampling equipment after decontamination, collected into a sample container, and submitted to the testing laboratory with the other samples.

4.2.5 Field Documentation and Chain-of-Custody Forms

A field log book will be kept throughout the study to document all daily field activities. Core logs will also be produced for each continuous-push core and piston core collected. Photo documentation of each core will be collected and identified in the field book with sample identification and photograph number. The field team leader is responsible for completing all logbooks and forms, including updating a station location map as needed during sampling.

Sample labels will be completed for each sample. Each label will include station identification, date, time, sampling personnel, preservative, and analysis required. All labels will be made with indelible ink and covered with clear tape.

Chain-of-custody forms will be completed at the end of each sampling day to trace samples from collection to final disposition. The chain-of-custody form includes sample identification, collection date, time, matrix, analysis requested, number of containers, and preservative. Chain-of-custody forms will be completed in triplicate with one copy being retained by the field team leader.

5 ANALYTICAL PROGRAM

5.1 Sediment Chemistry

Sediment samples will be submitted to CRG Laboratories, Inc. and analyzed for TOC, metals, PCBs, and PAHs using standard USEPA methods. Table 3 depicts the entire list of constituents to be analyzed as well as analysis method and detection limits. Analysis will include laboratory blanks and control samples to ensure quality control. Data will be delivered within 15 business days of sample delivery date.

5.2 Groundwater Chemistry

Groundwater samples will be submitted to CRG Laboratories, Inc. and analyzed for TOC, metals, PCBs, and PAHs using standard USEPA methods. Table 4 depicts the entire list of constituents to be analyzed as well as analysis method and detection limits. Analysis will include laboratory blanks and control samples to ensure quality control. Data will be delivered within 15 business days of sample delivery date.

6 DATA EVALUATION

Information collected during the field and analysis program will be used to update the Site Conceptual Model and re-evaluate the potential for water quality impacts from impacted sediments in the project area. Data evaluation will include the following steps:

- Geological Characterization
- Waste Constituent Characterization, including tabulation of soil and groundwater analysis results
- Groundwater Flow Characterization
- Reevaluation of Fate and Transport of COC's. Results will be used to update conclusions cited in the Data Evaluation Report (Anchor 2004)

6.1 Delineate Lateral and Vertical Extent of Waste Constituents

Concentrations of COCs in sediments will be summarized by upland fill, surface sediment, and Bay Point Formation layer to determine both the vertical and spatial extent of COCs. To determine vertical distribution of COCs, concentrations within the Bay Point Formation from all cores will be summarized and compared to the concentrations found in the upland fill and surface sediment layers. To determine horizontal extent of COCs, similar sediment layers from individual cores will be compared against one another. This information will supplement the results of confirmational sampling that was done following SWM's 1998 sediment removal project (described in Section 2.3).

The complete information will be used to update the Site Conceptual Model, the previously presented analysis of fate and transport of waste constituents, and the potential for impacts on water quality (Anchor 2004). The analysis of fate and transport will include application of a standard flow and partitioning model (i.e., one of several models in Boudreau 1997 and/or promulgated by the Army Corps of Engineers) to the site conditions in order to quantify potential water quality impacts.

In accordance with the RWQCB's letter dated September 14, 2004, a Site Investigation and Characterization Report (Report) will be prepared and submitted for RWQCB review. This Report will contain the following information:

- A description of the updated Site Conceptual Model

- Characterization of potential sources of waste constituent discharges to the soil, groundwater, and (as appropriate) stormwater conveyance systems based on historic records and data collected from the site
- Geologic characterization of subsurface layers – upland fill, surface sediments, and Bay Point Formation – that could be affected by COCs
- Identification of the vertical and lateral extent of potential COCs in upland fill, surface sediments, and the underlying Bay Point Formation
- Identification of the vertical and lateral extent of potential COCs in groundwater within upland fill, surface sediments, and Bay Point Formation
- Groundwater flow characteristics within the upland fill, surface sediments, and , Bay Point Formation. This discussion will be supplemented by a review of any available groundwater data from shoreline areas of other nearby properties
- Results of our evaluation and modeling of fate and transport of COCs in each media
- Description of field and analytical methodologies, including figures depicting sampling locations

7 REFERENCES

Anchor, 2004. Data Evaluation Report, in support of Water Quality Certification for Southwest Marine Bulkhead Extension and Yard Improvement Phase 2 Activites. August 2004.

Boudreau, B.P. 1997. Diagenetic Models and Their Implementation, Modelling Transport and Reactions in Aquatic Sediments. Springer. New York, New York.

Christian-Wheeler Engineering, 2002. Geotechnical Recommendations and Design Criteria, Proposed Quay Wall Construction Project, Southwest Marine Facilities, San Diego, California. Prepared for Triton Engineers, April 4, 2002.

ENV America, 2002. Workplan for Site Assessment, Former Wastewater Ponds, Silver Gate Power Plant. Prepared for San Diego Gas and Electric Company, August 21, 2002.

Exponent, 2003. NASSCO and Southwest Marine Detailed Sediment Investigation, prepared for NASSCO and Southwest Marine, September 2003.

USEPA 1986. General QA/QC considerations for collecting environmental samples in Puget Sound. U.S. Environmental Protection Agency, Region 10, Office of Puget Sound, Puget Sound Estuary Program Seattle, WA.

TABLES

Tab[illegible]
Bulk Sediment Chemistry - Sediment Cores SW04 and SW08

Analyte of Concern / Core ID / Sample Date / Depth Interval	SW04 8/7/2001 0-2 cm	SW04 9/10/2002 0-2 cm	SW04 8/27/2002 0-2 ft	SW04 8/27/2002 2-4.1 ft	SW04 Depth Averaged	SW08 8/8/2001 0-2 cm	SW08 8/28/2002 0-2 ft	SW08 8/28/2002 0-2 ft	SW08 8/28/2002 2-4 ft	SW08 8/28/2002 4-6 ft	SW08 8/28/2002 6-6.5 ft	SW08 Depth Averaged
Conventionals												
Fines content (%)	31.8	-	-	-	31.8	68.8	-	-	-	-		68.8
TOC (% dry)	1.59	-	0.91	1.8	1.37	3.35	1.5	-	1.1	0.12	-	0.93
Metals (mg/kg)												
Arsenic	95.5	-	67.7	107	89.65	25.5	26.6	-	13.2	4.9	-	15.12
Cadmium	2.35	-	0.79	3.17	2.05	0.67	1.13	-	0.86	0.07	-	0.69
Chromium	64.7	-	25.5	97.2	63.36	77.8	110	-	109	7.4	-	76.00
Copper	1880	-	370	2170	1325.60	1030	1540	-	1480	49	-	1029.94
Lead	482	-	154	413	295.73	248	343	-	341	10.6	-	233.26
Mercury	1.19	-	1.14	7.4	4.36	2.53	4.97	-	5.95	0.3	-	3.75
Nickel	20.1	-	8.3	40	24.87	22.7	16.8	-	9.1	2.6	-	9.71
Selenium	1.2	-	1.2 U	3.1	2.19	1 U	1.6 U	-	1.4 U	1.2 U	-	1.6 U
Silver	1.72	-	0.59	1.4	1.04	1.38	1.04	-	0.49	0.03	-	0.53
Zinc	4550	-	669	1450	1158.31	859	1410	-	786	33.7	-	749.46
PCB (µg/kg)												
Aroclor 1016	190 U	-	150 U	1500 U	1500 U	330 U	1900 U	950 U	1400 U	130 U	12 U	1900 U
Aroclor 1221	370 U	-	290 U	2900 U	2900 U	650 U	3800 U	1900 U	2800 U	250 U	24 U	3800 U
Aroclor 1232	190 U	-	150 U	1500 U	1500 U	330 U	1900 U	950 U	1400 U	130 U	12 U	1900 U
Aroclor 1242	190 U	-	150 U	1500 U	1500 U	330 U	1900 U	950 U	1400 U	130 U	12 U	1900 U
Aroclor 1248	190 U	-	1300	16000	8664	990	9300	12000	15000	1100	12 U	8223
Aroclor 1254	2400	-	1200	13000	7153	2400	7000	8700	12000	600	12 U	6303
Aroclor 1260	600	-	610	6500	3570	640	4100	4400	6600	290	12 U	3427
Total PCBs	3000		3110	35500	19387	4030	20400	25100	33600	1990	0	17954
PAHs (µg/kg)												
2-Methylnaphthalene	31	-	10	460	240	32	18	-	50	6.1 U	-	25
Acenaphthene	110	-	22	3100	1594	83	54	-	110	6.1 U	-	57
Acenaphthylene	120	-	47	190	122	280	100	-	84	6.1 U	-	66
Anthracene	710	-	150	2400	1312	1500	360	-	360	10	-	258
Benz(a)anthracene	1100	-	370	3400	1937	2300	770	-	950	17	-	601
Benzo(a)pyrene	1500	-	1100	5800	3527	2900	2600	-	3000	85	-	1918
Benzo(b)fluoranthene	1600	-	950	5800	3456	3500	2900	-	3000	88	-	2025
Benzo(ghi)perylene	640	-	630	2100	1393	1300	970	-	1000	26	-	677
Benzo(k)fluoranthene	1300	-	790	5200	3065	2400	2600	-	2900	85	-	1880
Chrysene	1800	-	580	4500	2615	4900	1200	-	1200	38	-	862
Dibenzo(a,h)anthracene	230	-	120	650	395	450	310	-	370	8.4	-	233
Fluoranthene	2100	-	700	10000	5485	3500	1000	-	1200	25	-	776
Fluorene	180	-	34	1500	785	220	77	-	120	6.1 U	-	70
Indeno[1,2,3-cd]pyrene	880	-	750	2600	1711	1800	1400	-	1300	34	-	927
Naphthalene	38	-	20	3800	1949	38	19	-	58	6.1 U	-	28
Phenanthrene	1100	-	260	5000	2699	1300	490	-	620	13	-	387
Pyrene	2000	-	1400	18000	9906	2600	6000	-	8400	51	-	4826
Total PAHs	15439	-	7933	74500	42191	29103	20868	-	24722	510.9	-	15617

Notes:
U = analyte not detected at the indicated detection limit
From Exponent (2003)

within construction footprint.

Tab[illegible]
Chemical Concentrations Mea[illegible]red in Well Point Samples

Chemical	Well Point 1 ASW-WP1 µg/L (Dissolved)	Well Point 2 ASW-WP2 µg/L (Dissolved)	Ambient Concentrations Measured in Site Surface Water ASW-SW1 Ambient [1]	Ambient [2]	Water Quality Criteria in µg/L (Dissovled) [3] Acute	Chronic
Conventionals						
Total Suspended Solids (mg/L)	24	120	15			
Salinity (ppt)	33	30	33			
Fines content (%)				-		
TOC (% dry)				-		
Metals (mg/kg or µg/L)						
Arsenic	1.03	14.4	1.35	8.8 J	69	36
Cadmium	0.215	0.33	0.1	1.2 U	42	9.3
Chromium[4]	1.18	2.06	0.99	2.1 J	1100	50
Copper	2.005	0.98	5.42	5	4.8	3.1
Lead	0.32	0.36	0.07	0.55 J	210	8.1
Mercury	0.1 U	.01 U	.01 U	0.1 U	0.4	0.04
Nickel	1.545	0.98	1.05	5 U	74	8.2
Selenium	0.035	0.01	0.02	11	290	71
Silver	0.36	0.33	0.27	1.2 U	1.9	-
Zinc	7.22	18.8	9.03	18	90	81
Butyltins (µg/kg)						
Tributyltin				15.43		
PCB (µg/kg or µg/L)						
Aroclor 1016	0.15 U [5]	0.15 U [5]	1 U	0.5 U		
Aroclor 1221	0.10 U	0.10 U	1 U	0.5 U		
Aroclor 1232	0.10 U	0.10 U	1 U	0.5 U		
Aroclor 1242	0.10 U	0.10 U	1 U	0.5 U		
Aroclor 1248	1.3	0.63	1 U	0.5 U		
Aroclor 1254	0.10 U	0.10 U	1 U	0.5 U		
Aroclor 1260	1.1	0.63	0.1 U	0.5 U		
Aroclor 1262	0.10 U	0.10 U				
Aroclor 1268	0.024 U	0.024 U				
Total PCBs[8]	2.7[6]	1.6[6]	1 U	-	10[7]	0.03[7]
PAHs (µg/kg or µg/L)						
2-Methylnaphthalene	1.0 U	1.0 U	1.0 U	-		
Acenaphthene	1.0 U	1.0 U	1.0 U	1 U		
Acenaphthylene	1.0 U	1.0 U	1.0 U	5 U		
Anthracene	1.0 U	1.0 U	1.0 U	5 U		
Benz(a)anthracene	1.0 U	1.0 U	1.0 U	5 U		
Benzo(a)pyrene	1.0 U	1.0 U	1.0 U	5 U		
Benzo(b)fluoranthene	1.0 U	1.0 U	1.0 U	5 U		

Tab
Chemical Concentrations Measured in Well Point Samples

Chemical	Well Point 1 ASW-WP1 µg/L (Dissolved)	Well Point 2 ASW-WP2 µg/L (Dissolved)	Ambient Concentrations Measured in Site Surface Water ASW-SW1 Ambient [1]	Ambient Concentrations Measured in Site Surface Water Ambient [2]	Water Quality Criteria in µg/L (Dissovled) [3] Acute	Water Quality Criteria in µg/L (Dissovled) [3] Chronic
Benzo(ghi)perylene	1.0 U	1.0 U	1.0 U	5 U		
Benzo(k)fluoranthene	1.0 U	1.0 U	1.0 U	5 U		
Chrysene	1.0 U	1.0 U	1.0 U	5 U		
Dibenzo(a,h)anthracene	1.0 U	1.0 U	1.0 U	5 U		
Fluoranthene	1.0 U	1.0 U	1.0 U	1 U		
Fluorene	1.0 U	1.0 U	1.0 U	5 U		
Indeno[1,2,3-cd]pyrene	1.0 U	1.0 U	1.0 U	5 U		
Naphthalene	1.0 U	1.0 U	1.0 U	1 U		
Phenanthrene	1.0 U	1.0 U	1.0 U	5 U		
Pyrene	1.0 U	1.0 U	1.0 U	5 U		
Total PAHs [8]	1.0 U	1.0 U	1.0 U	-	300 [7]	

Notes:

U = analyte not detected at the indicated detection limit

J = estimated value

- = not measured or not applicable

[1] Dissolved San Diego (SD) Bay reference samples taken 7/2/2004 concurrent with Well Point sampling, 200 feet west of proposed bulkhead location.

[2] SD Bay reference samples taken 3/26/2002 as part of SWM Water Quality Monitoring Program, 300 feet west of SWM Pier 3.

[3] U.S. EPA, 40 CFR, Part 131.38. Water Quality Standards, Establishment of Numeric Criteria for Priority Toxic Pollutants for the State of California. Federal Register/Vol. 65, No. 97, May 18, 2000.

[4] Hexavalent Chromium for well point and 2004 ambient surface water data.

[5] Maximum detection limit for PCBs in well point samples was 0.10 to 0.25 µg/L. Reporting Limit for PCBs in Well Point Samples was 1 µg/L.

[6] Sums were calculated using one-half the detection limit for those compounds that were not detected.

[7] Ambient Marine Water Quality Criteria for PCBs and total PAHs are from EPA and NOAA Screening Quick Reference Tables, September 1999.

[8] Water concentrations for Total PCBs and Total PAHs were calculated by summing the values of the individual Aroclors and PAHs, respectively.

Table 3
Sediment Chemistry Analytes, Methods, and Limits

Sediment Matrix	Method	MDL	RL	Units	Volume/Container	Holding Time
Total Organic Carbon	Plumb, 1981/EPA 415.1	0.01	0.05	% Dry Weight	50 g glass jar	28 Days
Trace Metals						
Arsenic	USEPA 6020	0.025	0.05	µg/g	50 g glass jar	6 Months
Cadmium	USEPA 6020	0.025	0.05	µg/g		6 Months
Chromium	USEPA 6020	0.025	0.05	µg/g		6 Months
Copper	USEPA 6020	0.025	0.05	µg/g		6 Months
Lead	USEPA 6020	0.025	0.05	µg/g		6 Months
Mercury	USEPA 6020	0.005	0.01	µg/g		6 Months
Nickel	USEPA 6020	0.025	0.05	µg/g		6 Months
Selenium	USEPA 6020	0.025	0.05	µg/g		6 Months
Silver	USEPA 6020	0.025	0.05	µg/g		6 Months
Zinc	USEPA 6020	0.025	0.05	µg/g		6 Months
Polychorinated Biphenyls						
Aroclor 1016	USEPA 8270C	10	20	ng/g	50 g glass jar	40 Days
Aroclor 1221	USEPA 8270C	10	20	ng/g		40 Days
Aroclor 1232	USEPA 8270C	10	20	ng/g		40 Days
Aroclor 1242	USEPA 8270C	10	20	ng/g		40 Days
Aroclor 1248	USEPA 8270C	10	20	ng/g		40 Days
Aroclor 1254	USEPA 8270C	10	20	ng/g		40 Days
Aroclor 1260	USEPA 8270C	10	20	ng/g		40 Days
Polynuclear Aromatic Hydrocarbons						
1-Methylnaphthalene	USEPA 8270C	1	5	ng/g	50 g glass jar	40 Days
1-Methylphenanthrene	USEPA 8270C	1	5	ng/g		40 Days
2,3,5-Trimethylnaphthalene	USEPA 8270C	1	5	ng/g		40 Days
2,6-Dimethylnaphthalene	USEPA 8270C	1	5	ng/g		40 Days
2-Methylnaphthalene	USEPA 8270C	1	5	ng/g		40 Days
Acenaphthene	USEPA 8270C	1	5	ng/g		40 Days
Acenaphthylene	USEPA 8270C	1	5	ng/g		40 Days
Anthracene	USEPA 8270C	1	5	ng/g		40 Days
Benz[a]anthracene	USEPA 8270C	1	5	ng/g		40 Days
Benzo[a]pyrene	USEPA 8270C	1	5	ng/g		40 Days
Benzo[b]fluoranthene	USEPA 8270C	1	5	ng/g		40 Days
Benzo[e]pyrene	USEPA 8270C	1	5	ng/g		40 Days
Benzo[g,h,i]perylene	USEPA 8270C	1	5	ng/g		40 Days
Benzo[k]fluoranthene	USEPA 8270C	1	5	ng/g		40 Days
Biphenyl	USEPA 8270C	1	5	ng/g		40 Days
Chrysene	USEPA 8270C	1	5	ng/g		40 Days
Dibenz[a,h]anthracene	USEPA 8270C	1	5	ng/g		40 Days
Fluoranthene	USEPA 8270C	1	5	ng/g		40 Days
Fluorene	USEPA 8270C	1	5	ng/g		40 Days
Indeno[1,2,3-c,d]pyrene	USEPA 8270C	1	5	ng/g		40 Days
Naphthalene	USEPA 8270C	1	5	ng/g		40 Days
Perylene	USEPA 8270C	1	5	ng/g		40 Days
Phenanthrene	USEPA 8270C	1	5	ng/g		40 Days
Pyrene	USEPA 8270C	1	5	ng/g		40 Days

Notes:

Plumb, Russell H. 1981. Procedures for Handling and Chemical Analysis of Sediment and Water Samples. USEPA/Corps of Engineers. May.

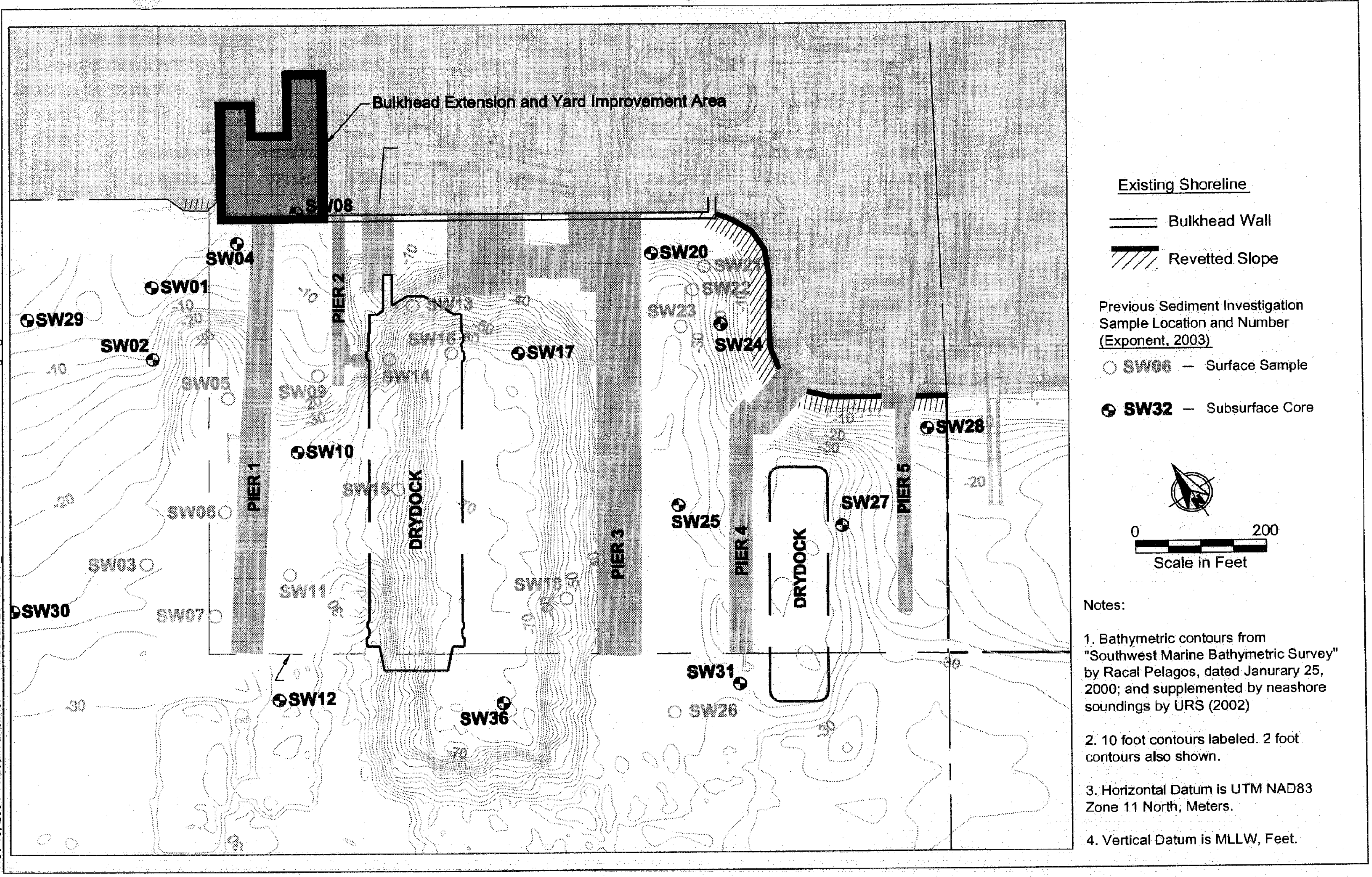
From CRG Laboratories, Torrance, California

Table 4
Water Chemistry Analytes, Methods, and Limits

Water Matrix	Method	MDL	RL	Units	Volume/Container	Holding Time
Salinity	SM 2510 B	1	2	ppt	250 mL Plastic/Glass	ASAP/24 Hours
Total Dissolved Solids	SM 2450 C	0.1	0.2	mg/L	1L HDPE Plastic	7 Days
Total Trace Metals						
Arsenic	USEPA 1640	0.01	0.015	µg/L	1L HDPE Plastic	6 Months
Cadmium	USEPA 1640	0.005	0.01	µg/L		
Chromium	USEPA 1640	0.005	0.01	µg/L		
Copper	USEPA 1640	0.005	0.01	µg/L		
Lead	USEPA 1640	0.005	0.025	µg/L		
Mercury	USEPA 1640	0.005	0.0100	µg/L		
Nickel	USEPA 1640	0.005	0.01	µg/L		
Selenium	USEPA 1640	0.01	0.0150	µg/L		
Silver	USEPA 1640	0.005	0.01	µg/L		
Zinc	USEPA 1640	0.005	0.01	µg/L		
Chromium VI	SM 3500-Cr	0.005	0.01	mg/L	250 mL HDPE Plastic	24 Hours
Polychorinated Biphenyls in Water Analysis						
Aroclor 1016	USEPA 625	10	20	ng/L	2 L Amber Glass	7 Days/40 Days
Aroclor 1221	USEPA 625	10	20	ng/L		
Aroclor 1232	USEPA 625	10	20	ng/L		
Aroclor 1242	USEPA 625	10	20	ng/L		
Aroclor 1248	USEPA 625	10	20	ng/L		
Aroclor 1254	USEPA 625	10	20	ng/L		
Aroclor 1260	USEPA 625	10	20	ng/L		
Polynuclear Aromatic Hydrocarbons						
1-Methylnaphthalene	USEPA 625	1	5	ng/L	2 L Amber Glass	7 Days/40 Days
1-Methylphenanthrene	USEPA 625	1	5	ng/L		
2,3,5-Trimethylnaphthalene	USEPA 625	1	5	ng/L		
2,6-Dimethylnaphthalene	USEPA 625	1	5	ng/L		
2-Methylnaphthalene	USEPA 625	1	5	ng/L		
Acenaphthene	USEPA 625	1	5	ng/L		
Acenaphthylene	USEPA 625	1	5	ng/L		
Anthracene	USEPA 625	1	5	ng/L		
Benz[a]anthracene	USEPA 625	1	5	ng/L		
Benzo[a]pyrene	USEPA 625	1	5	ng/L		
Benzo[b]fluoranthene	USEPA 625	1	5	ng/L		
Benzo[e]pyrene	USEPA 625	1	5	ng/L		
Benzo[g,h,i]perylene	USEPA 625	1	5	ng/L		
Benzo[k]fluoranthene	USEPA 625	1	5	ng/L		
Biphenyl	USEPA 625	1	5	ng/L		
Chrysene	USEPA 625	1	5	ng/L		
Dibenz[a,h]anthracene	USEPA 625	1	5	ng/L		
Fluoranthene	USEPA 625	1	5	ng/L		
Fluorene	USEPA 625	1	5	ng/L		
Indeno[1,2,3-c,d]pyrene	USEPA 625	1	5	ng/L		
Naphthalene	USEPA 625	1	5	ng/L		
Perylene	USEPA 625	1	5	ng/L		
Phenanthrene	USEPA 625	1	5	ng/L		
Pyrene	USEPA 625	1	5	ng/L		

Notes:
From CRG Laboratories, Torrance, California

FIGURES



Notes:

1. Bathymetric contours from "Southwest Marine Bathymetric Survey" by Racal Pelagos, dated Janurary 25, 2000; and supplemented by neashore soundings by URS (2002)

2. 10 foot contours labeled. 2 foot contours also shown.

3. Horizontal Datum is UTM NAD83 Zone 11 North, Meters.

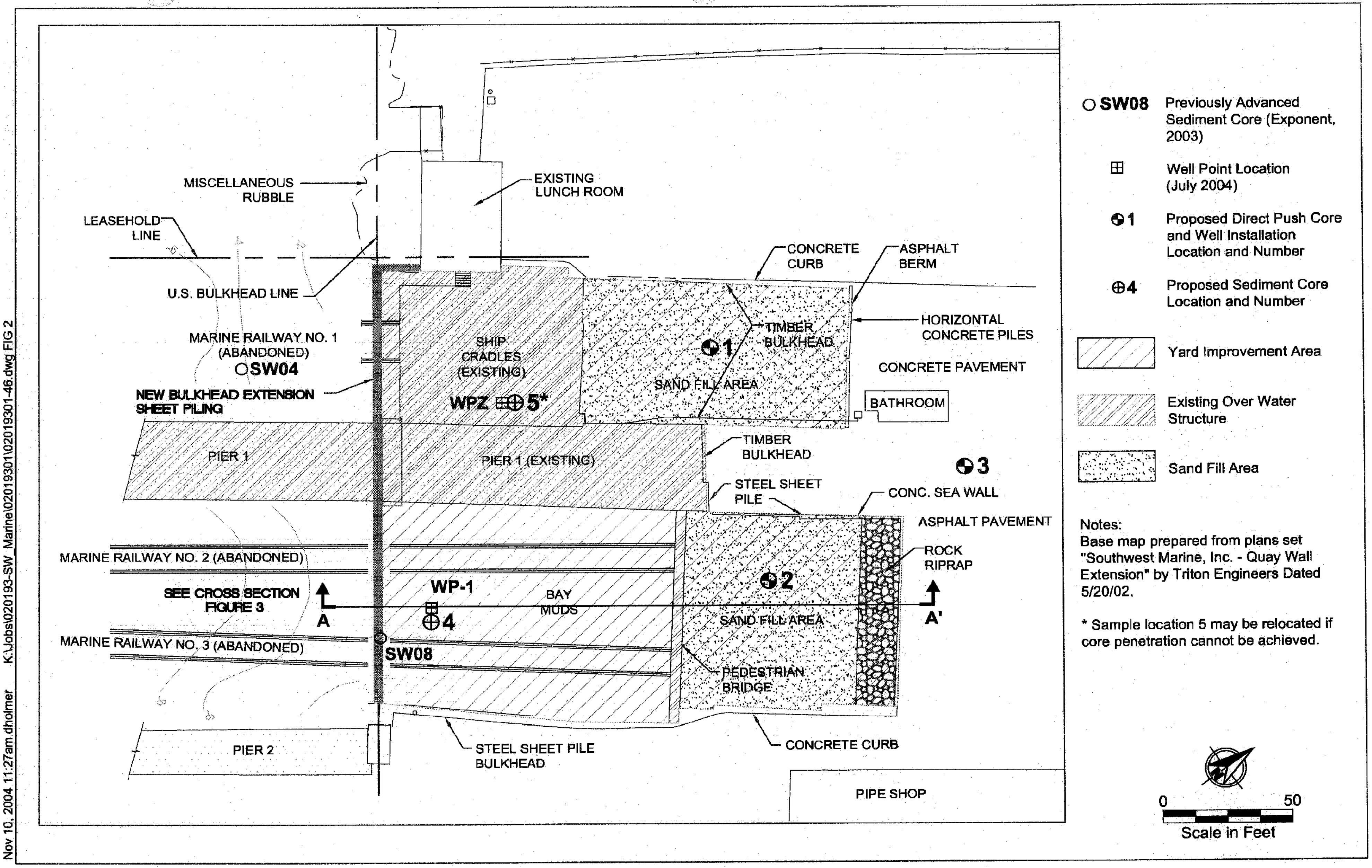
4. Vertical Datum is MLLW, Feet.

Nov 10, 2004 11:25am dholmer K:\Jobs\020193-SW_Marine\02019301\02019301-39.dwg Fig 1

ANCHOR ENVIRONMENTAL, L.L.C.

Figure 1
General Location of Planned Bulkhead Extension and Yard Improvement
Southwest Marine Inc.
San Diego, CA

Nov 10, 2004 11:27am dholmer K:\Jobs\020193-SW_Marine\02019301\02019301-46.dwg FIG 2

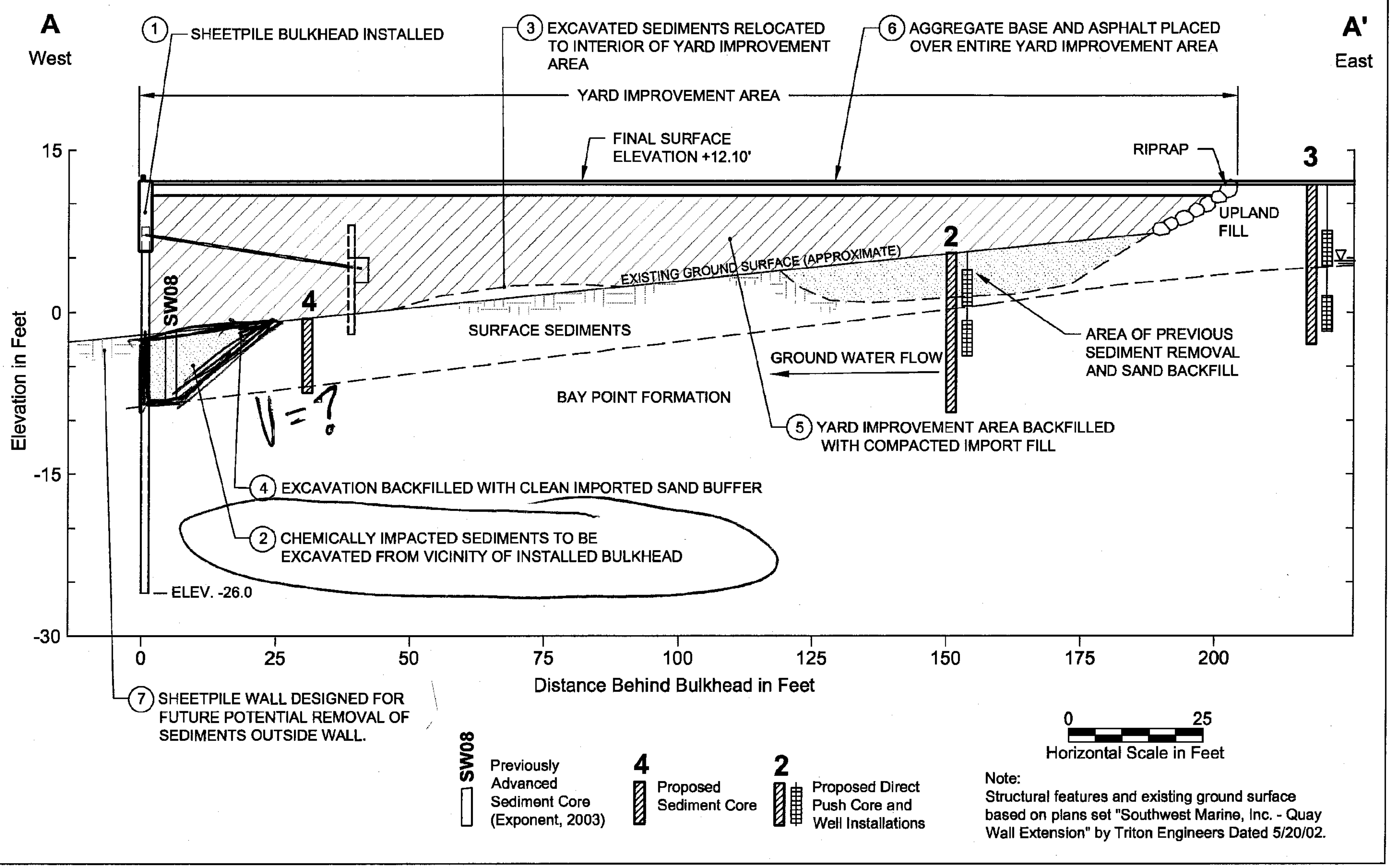


Notes:
Base map prepared from plans set "Southwest Marine, Inc. - Quay Wall Extension" by Triton Engineers Dated 5/20/02.

* Sample location 5 may be relocated if core penetration cannot be achieved.

ANCHOR ENVIRONMENTAL, L.L.C.

Figure 2
Bulkhead Extension and Yard Improvements
Proposed Exploration Locations
Southwest Marine, Inc.



Note:
Structural features and existing ground surface based on plans set "Southwest Marine, Inc. - Quay Wall Extension" by Triton Engineers Dated 5/20/02.

ANCHOR ENVIRONMENTAL, L.L.C.

Figure 3
Bulkhead Extension and Yard Improvement
Cross Section A-A' and Sequence of Construction Events
Southwest Marine, Inc.

APPENDIX A

QUALITY ASSURANCE PROJECT PLAN (QAPP)

BULKHEAD EXTENSION AND YARD IMPROVEMENT PROJECT PHASE 2 ACTIVITIES

QUALITY ASSURANCE PROJECT PLAN
SEDIMENT AND GROUNDWATER SITE INVESTIGATION

SOUTHWEST MARINE
BULKHEAD EXTENSION AND YARD IMPROVEMENT
PHASE 2 ACTIVITIES

Prepared for

Southwest Marine, Inc.
2205 E. Belt Street
San Diego, California 92113

Prepared by

Anchor Environmental, CA LP
3914 Murphy Canyon Road
San Diego, California 92123

November 2004

Approvals

California Regional Water Quality Control Board, San Diego Region, Project Manager

Shaun Halvax, Southwest Marine Shipyard Project Manager

Michael Whelan, Anchor Environmental Project Manager

Jody Edmunds, Anchor Environmental QA/QC Coordinator

Steve Cappellino, Anchor Environmental Field Team Leader

Table of Contents

List of Tables

1 INTRODUCTION

This quality assurance project plan (QAPP) describes the quality assurance and quality control (QA/QC) procedures that will be used to support the analytical data generated by the bulkhead extension/yard improvement area site investigation at the Southwest Marine, Inc. (SWM) shipyard in San Diego, California. These QA/QC procedures ensure that the data generated during this site investigation are representative of actual field conditions and meet the project's quality objectives. This QAPP was developed using guidance provided by the United States Environmental Protection Agency (USEPA 2001).

A complete description of the project, including results from previous investigations and rationale for the current sampling specifications and intended use of the data are provided in the Workplan for the site investigation (main text of this report).

This QAPP contains the following sections:

- Project Management
- Data Acquisition
- Assessment and Oversight
- Data Verification, Validation, and Usability
- References

2 PROJECT MANAGEMENT

2.1 Project Organization

Southwest Marine will be responsible for planning and managing the site investigation, with regulatory oversight and approval by the California Regional Water Quality Control Board, San Diego Region (RWQCB). Table A-1 identifies the personnel responsible for planning and implementing field and laboratory operations, QA/QC procedures for this project, and describes each individual's task for project management and quality assurance (QA). Laboratory QA officers are also identified in Table A-1 to ensure appropriate procedures are followed during sample analysis and preparation of the data packages.

The chemical testing laboratory for this investigation will be CRG Laboratories, Inc. in Torrance, California.

No changes in procedures specified in this QAPP and in the laboratory QA manual will be permitted without written justification and a detailed explanation of the intended change. All changes are subject to approval by the QA/QC personnel, SWM Project Manager and the RWQCB Project Manager.

Table A-1
Project Personnel and Responsibilities

RWQCB Project Manager	Provide final approval of the sediment investigation Workplan and QAPP.
Shaun Halvax SWM Shipyard Project Manager	Overall responsibility for SWM activities. Oversee all program activities to ensure compliance, perform technical oversight and consultation on major QA problems, and provide final approval of all necessary actions and adjustments for activities to accomplish project objectives.
Michael Whelan Anchor Environmental Project Manager	Oversee all sediment and ground water investigation activities under SWM direction to ensure appropriate quality control review, provide technical oversight, and implement necessary actions and adjustments for activities to accomplish project objectives.
ddy Edmunds Anchor Environmental QA/QC Coordinator	Provide technical QA assistance for testing laboratory, oversee QA activities to ensure testing laboratory compliance with QAPP, and coordinate and supervise data validations and data quality report preparation.
Steve Cappellino Anchor Environmental Field Team Leader	Coordinate and supervise field activities, ensure field procedures are completed in accordance with the work plan and QAPP, authorize adjustments in station locations in response to field conditions, communicate with Project Managers, and initiate chain-of-custody forms.
Michelle McClelland Anchor Environmental Database Administrator	Organize and maintain project database. Ensure data is stored in accordance with this QAPP. Supervise data management personnel.
Laboratory Quality Assurance Officers	Ensure that sample receipt and custody records are properly handled and data are reported within specified turnaround times, calibrate and maintain instruments as specified, perform internal quality control measures and analytical methods as required, and report data and supporting QA information as specified in this QAPP

2.2 Project Description

The site investigation will provide additional vertical and lateral characterization of chemicals of concern (COCs) in the soil, sediment and groundwater at the SWM bulkhead extension/yard improvement area. Three continuous core samples and two piston core samples will be collected to analyze the soil and sediments in the upland fill, surface sediment, and underlying Bay Point Formation layers. In addition, six piezometers will be installed (two at each continuous core station) to collect groundwater samples from each of the layers. Groundwater levels will also be measured under different tidal conditions to characterize hydrologic gradients for the upland fill, surface sediments, and underlying Bay Point Formation.

Details of the site investigation are found in the main text of the project Workplan. Details of various components of the site investigation are provided below and are summarized in Table A-2.

2.2.1 Soil/Sediment Chemistry

Soil and sediment samples collected from the site will be analyzed for metals (arsenic, cadmium, chromium, chromium VI, copper, lead, mercury, nickel, selenium, silver, and zinc), total PCBs, PCB Aroclors, and polycyclic aromatic hydrocarbons (PAHs). Samples will also be analyzed for total organic carbon (TOC).

2.2.2 Groundwater Chemistry

Groundwater samples collected from the site will be analyzed for metals (arsenic, cadmium, chromium, chromium VI, copper, lead, mercury, nickel, selenium, silver, and zinc), total PCBs, PCB Aroclors, and PAHs. Samples will also be analyzed for total dissolved solids (TDS) and salinity.

2.2.3 Groundwater Elevation

Groundwater levels will be measured in each piezometer on four different occasions over two days to characterize hydrologic gradients for the upland fill, surface sediments, and underlying Bay Point Formation under different tidal conditions. Groundwater levels will be measured using a decontaminated electronic tape measure lowered into each well and recorded on a data sheet.

Table A-2
Summary of Analyses for Southwest Marine Site Investigation

Analysis	Continuous Sediment Cores		Piston Cores (composite)	Groundwater
	Upland Fill Layer (composite)	Bay Point Formation Layer (composite)		
Metals	1	2	2	6
PCBs	1	2	2	6
PAHs	1	2	2	6
TOC	1	2	2	
TDS				6
Salinity				6
Groundwater Level				24 readings

2.3 Data Quality Objectives and Criteria

The QA objective for this project is to ensure that the data collected are of known and acceptable quality and are representative of the conditions present at the site. The sampling plan for the site investigation has been developed to ensure the collection of sufficient samples from appropriate locations to provide representative data for chemical concentrations of COCs in soil/sediment and groundwater. The data quality objectives (DQOs) of the laboratory data are assessed by precision, accuracy, and completeness. Definitions of these parameters and the applicable quality control procedures are given below. Applicable quantitative goals for these data quality parameters are listed or referenced in Table A-3.

2.4 Documentation and Records

Procedures, observations, and test results will be documented for all sample collection, laboratory analysis and reporting, and data validation activities. In addition to data reports provided by the laboratories, reports will be prepared that address data quality and usability, provide tabulated laboratory and field data, and interpret the sediment data.

2.4.1 Field Records

Field records will be maintained during all stages of sample collection and preparation for shipment to laboratories. Field records will include:

- Field logbook to record daily sampling activities and conditions

- Combined station/sample log to document station locations and date and time of collection
- Sample labels
- Chain-of-custody forms

2.4.2 Laboratory Data Reports

The analytical laboratory will submit a complete data package that will include the following:

Project Narrative

This summary in the form of a cover letter will discuss problems, if any, encountered during any aspect of analysis. This summary should discuss, but not be limited to, quality control, sample shipment, sample storage, and analytical difficulties. Any problems encountered, actual or perceived, and their resolutions will be documented in as much detail as appropriate.

Chain-of-Custody Records

Legible copies of the custody forms will be provided as part of the data package. This documentation will include the time of receipt and condition of each sample received by the laboratory. Additional internal tracking of sample custody by the laboratory will also be documented.

Sample Results

The data package will summarize the results for each sample analyzed. The summary will include the following information when applicable:

- Field sample identification code and the corresponding laboratory identification code
- Sample matrix
- Date of sample extraction
- Date and time of analysis
- Weight and/or volume used for analysis
- Final dilution volumes or concentration factor for the sample
- Identification of the instrument used for analysis

- Method reporting and quantitation limits
- Analytical results with reporting units identified
- Data qualifiers and their definitions
- An electronic data deliverable (EDD) delivered to the Data Manager

Quality Assurance/Quality Control Summaries

This section will contain the results of the laboratory QA/QC procedures. Each QA/QC sample analysis will be documented with the same information required for the sample results (see above). No recovery or blank corrections will be made by the laboratory. The required summaries are listed below; additional information may be requested.

Calibration Data Summary

Report the concentrations of the initial calibration and daily calibration standards, and the date and time of analysis. List the response factor, percent relative standard deviations (%RSD), percent difference, and retention time for each analyte as appropriate. Report results for standards to indicate instrument sensitivity.

Method Blank Analysis

Report the method blank analyses associated with each sample and the concentration of all compounds of interest identified in these blanks.

Surrogate Spike Recovery

Report all surrogate spike recovery data for organic compounds. List the name and concentration of all compounds added, percent recoveries, and range of recoveries.

Matrix Spike Recovery

Report all matrix spike recovery data for organic and metal compounds. List the name and concentration of all compounds added, percent recoveries, and range of recoveries. Report the relative percent difference (RPD) for all duplicate analyses.

Matrix Duplicate

Report the RPD for all matrix duplicate analyses.

2.4.3 Location of Records and Reports

The electronic and hard copy data generated for this study will be retained at the Anchor Environmental (Anchor) office in the custody of the project data manager. Field logs, sample records, and chain-of-custody records will be kept with the Anchor project files for reference purposes.

Table 3
Summary of Data Quality Objectives

Analysis	Method	MDL	RL	Units	Precision (%RSD)	Accuracy (% Recovery)	Completeness (%)	Volume/Container	Holding Time
Sediment									
Total Organic Carbon	Plumb, 1981/USEPA 415.1	0.01	0.05	% Dry Weight	0-30	75-125	95	50 g glass jar	28 Days
Trace Metals									
Arsenic (As)	USEPA 6020	0.025	0.05	µg/g	0-30	75-125	95	50 g glass jar	6 Months
Cadmium (Cd)	USEPA 6020	0.025	0.05	µg/g	0-30	75-125	95		6 Months
Chromium (Cr)	USEPA 6020	0.025	0.05	µg/g	0-30	75-125	95		6 Months
Copper (Cu)	USEPA 6020	0.025	0.05	µg/g	0-30	75-125	95		6 Months
Lead (Pb)	USEPA 6020	0.025	0.05	µg/g	0-30	75-125	95		6 Months
Mercury (Hg)	USEPA 6020	0.005	0.01	µg/g	0-30	75-125	95		6 Months
Nickel (Ni)	USEPA 6020	0.025	0.05	µg/g	0-30	75-125	95		6 Months
Selenium (Se)	USEPA 6020	0.025	0.05	µg/g	0-30	75-125	95		6 Months
Silver (Ag)	USEPA 6020	0.025	0.05	µg/g	0-30	75-125	95		6 Months
Zinc (Zn)	USEPA 6020	0.025	0.05	µg/g	0-30	75-125	95		6 Months
Polychorinated Biphenyls									
Aroclor 1016	USEPA 8270C	10	20	ng/g	0-30	75-125	95	50 g glass jar	40 Days
Aroclor 1221	USEPA 8270C	10	20	ng/g	0-30	75-125	95		40 Days
Aroclor 1232	USEPA 8270C	10	20	ng/g	0-30	75-125	95		40 Days
Aroclor 1242	USEPA 8270C	10	20	ng/g	0-30	75-125	95		40 Days
Aroclor 1248	USEPA 8270C	10	20	ng/g	0-30	75-125	95		40 Days
Aroclor 1254	USEPA 8270C	10	20	ng/g	0-30	75-125	95		40 Days
Aroclor 1260	USEPA 8270C	10	20	ng/g	0-30	75-125	95		40 Days
Polynuclear Aromatic Hydrocarbons									
1-Methylnaphthalene	USEPA 8270C	1	5	ng/g	0-30	75-125	95	50 g glass jar	40 Days
1-Methylphenanthrene	USEPA 8270C	1	5	ng/g	0-30	75-125	95		40 Days
2,3,5-Trimethylnaphthalene	USEPA 8270C	1	5	ng/g	0-30	75-125	95		40 Days
2,6-Dimethylnaphthalene	USEPA 8270C	1	5	ng/g	0-30	75-125	95		40 Days
2-Methylnaphthalene	USEPA 8270C	1	5	ng/g	0-30	75-125	95		40 Days
Acenaphthene	USEPA 8270C	1	5	ng/g	0-30	75-125	95		40 Days
Acenaphthylene	USEPA 8270C	1	5	ng/g	0-30	75-125	95		40 Days
Anthracene	USEPA 8270C	1	5	ng/g	0-30	75-125	95		40 Days
Benz[a]anthracene	USEPA 8270C	1	5	ng/g	0-30	75-125	95		40 Days
Benzo[a]pyrene	USEPA 8270C	1	5	ng/g	0-30	75-125	95		40 Days
Benzo[b]fluoranthene	USEPA 8270C	1	5	ng/g	0-30	75-125	95		40 Days
Benzo[e]pyrene	USEPA 8270C	1	5	ng/g	0-30	75-125	95		40 Days
Benzo[g,h,i]perylene	USEPA 8270C	1	5	ng/g	0-30	75-125	95		40 Days
Benzo[k]fluoranthene	USEPA 8270C	1	5	ng/g	0-30	75-125	95		40 Days
Biphenyl	USEPA 8270C	1	5	ng/g	0-30	75-125	95		40 Days
Chrysene	USEPA 8270C	1	5	ng/g	0-30	75-125	95		40 Days
Dibenz[a,h]anthracene	USEPA 8270C	1	5	ng/g	0-30	75-125	95		40 Days
Fluoranthene	USEPA 8270C	1	5	ng/g	0-30	75-125	95		40 Days

Tabl 3
Summary of Data Quality Objectives

Analysis	Method	MDL	RL	Units	Precision (%RSD)	Accuracy (% Recovery)	Completeness (%)	Volume/Container	Holding Time
Fluorene	USEPA 8270C	1	5	ng/g	0-30	75-125	95		40 Days
Indeno[1,2,3-c,d]pyrene	USEPA 8270C	1	5	ng/g	0-30	75-125	95		40 Days
Naphthalene	USEPA 8270C	1	5	ng/g	0-30	75-125	95		40 Days
Perylene	USEPA 8270C	1	5	ng/g	0-30	75-125	95		40 Days
Phenanthrene	USEPA 8270C	1	5	ng/g	0-30	75-125	95		40 Days
Pyrene	USEPA 8270C	1	5	ng/g	0-30	75-125	95		40 Days
Water									
Salinity	SM 2510 B	1	2	ppt	0-30	75-125	95		
Total Dissolved Solids	SM 2450 C	0.1	0.2	mg/L	0-30	75-125	95		
Total Trace Metals									
Arsenic (As)	USEPA 1640	0.01	0.015	µg/L	0-30	75-125	95		
Cadmium (Cd)	USEPA 1640	0.005	0.01	µg/L	0-30	75-125	95		
Chromium (Cr)	USEPA 1640	0.005	0.01	µg/L	0-30	75-125	95		
Copper (Cu)	USEPA 1640	0.005	0.01	µg/L	0-30	75-125	95		
Lead (Pb)	USEPA 1640	0.005	0.025	µg/L	0-30	75-125	95		
Mercury (Hg)	USEPA 1640	0.005	0.0100	µg/L	0-30	75-125	95		
Nickel (Ni)	USEPA 1640	0.005	0.01	µg/L	0-30	75-125	95		
Selenium (Se)	USEPA 1640	0.01	0.0150	µg/L	0-30	75-125	95		
Silver (Ag)	USEPA 1640	0.005	0.01	µg/L	0-30	75-125	95		
Zinc (Zn)	USEPA 1640	0.005	0.01	µg/L	0-30	75-125	95		
Chromium VI (CR+6)	SM 3500-Cr	0.005	0.01	mg/L	0-30	75-125	95		
Polychorinated Biphenyls in Water Analysis									
Aroclor 1016	USEPA 625	10	20	ng/L	0-30	75-125	95		
Aroclor 1221	USEPA 625	10	20	ng/L	0-30	75-125	95		
Aroclor 1232	USEPA 625	10	20	ng/L	0-30	75-125	95		
Aroclor 1242	USEPA 625	10	20	ng/L	0-30	75-125	95		
Aroclor 1248	USEPA 625	10	20	ng/L	0-30	75-125	95		
Aroclor 1254	USEPA 625	10	20	ng/L	0-30	75-125	95		
Aroclor 1260	USEPA 625	10	20	ng/L	0-30	75-125	95		
Polynuclear Aromatic Hydrocarbons	USEPA 625	1	5	ng/L	0-30	75-125	95		
1-Methylnaphthalene	USEPA 625	1	5	ng/L	0-30	75-125	95		
1-Methylphenanthrene	USEPA 625	1	5	ng/L	0-30	75-125	95		
2,3,5-Trimethylnaphthalene	USEPA 625	1	5	ng/L	0-30	75-125	95		
2,6-Dimethylnaphthalene	USEPA 625	1	5	ng/L	0-30	75-125	95		
2-Methylnaphthalene	USEPA 625	1	5	ng/L	0-30	75-125	95		
Acenaphthene	USEPA 625	1	5	ng/L	0-30	75-125	95		
Acenaphthylene	USEPA 625	1	5	ng/L	0-30	75-125	95		
Anthracene	USEPA 625	1	5	ng/L	0-30	75-125	95		
Benz[a]anthracene	USEPA 625	1	5	ng/L	0-30	75-125	95		
Benzo[a]pyrene	USEPA 625	1	5	ng/L	0-30	75-125	95		

Tabl[illegible]3
Summary of Data Quality Objectives

Analysis	Method	MDL	RL	Units	Precision (%RSD)	Accuracy (% Recovery)	Completeness (%)	Volume/Container	Holding Time
Benzo[b]fluoranthene	USEPA 625	1	5	ng/L	0-30	75-125	95		
Benzo[e]pyrene	USEPA 625	1	5	ng/L	0-30	75-125	95		
Benzo[g,h,i]perylene	USEPA 625	1	5	ng/L	0-30	75-125	95		
Benzo[k]fluoranthene	USEPA 625	1	5	ng/L	0-30	75-125	95		
Biphenyl	USEPA 625	1	5	ng/L	0-30	75-125	95		
Chrysene	USEPA 625	1	5	ng/L	0-30	75-125	95		
Dibenz[a,h]anthracene	USEPA 625	1	5	ng/L	0-30	75-125	95		
Fluoranthene	USEPA 625	1	5	ng/L	0-30	75-125	95		
Fluorene	USEPA 625	1	5	ng/L	0-30	75-125	95		
Indeno[1,2,3-c,d]pyrene	USEPA 625	1	5	ng/L	0-30	75-125	95		
Naphthalene	USEPA 625	1	5	ng/L	0-30	75-125	95		
Perylene	USEPA 625	1	5	ng/L	0-30	75-125	95		
Phenanthrene	USEPA 625	1	5	ng/L	0-30	75-125	95		
Pyrene	USEPA 625	1	5	ng/L	0-30	75-125	95		

Notes:

Plumb, Russell H. 1981. Procedures for Handling and Chemical Analysis of Sediment and Water Samples. USEPA/Corps of Engineers. May.

3 DATA ACQUISITION

3.1 Sampling Design

The site investigation will provide additional vertical and lateral characterization of COCs in the soil, sediment and groundwater at the SWM bulkhead extension/yard improvement area.

Continuous core samples will be collected at three stations to sample the upland fill, surface sediments, and underlying Bay Point Formation layers (Figures 2 and 3 of the Workplan). Composite samples from selected layers will be analyzed for TOC, metals, PCBs and PAHs (Table A-3) to determine the chemical and physical properties of each of the layers.

Two additional piston cores will be taken at the former well point locations sampled in July 2004. A composite sample from each core will be analyzed for metals, PCBs, and PAHs for sediment characterization.

To determine the spatial extent of the chemical and hydrologic characteristics of groundwater, two piezometers will be installed at the continuous core sample stations (Figure 2 of the Workplan). Groundwater will be sampled from the upland fill/surface sediments layer and the underlying Bay Point Formation layer, and analyzed for metals, PCBs and PAHs (Table A-3). Groundwater levels will also be measured under different tidal conditions to characterize hydrologic gradients for the geologic units.

3.2 Sampling Methods

3.2.1 Direct Push Continuous Cores

Three continuous soil cores will be collected from Stations 1, 2 and 3 using direct-push sampling methods to a target depth of 20 feet or until refusal. 4- foot acetate core liners will be decontaminated immediately prior to use following the procedures outlined in this QAPP. Care will be taken during sampling to avoid sample tube contact with potentially contaminated surfaces. Extra sample tubes will be available during sample operations for uninterrupted sampling in the event of a potential core tube breakage or contamination. Core tubes suspected to have been accidentally contaminated will not be used.

Each core will be split open vertically, photographed and geologically characterized into a core log. The core will then be sectioned into two distinct layers, the upland fill or surface sediment layer (depending on the sample location) and the underlying Bay Point Formation layer. From stations 1 and 2, a composite sample will be collected from the Bay Point Formation for analysis of TOC, trace metals, PCBs, and PAHs. A composite sample will be collected from the upland fill layer at Station 3. Each composite sample will be split into four 50g glass containers for laboratory analysis. Constituents, analysis methods, containers and holding times are depicted in Table A-3. Sampling information, including sample identifier, sample location, date and time of sampling, requested analysis, and sampler name, will be recorded on a chain-of-custody form and on the sampling jar label. Following collection, samples will be placed in a cooler with ice pending delivery to the laboratory.

3.2.2 Fixed-Piston Sediment Cores

A piston corer fitted with polycarbonate tubing (7.6-cm inner diameter) will be used to collect surface sediment cores from Stations 4 and 5. All cores will be driven until refusal, expected to be on the order of 4 to 7 feet below surface.

The core tubes will be decontaminated immediately prior to use following the procedures outlined in this QAPP. Care will be taken during sampling to avoid sample tube contact with potentially contaminated surfaces. Extra sample tubes will be available during sample operations for uninterrupted sampling in the event of a potential core tube breakage or contamination. Core tubes suspected to have been accidentally contaminated will not be used.

The piston depth will be set at approximately 20 cm above the surveyed sediment-water interface, and driven into the sediment with drive rods. Penetration and recovery will be assessed using Velcro® on the outside of the core tube. The corer will be retrieved slowly and steadily to avoid agitating the sample. Prior to lifting the core tube out of the water, a plug will be inserted into the bottom of the core tube to prevent sediment from slipping out of the bottom. During deployment and retrieval of the coring device, care will be taken to ensure that the end of the core tube does not become contaminated. After retrieval, each core will be split open vertically, photographed and geologically characterized into a core log. Each core will then be composited into one sample and split into three 50g glass containers for analytical testing of metals, PCBs, and PAHs. Sampling information, including sample identifier, sample location, date and time of sampling, requested analysis, and sampler name, will be recorded on a chain-of-custody form and on the sampling jar label. Following collection, samples will be placed in a cooler with ice pending delivery to the laboratory.

3.2.3 Groundwater

Upon completion of the continuous push cores at Stations 1, 2, and 3, each boring will be converted into a ¾ inch temporary groundwater well. This will involve installing direct-push geoprobes in paired piezometer nests at each of the three sampling locations. The paired piezometer nests consist of a 5-foot prepacked screen to be installed within the Bay Point Formation, with a second 5- foot screen placed in the same vicinity within the overlying upland fill or surface sediments. The first well will collect groundwater from within the Bay Point Formation layer, the second from the overlying fill or sediment layer.

Groundwater samples will be collected from each of the newly installed monitoring wells after 24 hours to allow the wells to equilibrate, using a peristaltic pump with disposable tubing. Sampling for COCs will be conducted as close to low tide as possible, particularly in the wells located near the shore. Wells will be purged of several well volumes of groundwater prior to sampling. Following the removal of each well volume from the monitoring wells, specific conductance and pH of the water will be measured. The results of these measurements, in addition to the volume of groundwater removed, will be recorded on the sampling log. Groundwater samples will be collected by discharging water from the peristaltic pump directly into the laboratory-provided sample jars described in Table A-3. All samples collected for dissolved metals analysis will be filtered with a 0.45 µm in-line filter prior to placement in a sampling bottle. Sampling information, including sample identifier, sample location, date and time of sampling, requested analysis, and sampler name, will be recorded on a chain-of-custody form and on the sampling jar label. Following collection, samples will be placed in a cooler with ice pending delivery to the laboratory.

Groundwater levels will also be measured in each piezometer on four different occasions over two days to characterize hydrologic gradients for the upland fill/surface sediments and the underlying Bay Point Formation, under different tidal conditions. Groundwater levels will be measured using a decontaminated electronic tape measure lowered into each well and recorded on a data sheet.

3.3 Sample Handling and Custody

All sample containers will be provided by the testing laboratory and prepared in accordance with USEPA guidelines (USEPA 1986) prior to field operations. Sample containers for chemical analysis will be kept closed and stored in a box or cooler until they are used. As they are collected, samples will be labeled, recorded on a field data log sheet, and placed as soon as possible on ice in a cooler at 4± 2°C.

Samples for all chemical analyses will be shipped on ice (4± 2°C) to the testing laboratory and will be stored at this temperature until analysis. Samples in glass containers will be packed in bubble wrap to prevent breakage and chain-of-custody forms will be placed in Ziploc® bags taped to the inside cooler lid. Samples will be shipped overnight to the testing laboratory and signed in at the laboratory upon receipt. A copy of the signed chain-of-custody form will be returned by the testing laboratory along with the analysis results.

3.4 Analytical Methods

CRG Laboratories, Inc. has established protocols and quality assurance procedures that meet or exceed any USEPA guidelines. These protocols and procedures will be adhered to for the site investigation. The laboratory is expected to meet the following minimum requirements:

- Adhere to the methods outlined in the QAPP, including methods referenced for each analytical procedure
- Deliver fax, hard copy, and electronic data as specified
- Meet reporting requirements for deliverables
- Meet turnaround times for deliverables
- Implement QA/QC procedures, including the QAPP data quality requirements, laboratory QA requirements, and performance evaluation testing requirements
- Allow laboratory and data audits to be performed, if deemed necessary

Sediment and soil samples will be submitted for chemical analysis of:

- Trace metals (arsenic, cadmium, chromium, chromium VI, copper, lead, mercury, nickel, selenium, silver, and zinc) (USEPA Method 6020)
- PAHs (USEPA Method 8270C)
- PCBs (USEPA Method 8270C)
- TOC (USEPA Method 415.1)

Groundwater samples will be submitted for chemical analysis of:

- Trace metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, and zinc) (USEPA Method 1640)
- Chromium VI (Standard Methods SM3500-Cr)
- PAHs (USEPA Method 625)
- PCBs (USEPA Method 625)
- Salinity (Standard Methods SM2510B)
- TDS (Standard Methods SM2450C)

Table A-3 presents the method of analysis and DQOs for the samples.

Prior to the analysis of the samples, the laboratory will calculate method detection limits for each analyte of interest. Method detection limits will be below the DQOs. To achieve the required detection limits, some modifications to the methods may be necessary. These modifications from the specified analytical methods will be provided by the laboratory at the time of establishing the laboratory contract, and must be approved by USEPA.

3.5 Quality Control

3.5.1 Field Quality Control Procedures

To control the quality of field samples, field duplicate samples of both sediments and groundwater samples will be collected. Although validation guidelines have not been established for field quality control samples, their analysis is useful in identifying possible problems resulting from sample collection or sample processing in the field. All field quality control samples will be documented in the field logbook and verified by the QA Manager, or designee.

3.5.2 Laboratory Quality Control Procedures

Laboratory Quality Control Criteria

Results of the quality control samples from each sample group will be reviewed by the analyst immediately after a sample group has been analyzed. The quality control sample results will then be evaluated to determine if control limits have been exceeded. If control limits are exceeded in the sample group, the Project QA/QC Manager will be contacted immediately, and corrective action (e.g., method modifications followed by reprocessing the affected samples) will be initiated prior to processing a subsequent group of samples.

All primary chemical standards and standard solutions used in this project will be traceable to documented, reliable, commercial sources. Standards will be validated to determine their accuracy by comparison with an independent standard. Any impurities found in the standard will be documented.

The following sections summarize the procedures that will be used to assess data quality throughout sample analysis.

Initial and Continuing Calibration

Multipoint initial calibration will be performed on each instrument at the start of the project, after each major interruption to the analytical instrument, and when any ongoing calibration does not meet control criteria. Ongoing calibration will be performed daily for metals and organic analyses and with every sample batch for conventional parameters (when applicable) to track instrument performance.

Instrument blanks or continuing calibration blanks provide information on the stability of the baseline established. Continuing calibration blanks will be analyzed immediately prior to continuing calibration verification at a frequency of one continuing calibration blank for every 10 samples analyzed at the instrument for inorganic analyses and every 21 hours for organic analyses. If the ongoing calibration is out of control, the analysis must come to a halt until the source of the control failure is eliminated or reduced to meet control specifications. All project samples analyzed while instrument calibration was out of control will be reanalyzed.

Laboratory Duplicates

Analytical duplicates provide information on the precision of the analysis and are useful in assessing potential sample heterogeneity and matrix effects. Analytical duplicates are subsamples of the original sample that are prepared and analyzed as a separate sample. A minimum of one duplicate will be analyzed per sample group or for every 20 samples, whichever is more frequent. For conventionals, a laboratory triplicate will be analyzed per sample group or for every 20 samples, whichever is more frequent, when possible.

Matrix Spikes and Matrix Spike Duplicates (MS/MSD)

Analysis of matrix spike samples provides information on the extraction efficiency of the method on the sample matrix. By performing duplicate matrix spike analyses, information on the precision of the method is also provided for organic analyses. A minimum of one MS/MSD will be analyzed for every sample group or for every 20 samples, whichever is more frequent, when possible.

Surrogate Spikes

All project samples analyzed for organic compounds will be spiked with appropriate surrogate compounds as defined in the analytical methods. Surrogate recoveries will be reported by the laboratories; however, no sample result will be corrected for recovery using these values.

Method Blanks

Method blanks are analyzed to assess possible laboratory contamination at all stages of sample preparation and analysis. A minimum of one method blank will be analyzed for every extraction batch or for every 20 samples (10 samples for conventional parameters), whichever is more frequent.

3.6 Instrument and Equipment Testing, Inspection and Maintenance

Service contracts may be maintained for the major instrumentation and equipment that are no longer under warranty. The gas chromatographs, Inductively Coupled Mass Spectrometer (ICPMS) instrumentation, and balances are typical examples of equipment that might be covered by a maintenance contract. Records of maintenance are kept by the person responsible for the equipment. Specific examples of routine preventive maintenance are further discussed below:

- Hewlett Packard 5972 Gas Chromatograph/Mass Spectrometer System
  1. Every six months, replace the Matrix Spike Duplicate (MSD) foreline pump oil and foreline trap pellets. During the fluid exchange, replace the outlet mist filter.
  2. Every year, check and replace the diffusion pump fluid, if necessary.
  3. As needed, clean the ion source of the MSD (typically every six months).
  4. As needed, the glass injector sleeve and injector septum for the split-splitless injector is replaced (typically once per month).
  5. As needed, the gas purifiers and filters for the carrier gas are replaced.

- Hewlett Packard 4500 ICPMS System
  1. Every six months, replace the oil and foreline trap pellets for the rough pumps. During the fluid exchange, replace the outlet mist filter.
  2. Every year check and replace the turbo molecular pump fluid.
  3. Once per month, clean the sample and skimmer cones.
  4. Once per week, replace the peripump tubing.
  5. As needed, clean the ion source of the mass spectrometer.
  6. Every three months, clean the nebulizer.

3.7 Instrument and Equipment Calibration

All instrumentation is calibrated at a frequency that ensures the validity of the results. These procedures are carried out following USEPA guidelines and the recommendations of the instrument manufacturer.

Calibration standards are prepared either from purchased stock standards or from stock standards prepared in-house utilizing reagents suitable for the preparation of standards. When available, calibration standards are prepared from starting materials that are certified traceable to the National Institute of Standards Technology (NIST).

The following is a brief summary of the instrumentation calibration procedures employed at CRG Laboratories, Inc. Detailed descriptions of these procedures are contained with the appropriate method.

The gas chromatograph or gas chromatograph mass spectrometer is calibrated using either an external calibration procedure or internal standard. For each parameter of interest, at least three to five different concentrations of standards are employed. One of the concentrations is near the Method Detection Limit (MDL) for each parameter. Concentrations of the remaining standards correspond to the expected range of concentrations found in the samples analyzed. Calibration standards are prepared by utilizing secondary dilution standards and/or stock solutions. Calibration standards may include a set of internal standards at a known constant amount. The base peak m/z shall be used as the primary m/z for quantification of the standards. Sensitivity of the instrument is checked every 10 samples by analyzing the external reference samples. If the result is not within a predetermined range, the problem is corrected, and the samples immediately following the last acceptable check are reanalyzed.

The ICPMS is calibrated before each use. For each parameter of interest, at least three to five different concentrations of standards are employed. One of the concentrations is near the MDL for each parameter. Concentrations of the remaining standards correspond to the expected range of concentrations found in the samples analyzed. Calibration standards are prepared by utilizing secondary dilution standards and/or stock solutions. Calibration standards may include a set of internal standards at a known constant amount. Sensitivity of the instrument is checked every 10 samples by analyzing the external reference samples. If the result is not within a predetermined range, the problem is corrected, and the samples immediately following the last acceptable check are reanalyzed.

The performance of the balances is monitored against a set of calibration weights that are traceable to NIST (a log is maintained of these inspections).

Temperature records are maintained for all refrigerators, incubators, water baths, and ovens. The temperatures are monitored at a frequency determined by how often the equipment is placed in service.

3.8 Inspection and Acceptance of Supplies and Consumables

Supplies and consumables are required for sample collection and laboratory activities. During sample collection, the most crucial supplies affecting data quality are those used for decontamination. Acceptance for all supplies will require an intact seal upon receipt, maintenance at appropriate temperature, and use only prior to the expiration date. The date opened and initials of the individual who opened the container will be written on the solvent bottle and on any smaller containers used to transfer solvent, such as a squirt bottle. This method of documentation allows any contamination problem to be traced to its source and will enable identification of related samples that may have been affected. Acceptance requirements will include a basic inspection of all containers received and rejection of unacceptable supplies.

Reagents of appropriate purity, and suitably cleaned equipment, must be used for all stages of laboratory analyses. In addition, the laboratory must ensure that the concentrations of calibration and spiking standard are accurate and that instrumentation is functioning properly. The lot numbers of all standards are routinely tracked by laboratories, from purchase of stock standards to preparation of secondary and working calibration standards. All calibration and spiking standards are checked against standards from another source.

3.9 Non-direct Measurements

Non-direct measurements for this study will include data collected previously from the SWM shipyard area. If other relevant prior data sets are identified during the course of the study, they will be considered if the data are of known and acceptable quality. Laboratory data for previous studies at the site will be reviewed for accuracy and precision and will not be used if the data quality is poor or insufficiently documented. Any limitations to the quality of historical data and implications for data usability will be discussed in the site investigation report.

Literature-based toxicity reference values will be used for ecological risk assessment. This data will be obtained from state or federal regulations, specifically California Toxics Rule.

Non-direct measurements may also include engineering, feasibility, and cost information derived from previous projects implemented at the shipyards.

3.10 Data Management

Computerized systems will be used to record, store, and sort the technical data that will e generated to support the sediment study. Automated data handling increases data integrity by reducing errors, omissions, and ambiguities that can be introduced by manual procedures. In addition, automated procedures will be used by the laboratory to capture and summarize analytical results. In this case, electronic data files can be imported directly from the laboratory to the project database, minimizing both data entry effort and opportunities for error. Sampling location coordinates will be entered into the database to enable the generation of maps and figures using ArcView software.

Field logbooks, station/sample forms, and chain-of-custody forms are prepared by the field team while sample collection activities are in progress. Sample information from the field is entered manually into the database. Each data record will include a unique sample code, station ID, sample type (matrix), analyte, analyte concentration, and units. Data from the laboratory are entered directly from the EDD. Electronic data summaries are produced to support data validation procedures. Data qualifiers are entered into the database when validation is completed and verified, and the data set is approved as final. All data entries are verified by the data manager or validation personnel.

4 ASSESSMENT AND OVERSIGHT

4.1 Assessments and Response Actions

Once data is received from the laboratory, a number of QC procedures will be followed to provide an accurate evaluation of the data quality. Specific procedures will be followed to assess data precision, accuracy, and completeness.

An USEPA Level III data quality review will be performed by a qualified Data Validation Specialist on the data, in accordance with USEPA National Functional Guidelines (USEPA 1994). The data will be evaluated in accordance with the QAPP. All chemical data will be reviewed with regard to the following, as appropriate to the particular analysis.

- Chain-of-custody/documentation
- Holding times
- Instrument calibration
- Method blanks
- Detection limits
- Surrogate recoveries
- Matrix spike/matrix spike recoveries
- Laboratory control sample recoveries
- Laboratory and field duplicate relative percent differences

The results of the data quality review, including text assigning qualifiers in accordance with the USEPA National Functional Guidelines (USEPA 1994) and a tabular summary of qualifiers will be generated by the Data Validation Specialists and submitted to the Project QA Coordinator for final review and confirmation of the validity of the data. A QA summary of the review will be generated by the Project QA Coordinator.

4.1.1 Laboratory and Field Performance Assessment

Laboratory and field performance audits consist of on-site reviews of QA systems and equipment for sampling, calibration, and measurement. Laboratory audits will not be conducted as part of this study; however, all laboratory audit reports will be made available to the Project QA Coordinator upon request. All laboratories are required to have written procedures addressing internal QA/QC; these procedures have been submitted and will be reviewed by the Project QA Coordinator to ensure compliance with the QAPP. All laboratories must ensure that personnel engaged in sampling and analysis tasks have appropriate training. The laboratory will, as part of the audit process, provide written details of any and all method modifications planned for consultant's review.

Response Action for Field Sampling

The Field QA Officer will be responsible for correcting equipment malfunctions during the field sampling effort. The Project QA Coordinator will be responsible for resolving situations in the field that may result in noncompliance with the QAPP. All corrective measures will be immediately documented in the field logbook.

Responsive Action for Laboratory Analyses

The laboratory is required to comply with their Standard Operating Procedures (SOPs). The Laboratory Project Manager will be responsible for ensuring that appropriate corrective actions are initiated as required for conformance with this QAPP. All laboratory personnel will be responsible for reporting problems that may compromise the quality of the data.

The Project QA/QC Coordinator will be notified immediately if any quality control sample exceeds the project-specified control limits. The analyst will identify and correct the anomaly before continuing with the sample analysis. The Laboratory Project Manager will document the corrective action taken, in a memorandum submitted to the Project QA Coordinator within 5 days of the initial notification. A narrative describing the anomaly, the steps taken to identify and correct the anomaly, and the treatment of the relevant sample batch (i.e., recalculation, reanalysis, re-extraction) will be submitted with the data package in the form of a cover letter.

4.2 Reports to Management

Reports will be prepared for any condition that requires corrective action and for technical system audits (if conducted). The reports will be prepared by the individual who conducted the audit, approved by the Project QA/QC Coordinator, and provided to the SWM Project Manager. Any significant problems identified in any of the reports will be discussed with the RWQCB.

At the completion of the site investigation, a data quality and usability report will be prepared that will include the following items:

- A discussion of sampling procedures and any anomalies encountered during sample collection
- A discussion of laboratory procedures
- A discussion of quality control procedures and data validation results
- A description and discussion of any other conditions that may have affected the quality of the data
- A summary of the quality of the project data
- A description of the data usability and limitation for the project

The report will be prepared under the direction of the Anchor field team leader and the Project QA/QC Coordinator. The report will be provided to RWQCB.

5 DATA VERIFICATION, VALIDATION, AND USABILITY

5.1 Data Review, Validation, and Verification

Data files will be reviewed by the data manager to identify outliers, spurious results, or omissions. Any problems will be reported to the project manager. QA personnel will review data for compliance with data quality objectives. Any problems with data quality will be included in the final report.

5.1.1 Requirements for Verification of Field Procedures

Field procedures will be followed as described in the Workplan and this QAPP. All protocols related to sample collection, storage, shipping, and handling include requirements for QA procedures and documentation of activities. Any deviation from specified procedures should be documented in detail in the field logbook and fully justified. Specific requirements include, but are not limited to the following:

- Sampling locations must be fully documented and correct. Errors in the sampling location may result in the rejection of the data.
- Sample collection, compositing, and homogenization procedures must be completed as planned and fully documented. Difficulties encountered during sampling that may affect the representativeness of the sample should be minimized.
- Sample shipping and handling procedures must be completed as described in the Workplan and this QAPP. Maintaining appropriate sample temperatures during field activities and shipping is particularly important.
- Results for field quality control samples should meet control limits. The precision guidelines (Table A-3) will be used as a control limit for field duplicates. Equipment rinsate blank contamination will result in the qualification of related data as described in the functional guidelines (USEPA 1994).

Failure to meet these requirements may result in qualification or rejection of data during data validation (see Section 5.2)

5.1.2 Requirements for Verification of Laboratory Procedures

Laboratory procedures should be followed as described in this QAPP, methods cited in Table A-3, and in the laboratory and SOPs. Any deviations from the specified procedures should be documented in detail and fully justified in the case narrative for the data package.

Chemical data will be evaluated according to criteria specified in the functional guidelines for data validation (USEPA 1994). Data may be qualified as estimated or rejected if any of the following quality control samples and procedures do not meet control limits:

- Sample holding time (Table A-3)
- Method of analysis
- Initial and continuing instrument calibration
- Calibration and method blanks
- Matrix spike samples
- Matrix duplicate samples
- Surrogate recovery
- Analyte identification and qualification.

5.2 Verification and Validation Methods

Data validation includes signed entries by the field and laboratory technicians on field data sheets and laboratory datasheets, respectively; review for completeness and accuracy by the field supervisor and laboratory manager; review by the data manager for outliers and omissions; and the use of quality control criteria to accept or reject specific data. All data will be entered into a database and the raw data file printed. 100 percent verification of data will be performed by a second data manager or designee. Any errors found will be corrected on the raw data printout sheet. After the raw data are checked, the top sheet will be marked with the date the checking is completed and the initials of the person doing the checking. Any errors in the raw data file will be corrected, and the database established.

5.2.1 Field Procedures

Field activities are to conform to the specifications in the Workplan and this QAPP and will be verified by the field team leader and Anchor Project Manager on an ongoing basis while field activities are in progress. Any deviation from the sampling procedures will be described in the logbook.

Sample locations are described in the Workplan. If a sample cannot be collected as planned, the field leader will decide on an alternate location and inform both the SWM Project Manager and the Anchor Project Manager. The new station location will be logged into the logbook.

Sample completeness, completeness of chain-of-custody forms, and packing of samples will be verified at the end of each sampling day by the field leader.

Sample identification information in the sample logs and chain-of-custody forms will be verified by the data manager or sampling personnel when the field data are entered into the database. Station location information will be verified by the Project Manager when station coordinates are used to generate project maps. Any deviations that affect data quality or completeness will be discussed in the data quality report and data will be rejected, as appropriate.

5.2.2 *Laboratory Procedures*

Data verification includes checking that quality control procedures were performed at the required frequencies and that the quality control results meet control limits defined in the method description. The equations that will be used to determine if measurement targets were met for each quality control procedure are provided below.

Precision

Precision measures the reproducibility of measurements under a given set of conditions. Specifically, it is a quantitative measure of the variability of a group of measurements compared to their average values. Analytical precision is measured through MS/MSD samples for organic analysis and through laboratory duplicate samples for inorganic analyses.

Analytical precision measurements will be carried out on project-specific samples at a minimum frequency of one per laboratory analysis group or one in twenty samples, whichever is more frequent per matrix analyzed, as practical. Laboratory precision will be evaluated against quantitative RPD performance criteria provided by the laboratory. Field precision will be evaluated by the collection of blind field duplicates at a frequency of 20 percent. Field duplicate precision will be screened against a RPD of 50 percent for groundwater samples. However, no data will be qualified based solely on field duplicate precision.

Precision measurements can be affected by the nearness of a chemical concentration to the method detection limit, where the percent error (expressed as RPD) increases. The equations used to express precision are as follows:

$$\mathrm{RPD} = \frac{(C_1 - C_2) \times 100\%}{(C_1 + C_2)/2}$$

Where:

RPD = relative percent difference
C_1 = larger of the two observed values
C_2 = smaller of the two observed values

Accuracy

Accuracy is an expression of the degree to which a measured or computed value represents the true value. Field accuracy is controlled by adherence to sample collection procedures outlined in the Workplan.

Analytical accuracy may be assessed by analyzing "spiked" samples with known standards (surrogates, laboratory control samples, and/or matrix spike) and measuring the percent recovery. Accuracy measurements on matrix spike samples will be carried out at a minimum frequency of one in 20 samples per matrix analyzed.

Laboratory accuracy will be evaluated against quantitative matrix spike and surrogate spike recovery performance criteria provided by the laboratory. Accuracy can be expressed as a percentage of the true or reference value, or as a percent recovery in those analyses where reference materials are not available and spiked samples are analyzed. The equation used to express accuracy is as follows:

$$\%R = 100\% \times (S-U)/C_{sa}$$

Where:

$\%R$ = percent recovery

S = measured concentration in the spiked aliquot

U = measured concentration in the unspiked aliquot

C_{sa} = actual concentration of spike added

Completeness

Completeness is a measure of the amount of data that is determined to be valid in proportion to the amount of data collected. Completeness will be calculated as follows:

$$C = \frac{(\text{Number of acceptable data points}) \times 100}{(\text{Total number of data points})}$$

The data quality objective for completeness for all components of this project is 90 percent. Data that have been qualified as estimated because the quality control criteria were not met will be considered valid for the purpose of assessing completeness. Data that have been qualified as rejected will not be considered valid for the purpose of assessing completeness.

5.3 Reconciliation with User Requirements

The quality assurance personnel will review data after each survey to determine if DQOs have been met. If data do not meet the project's specifications, the QA personnel will review the errors and determine if the problem is due to calibration/maintenance, sampling techniques, or other factors. They will suggest corrective action. It is expected that the problem would be able to be corrected by retraining, revision of techniques, or replacement of supplies/equipment. If not, then the DQOs will be reviewed for feasibility. If specific DQOs are not achievable, the QA personnel will recommend appropriate modifications. Any revisions would need approval by the RWQCB, the SWM Project Manager and the Anchor Project Manager.

6 REFERENCES

USEPA. 1986. General QA/QC considerations for collecting environmental samples in Puget Sound. U.S. Environmental Protection Agency, Region 10, Office of Puget Sound, Puget Sound Estuary Program Seattle, WA.

USEPA. 1994. Laboratory data validations: Functional guidelines for evaluating inorganics analysis. Prepared by U.S. Environmental Protection Agency Work Group. U.S. Environmental Protection Agency, Hazardous Site Evaluation Division, Washington, DC.

USEPA. 2001. EPA requirements for quality assurance project plans. EPA QA/R-5. EPA/240/B-01/003. U.S. Environmental Protection Agency , Office of Environmental Information, Washington, DC.

ANCHOR
ENVIRONMENTAL, L.L.C.

Anchor Environmental, L.L.C.
1423 3rd Avenue, Suite 300
Seattle, Washington 98101
Phone 206.287.9130
Fax 206.287.9131

Memorandum

To: Shaun Halvax, Southwest Marine

From: Michael Whelan, P.E.

CC: David Keith

Date: June 2, 2004

Re: Analytical Results from Site Groundwater Sample

Attached is the analytical report received from Calscience Environmental Laboratory (CEL), for chemistry tests conducted on a groundwater sample obtained from the immediate vicinity of your site.

We obtained the groundwater sample on August 7, 2003 from a hydropunch sampling location installed by ENV America. This hydropunch was one of several explorations installed by ENV America on behalf of SDG&E, as part of a Site Assessment of the former wastewater ponds area located along the northwestern border of your site. Our groundwater sample was taken from sampling location B-5, and was obtained from a nominal depth of about 5 feet below the groundwater table.

The sample was submitted immediately to CEL for various tests for dissolved metals and chemical constituents, as are documented in the attached report.

Please call if you have any questions.

Calscience
Environmental
Laboratories, Inc.

August 14, 2003

David Keith
Anchor Environmental, CA L.P.
3914 Murphy Canyon Road, Suite A242
San Diego, CA 92123-0000

Subject:	**Calscience Work Order No.:**	**03-08-0356**
	Client Reference:	**Southwest Marine**

Dear Client:

Enclosed is an analytical report for the above-referenced project. The samples included in this report were received 8/7/2003 and analyzed in accordance with the attached chain-of-custody.

Unless otherwise noted, all analytical testing was accomplished in accordance with the guidelines established in our Quality Assurance Program Manual, applicable standard operating procedures, and other related documentation. The original report of any subcontracted analysis is provided herein, and follows the standard Calscience data package. The results in this analytical report are limited to the samples tested and any reproduction thereof must be made in its entirety.

If you have any questions regarding this report, please do not hesitate to contact the undersigned.

Sincerely,

Calscience Environmental
Laboratories, Inc.
Robert Stearns
Project Manager

Michael J. Crisostomo
Quality Assurance Manager

Calscience Environmental Laboratories, Inc.

ANALYTICAL REPORT

Anchor Environmental, CA L.P.
3914 Murphy Canyon Road, Suite A242
San Diego, CA 92123-0000

Date Received:	08/07/03
Work Order No:	03-08-0356
Preparation:	N/A
Method:	EPA 120.1

Project: Southwest Marine

Page 1 of 1

Client Sample Number	Lab Sample Number	Date Collected	Matrix	Date Prepared	Date Analyzed	QC Batch ID
B5-080703	**03-08-0356-1**	**08/07/03**	**Aqueous**	**N/A**	**08/07/03**	**30807SCD1**

Parameter	Result	RL	DF	Qual	Units
Specific Conductance	6100	10	1		umhos/cm

RL - Reporting Limit , DF - Dilution Factor , Qual - Qualifiers

ANALYTICAL REPORT

Anchor Environmental, CA L.P.
3914 Murphy Canyon Road, Suite A242
San Diego, CA 92123-0000

Date Received:	08/07/03
Work Order No:	03-08-0356
Preparation:	N/A
Method:	EPA 150.1

Project: Southwest Marine

Client Sample Number	Lab Sample Number	Date Collected	Matrix	Date Prepared	Date Analyzed	QC Batch ID
B5-080703	**03-08-0356-1**	**08/07/03**	**Aqueous**	**N/A**	**08/07/03**	**30807PHD2**

Parameter	Result	RL	DF	Qual	Units
pH	7.14	0.01	1		pH units

RL - Reporting Limit , DF - Dilution Factor , Qual - Qualifiers

Calscience
Environmental
Laboratories, Inc.

ANALYTICAL REPORT

Anchor Environmental, CA L.P.
3914 Murphy Canyon Road, Suite A242
San Diego, CA 92123-0000

Date Received:	08/07/03
Work Order No:	03-08-0356
Preparation:	N/A
Method:	EPA 160.1

Project: Southwest Marine

Client Sample Number	Lab Sample Number	Date Collected	Matrix	Date Prepared	Date Analyzed	QC Batch ID
B5-080703	**03-08-0356-1**	**08/07/03**	**Aqueous**	**N/A**	**08/08/03**	**30808TDSD1**

Parameter	Result	RL	DF	Qual	Units
Solids, Total Dissolved	4200	10	1		mg/L

RL - Reporting Limit , DF - Dilution Factor , Qual - Qualifiers

Calscience Environmental Laboratories, Inc.

ANALYTICAL REPORT

Anchor Environmental, CA L.P.
3914 Murphy Canyon Road, Suite A242
San Diego, CA 92123-0000

Date Received:	08/07/03
Work Order No:	03-08-0356
Preparation:	N/A
Method:	EPA 375.4

Project: Southwest Marine

Client Sample Number	Lab Sample Number	Date Collected	Matrix	Date Prepared	Date Analyzed	QC Batch ID
B5-080703	**03-08-0356-1**	**08/07/03**	**Aqueous**	**N/A**	**08/07/03**	**30807SO4L1**

Parameter	Result	RL	DF	Qual	Units
Sulfate	640	50	25	D	mg/L

Client Sample Number	Lab Sample Number	Date Collected	Matrix	Date Prepared	Date Analyzed	QC Batch ID
Method Blank	**099-05-091-1,139**	**N/A**	**Aqueous**	**N/A**	**08/07/03**	**30807SO4L1**

Parameter	Result	RL	DF	Qual	Units
Sulfate	ND	2.0	1		mg/L

RL - Reporting Limit , DF - Dilution Factor , Qual - Qualifiers

Calscience
Environmental
Laboratories, Inc.

ANALYTICAL REPORT

Anchor Environmental, CA L.P.
3914 Murphy Canyon Road, Suite A242
San Diego, CA 92123-0000

Date Received:	08/07/03
Work Order No:	03-08-0356
Preparation:	N/A
Method:	EPA 415.1

Project: Southwest Marine

Page 1 of 1

Client Sample Number	Lab Sample Number	Date Collected	Matrix	Date Prepared	Date Analyzed	QC Batch ID
B5-080703	**03-08-0356-1**	**08/07/03**	**Aqueous**	**N/A**	**08/09/03**	**30809DOCL1**

Parameter	Result	RL	DF	Qual	Units
Carbon, Dissolved Organic	8.4	2.5	5	D	mg/L

Method Blank	**099-05-115-148**	**N/A**	**Aqueous**	**N/A**	**08/09/03**	**30809DOCL1**

Parameter	Result	RL	DF	Qual	Units
Carbon, Dissolved Organic	0.92	0.50	1		mg/L

RL - Reporting Limit , DF - Dilution Factor , Qual - Qualifiers

Calscience
Environmental
Laboratories, Inc.

ANALYTICAL REPORT

Anchor Environmental, CA L.P.
3914 Murphy Canyon Road, Suite A242
San Diego, CA 92123-0000

Date Received: 08/07/03
Work Order No: 03-08-0356
Preparation: N/A
Method: SM 2320B

Project: Southwest Marine

Page 1 of 1

Client Sample Number	Lab Sample Number	Date Collected	Matrix	Date Prepared	Date Analyzed	QC Batch ID
B5-080703	**03-08-0356-1**	**08/07/03**	**Aqueous**	**N/A**	**08/08/03**	**30808ALKD1**

Parameter	Result	RL	DF	Qual	Units
Bicarbonate (as CaCO3)	840	5.0	1		mg/L

RL - Reporting Limit , DF - Dilution Factor , Qual - Qualifiers

Calscience Environmental Laboratories, Inc.

ANALYTICAL REPORT

Anchor Environmental, CA L.P.
3914 Murphy Canyon Road, Suite A242
San Diego, CA 92123-0000

Date Received: 08/07/03
Work Order No: 03-08-0356
Preparation: N/A
Method: SM 4500-Cl C

Project: Southwest Marine

Client Sample Number	Lab Sample Number	Date Collected	Matrix	Date Prepared	Date Analyzed	QC Batch ID
B5-080703	**03-08-0356-1**	**08/07/03**	**Aqueous**	**N/A**	**08/08/03**	**30808CLCB1**

Parameter	Result	RL	DF	Qual	Units
Chloride	1800	20	10	D	mg/L

Method Blank	**099-05-057-1,149**	**N/A**	**Aqueous**	**N/A**	**08/08/03**	**30808CLCB1**

Parameter	Result	RL	DF	Qual	Units
Chloride	ND	2.0	1		mg/L

Calscience
Environmental
Laboratories, Inc.

ANALYTICAL REPORT

Anchor Environmental, CA L.P.
3914 Murphy Canyon Road, Suite A242
San Diego, CA 92123-0000

Date Received:	08/07/03
Work Order No:	03-08-0356
Preparation:	N/A
Method:	SM 4500-O G

Project: Southwest Marine

Page 1 of 1

Client Sample Number	Lab Sample Number	Date Collected	Matrix	Date Prepared	Date Analyzed	QC Batch ID
B5-080703	**03-08-0356-1**	**08/07/03**	**Aqueous**	**N/A**	**08/07/03**	**30807DOD1**

Parameter	Result	RL	DF	Qual	Units
Dissolved Oxygen	1.09	0.01	1		mg/L

RL - Reporting Limit , DF - Dilution Factor , Qual - Qualifiers

Calscience Environmental Laboratories, Inc.

ANALYTICAL REPORT

Anchor Environmental, CA L.P.
3914 Murphy Canyon Road, Suite A242
San Diego, CA 92123-0000

Date Received:	08/07/03
Work Order No:	03-08-0356
Preparation:	EPA 3010A Total
Method:	EPA 6010B

Project: Southwest Marine

Page 1 of 1

Client Sample Number	Lab Sample Number	Date Collected	Matrix	Date Prepared	Date Analyzed	QC Batch ID
B5-080703	**03-08-0356-1**	**08/07/03**	**Aqueous**	**08/08/03**	**08/12/03**	**030808L02A**

Parameter	Result	RL	DF	Qual	Units	Parameter	Result	RL	DF	Qual	Units
Calcium	119	1	10		mg/L	Potassium	113	0.500	1		mg/L
Iron	0.497	0.100	1		mg/L	Sodium	1090	5	10		mg/L
Magnesium	197	1	10		mg/L	Silicon	12.0	0.0500	1		mg/L

Client Sample Number	Lab Sample Number	Date Collected	Matrix	Date Prepared	Date Analyzed	QC Batch ID
Method Blank	**097-01-003-3,165**	**N/A**	**Aqueous**	**08/08/03**	**08/12/03**	**030808L02A**

Parameter	Result	RL	DF	Qual	Units	Parameter	Result	RL	DF	Qual	Units
Calcium	ND	0.100	1		mg/L	Potassium	ND	0.500	1		mg/L
Iron	ND	0.100	1		mg/L	Sodium	ND	0.500	1		mg/L
Magnesium	ND	0.100	1		mg/L	Silicon	ND	0.0500	1		mg/L

Quality Control - Duplicate

Anchor Environmental, CA L.P.
3914 Murphy Canyon Road, Suite A242
San Diego, CA 92123-0000

Date Received:	08/07/03
Work Order No:	03-08-0356
Preparation:	N/A
Method:	EPA 120.1

Project: Southwest Marine

Quality Control Sample ID	Matrix	Instrument	Date Prepared:	Date Analyzed:	Duplicate Batch Number
03-08-0300-3	**Aqueous**	**SC 1**	**N/A**	**08/07/03**	**30807SCD1**

Parameter	Sample Conc	DUP Conc	RPD	RPD CL	Qualifiers
Specific Conductance	1600	1600	1	0-25	

Quality Control - Duplicate

Anchor Environmental, CA L.P.
3914 Murphy Canyon Road, Suite A242
San Diego, CA 92123-0000

Date Received:	08/07/03
Work Order No:	03-08-0356
Preparation:	N/A
Method:	EPA 150.1

Project: Southwest Marine

Quality Control Sample ID	Matrix	Instrument	Date Prepared:	Date Analyzed:	Duplicate Batch Number
03-08-0300-2	**Aqueous**	**PH 1**	**N/A**	**08/07/03**	**30807PHD2**

Parameter	Sample Conc	DUP Conc	RPD	RPD CL	Qualifiers
pH	6.65	6.65	0	0-25	

Quality Control - Duplicate

Anchor Environmental, CA L.P.		Date Received:	08/07/03
3914 Murphy Canyon Road, Suite A242		Work Order No:	03-08-0356
San Diego, CA 92123-0000		Preparation:	N/A
		Method:	EPA 160.1
Project:	Southwest Marine		

Quality Control Sample ID	Matrix	Instrument	Date Prepared:	Date Analyzed:	Duplicate Batch Number
03-08-0376-4	Aqueous	N/A	N/A	08/08/03	30808TDSD1

Parameter	Sample Conc	DUP Conc	RPD	RPD CL	Qualifiers
Solids, Total Dissolved	530	540	2	0-25	

Quality Control - Spike/Spike Duplicate

Anchor Environmental, CA L.P.
3914 Murphy Canyon Road, Suite A242
San Diego, CA 92123-0000

Date Received:	08/07/03
Work Order No:	03-08-0356
Preparation:	N/A
Method:	EPA 375.4

Project: Southwest Marine

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	MS/MSD Batch Number
03-08-0332-1	**Aqueous**	**UV 2**	**N/A**	**08/07/03**	**30807SO4S1**

Parameter	MS %REC	MSD %REC	%REC CL	RPD	RPD CL	Qualifiers
Sulfate	93	89	70-130	2	0-25	

Quality Control - Laboratory Control Sample

Anchor Environmental, CA L.P.
3914 Murphy Canyon Road, Suite A242
San Diego, CA 92123-0000

Date Received:	08/07/03
Work Order No:	03-08-0356
Preparation:	N/A
Method:	EPA 375.4

Project: Southwest Marine

Quality Control Sample ID	Matrix	Instrument	Date Analyzed	Lab File ID	LCS Batch Number
099-05-091-1,139	Aqueous	UV 2	08/07/03	NONE	30807SO4L1

Parameter	Conc Added	Conc Recovered	%Rec	%Rec CL	Qualifiers
Sulfate	20	18	89	80-120	

Quality Control - Spike/Spike Duplicate

Anchor Environmental, CA L.P.
3914 Murphy Canyon Road, Suite A242
San Diego, CA 92123-0000

Date Received: 08/07/03
Work Order No: 03-08-0356
Preparation: N/A
Method: EPA 415.1

Project: Southwest Marine

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	MS/MSD Batch Number
03-08-0380-1	**Aqueous**	**TOC 2**	**N/A**	**08/09/03**	**30809DOCS1**

Parameter	MS %REC	MSD %REC	%REC CL	RPD	RPD CL	Qualifiers
Carbon, Dissolved Organic	50	48	70-130	1	0-25	3

Quality Control - LCS/LCS Duplicate

Anchor Environmental, CA L.P.
3914 Murphy Canyon Road, Suite A242
San Diego, CA 92123-0000

Date Received: 08/07/03
Work Order No: 03-08-0356
Preparation: N/A
Method: EPA 415.1

Project: Southwest Marine

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	LCS/LCSD Batch Number
099-05-115-148	**Aqueous**	**TOC 2**	**N/A**	**08/09/03**	**30809DOCL1**

Parameter	LCS %REC	LCSD %REC	%REC CL	RPD	RPD CL	Qualifiers
Carbon, Dissolved Organic	93	93	80-120	0	0-20	

Quality Control - Duplicate

Anchor Environmental, CA L.P.
3914 Murphy Canyon Road, Suite A242
San Diego, CA 92123-0000

Date Received:	08/07/03
Work Order No:	03-08-0356
Preparation:	N/A
Method:	SM 2320B

Project: Southwest Marine

Quality Control Sample ID	Matrix	Instrument	Date Prepared:	Date Analyzed:	Duplicate Batch Number
03-08-0376-4	**Aqueous**	**PH 1**	**N/A**	**08/08/03**	**30808ALKD1**

Parameter	Sample Conc	DUP Conc	RPD	RPD CL	Qualifiers
Alkalinity, Total (as CaCO3)	240	240	0	0-25	
Bicarbonate (as CaCO3)	240	240	0	0-25	
Hydroxide (as CaCO3)	ND	ND	NA	0-25	
Carbonate (as CaCO3)	ND	ND	NA	0-25	

Quality Control - Duplicate

Anchor Environmental, CA L.P.	
3914 Murphy Canyon Road, Suite A242	
San Diego, CA 92123-0000	

Date Received:	08/07/03
Work Order No:	03-08-0356
Preparation:	N/A
Method:	SM 4500-Cl C

Project: Southwest Marine

Quality Control Sample ID	Matrix	Instrument	Date Prepared:	Date Analyzed:	Duplicate Batch Number
B5-080703	**Aqueous**	**N/A**	**N/A**	**08/08/03**	**30808CLCD1**

Parameter	Sample Conc	DUP Conc	RPD	RPD CL	Qualifiers
Chloride	1800	1800	1	0-25	

Quality Control - Duplicate

Anchor Environmental, CA L.P.
3914 Murphy Canyon Road, Suite A242
San Diego, CA 92123-0000

Project: Southwest Marine

Date Received: 08/07/03
Work Order No: 03-08-0356
Preparation: N/A
Method: SM 4500-O G

Quality Control Sample ID	Matrix	Instrument	Date Prepared:	Date Analyzed:	Duplicate Batch Number
B5-080703	**Aqueous**	**BOD 1**	**N/A**	**08/07/03**	**30807DOD1**

Parameter	Sample Conc	DUP Conc	RPD	RPD CL	Qualifiers
Dissolved Oxygen	1.09	1.09	0	0-25	

Calscience Environmental Laboratories, Inc.

Quality Control - Spike/Spike Duplicate

Anchor Environmental, CA L.P.
3914 Murphy Canyon Road, Suite A242
San Diego, CA 92123-0000

Date Received: 08/07/03
Work Order No: 03-08-0356
Preparation: EPA 3010A Total
Method: EPA 6010B

Project: Southwest Marine

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	MS/MSD Batch Number
B5-080703	Aqueous	ICP 3300	08/08/03	08/12/03	030808S02

Parameter	MS %REC	MSD %REC	%REC CL	RPD	RPD CL	Qualifiers
Calcium	4X	4X	80-120	4X	0-20	Q
Iron	103	100	80-120	3	0-20	
Magnesium	4X	4X	80-120	4X	0-20	Q
Potassium	4X	4X	80-120	4X	0-20	Q
Sodium	4X	4X	80-120	4X	0-20	Q
Silicon	4X	4X	80-120	4X	0-20	Q

Calscience
Environmental
Laboratories, Inc.

Quality Control - Laboratory Control Sample

Anchor Environmental, CA L.P.
3914 Murphy Canyon Road, Suite A242
San Diego, CA 92123-0000

Date Received: 08/07/03
Work Order No: 03-08-0356
Preparation: EPA 3010A Total
Method: EPA 6010B

Project: Southwest Marine

Quality Control Sample ID	Matrix	Instrument	Date Analyzed	Lab File ID	LCS Batch Number
097-01-003-3,165	**Aqueous**	**ICP 3300**	**08/12/03**	**030808-I-02**	**030808L02A**

Parameter	Conc Added	Conc Recovered	%Rec	%Rec CL	Qualifiers
Calcium	1.00	1.01	101	80-120	
Iron	1.00	1.05	105	80-120	
Magnesium	1.00	1.00	100	80-120	
Potassium	10.0	9.66	97	80-120	
Sodium	10.0	10.2	102	80-120	
Silicon	1.00	1.09	108	80-120	

GLOSSARY OF TERMS AND QUALIFIERS

Work Order Number: 03-08-0356

Qualifier	Definition
3	Spike or Spike Duplicate compound was out of control due to a matrix interference. The associated LCS and/or LCSD was in control and, therefore, the sample data was reported without further clarification.
D	The sample data was reported from a diluted analysis.
ND	Not detected at indicated reporting limit.
Q	Spike recovery and RPD control limits do not apply resulting from the sample concentration exceeding the spike concentration by a factor of four or greater.

LABORATORIES, INC.
7440 LINCOLN WAY
GARDEN GROVE, CA 92841-1432
TEL: (714) 895-5494 • FAX: (714) 894-7501

Date 8/7/03
Page 1 of 1

LABORATORY CLIENT: Ancitor Environmental CA., L.P.
ADDRESS: 3914 Murphy Canyon Rd, Ste A242
CITY San Diego STATE CA ZIP 92123
TEL: 858-262-2061 FAX: 858.715.6721 E-MAIL:
TURNAROUND TIME: ☐ SAME DAY ☐ 24 HR ☐ 48 HR ☐ 72 HR ☐ 5 DAYS ☒ 10 DAYS
SPECIAL REQUIREMENTS (ADDITIONAL COSTS MAY APPLY) ☐ RWQCB REPORTING ☐ COELT REPORTING
SPECIAL INSTRUCTIONS:

CLIENT PROJECT NAME / NUMBER: Southwest Marine
PROJECT CONTACT: David Keith
SAMPLER(S): (SIGNATURE) D. K.
COELT LOG CODE ☐☐☐☐
P.O. NO.:
LAB USE ONLY 08-0356
COOLER RECEIPT TEMP = ______ °C

REQUESTED ANALYSES

LAB USE ONLY	GEIMS ID	SAMPLE ID	SAMPLING DATE	SAMPLING TIME	MATRIX	NO. OF CONT.	EPA 120.1 Specific Conductance	EPA 150.1 pH	~~BTEX / MTBE (8021B)~~	~~HALOCARBONS (8021B)~~	EPA 375.4 Sulfate	~~VOCs (5035 / 8260B) EnCore~~	~~SVOCs (8270C)~~	~~PEST (8081A)~~	Si, Ca, Fe, Mg, K, Na	~~EDB/DBCP (504.1/or 8011)~~	~~CAC. T22 METALS (6010B)~~	~~PNAs (8310)~~	~~VOCs (TO-14A/or TO-15)~~	EPA 160.1 Total Dissolved Solids	EPA 415.1 Dissolved Organic Carbon	Bicarbonate (as CaCO3)	SM 4500-CL-E Chloride	SM 4500-O G Dissolved Oxygen
		BS-080703	8/7/03		W	3	X	X			X				X					X	X	X	X	X

Relinquished by: (Signature)
Received by: (Signature)
Date: 8/7/3 Time: 1500

Relinquished by: (Signature)
Received by: (Signature)
Date: Time:

Relinquished by: (Signature)
Received for Laboratory by: (Signature)
Date: 8/7/3 Time: 1815

DISTRIBUTION: White with final report, Green to File, Yellow and Pink to Client.
Please note that pages 1 and 2 of 2 of our T/Cs are printed on the reverse side of the Yellow and Pink copies respectively.

09/10/01 Revision

Q&Q Graphic (714) 898-9702

Calscience Environmental Laboratories, Inc.

WORK ORDER #: 03 - 08 - 0356

Cooler 1 **of** 1

SAMPLE RECEIPT FORM

CLIENT: Anchor

DATE: 8/7/3

TEMPERATURE – SAMPLES RECEIVED BY:

CALSCIENCE COURIER:

✓ Chilled, cooler with temperature blank provided.
____ Chilled, cooler without temperature blank.
____ Chilled and placed in cooler with wet ice.
____ Ambient and placed in cooler with wet ice.
____ Ambient temperature.
2 °C Temperature blank.

LABORATORY (Other than Calscience Courier):

____ °C Temperature blank.
____ °C IR thermometer.
____ Ambient temperature.

Initial: ____

CUSTODY SEAL INTACT:

Sample(s): ____ Cooler: ____ No (Not Intact) : ____ Not Applicable (N/A): ✓

Initial: ____

SAMPLE CONDITION:

	Yes	No	N/A
Chain-Of-Custody document(s) received with samples	✓		
Sample container label(s) consistent with custody papers	✓		
Sample container(s) intact and good condition	✓		
Correct containers for analyses requested	✓		
Proper preservation noted on sample label(s)	✓		
VOA vial(s) free of headspace			✓
Tedlar bag(s) free of condensation			✓

Initial: ____

COMMENTS:

2205 East Belt • Foot of Sampson Street • San Diego, CA 92113
P.O. Box 13308 • San Diego, CA 92170-3308
Bus: 619.238.1000 • Fax: 619.239.1751

SOUTHWEST MARINE INC.

January 11, 2002

Mr. John Pearson
Port of San Diego
Development Services Department
P.O. Box 488
San Diego, California 92112-0488

RE: Quaywall Improvement

Dear Mr. Pearson:

As you know, Southwest Marine Inc. (SWM) has made significant capital investment in the Port Tidelands property located at the foot of Sampson Street. These improvements include piers, buildings, roads and the necessary infrastructure. We believe that we have created a "world class" ship repair facility. We want to continue that progress with the redevelopment of the old (and now defunct) marine railways that were built many years ago and were in service until the late 1990's.

Southwest Marine desires to construct a 200 foot sheet pile bulkhead with concrete cap along the US Bulkhead line from the existing sheet pile bulkhead south of SWM's Ways #3 (now defunct) north to the vicinity of the existing SDGE cooling water inflow duct that leads to the Silver Gate power plant. The water/intertidal area to be filled is all east of the U.S. Bulkhead line, but within the U.S. Army Corps of Engineers jurisdiction for wetlands and is approximately 0.75 acres. An active cathodic protection system will be used to protect the sheet pile.

This project will have significant benefit to the Port, as the area is currently unusable in its existing configuration. It creates land that the Port will maintain in perpetuity, as this type of project cannot easily be removed at the end of the lease term. We must also observe that this project will not only increase revenue from SWM to the Port, it will also <u>properly</u> modernize the property for any future development as may occur. As such, the scope of this project is sufficiently far-reaching that we believe the Port's participation appropriate and of great value. That support from the Port should take two courses: financial and environmental (as mitigation will be required by the appropriate resource agencies). The project is estimated to cost approximately $2,000,000. A copy of our engineering study for the proposed project is provided for your review. Please consider it and the associated cost estimates proprietary information. Further, please note that the cost estimates are for the construction phase of the project and do not include fully developed estimates for mitigation or infrastructure.

We are committed to maintaining Southwest Marine's position as America's preeminent ship repair facility. This project will provide us and the port with modern and attractive industrial waterfront frontage that significantly enhances the value of the property. We suggest that this type of public - private partnership is in both of our long term interests, and we are excited about this project and its future.

Our point of contact for this project is Scott Mc Kay. He may be reached at 619-238-1000 x3900, by fax at 619-557-5218, or by email at mckays@swmarine.com.

Please favor us with a response not later than April 1st, 2002.

We look forward to our discussions and a successful conclusion of this project.

Very truly yours,

David R. Engel
Senior Vice President, Operations
Southwest Marine, Inc.

encl(s)

Caulerpa Survey Reporting Form
(Version 1.0, September 18, 2001)

This form is required to be submitted for any surveys conducted for the invasive exotic alga *Caulerpa taxifolia* that are required to be conducted under federal or state permits and authorizations issued by the U.S. Army Corps of Engineers or Regional Water Quality Control Boards (Regions 8 & 9). The form has been designed to assist in controlling the costs of reporting while ensuring that the required information necessary to identify and control any potential impacts of the authorized actions on the spread of *Caulerpa*. Surveys required to be conducted for this species are subject to modification through publication of revisions to the *Caulerpa* survey policy. It is incumbent upon the authorized permittee to ensure that survey work is following the latest protocols. For further information on these protocols, please contact: Robert Hoffman, National Marine Fisheries Service, (562) 980-4043, or William Paznokas, California Department of Fish & Game, (858) 467-4218).

Site Name: (common reference)	Southwest Marine Piers 1 and 5, located at the foot of Sampson St., San Diego CA.
Survey Contact: (name, phone, e-mail)	Adam H. Behle, (858) 560 5465, abehle@merkelinc.com
Permit Reference: (ACOE Permit No., RWQCB Order or Cert. No.)	ACOE Application for Quay Wall Pending
Hydrographic System: (bay, estuary, lagoon, or harbor)	San Diego Bay
Specific Location: (UTM, Lat./Long., datum, accuracy level, attach electronic survey area map if possible)	UTM NAD 83 coordinates: Pier 1 N 3617188.6 E 486388.0 Pier 5 N 3616959.6 E 486604.2
Was *Caulerpa* Detected: (if *Caulerpa* is found, please immediately contact the permitting agency project staff and NMFS or CDFG personnel identified above)	________ **Yes, Caulerpa was found at this site and** ________ **has been contacted on** ______ **date.** ____X____ **No, Caulerpa was not found at this site.**

Description of Permitted Work: (describe briefly the work to be conducted at the site under the permits identified above)	Construction will involve the demolition and removal of 185 linear feet of wooden pier and associated pilings, beams, and sub-structures and replacement with a new reinforced concrete section.	
Description of Site: (describe the physical and biological conditions within the survey area at the time of the survey and provide insight into variability, if known. Please provide units for all numerical information).	*Depth range:*	0-25 feet MLLW
	Substrate type:	mud, shell hash
	Temperature:	66 degrees Fahrenheit
	Salinity:	
	Dominant flora:	Eelgrass (*Zostera marina*)
	Dominant fauna:	Typical fauna included encrusting sessile organisms, such as sponges, cnidarians, tunicates, hydroids, anemones, molluscs, and crustaceans.
	Exotic species encountered:	Sargassum (*Sargassum muticum*) Musculista (*Musculista senhousia*)
	Other site description notes:	A deep channel is present on the north side of Pier 1 that gradually decreases in depth heading further north. Many remnants of man made structures and debris present throughout the site, including, wood piers, steel rails, bulkheads, and tires.
Description of Survey Effort: (please describe the surveys conducted including type of survey (SCUBA, remote video, etc.) and survey methods employed, date of work, and survey density (estimated percentage of the bottom actually viewed). Describe any limitations encountered during the survey efforts.	*Survey date and time period:*	September 27, 2002 from approximately 1200 to 1630.
	Horizontal visibility in water:	Ranged from 5-15 feet.
	Survey type and methods:	SCUBA was used to perform transects spaced 25 feet apart from a baseline established on the existing pier.

	Survey personnel:	Adam H. Behle, Megan R. Johnson
	Survey density:	60%
	Survey limitations:	While the survey location is present in an active ship yard, boats and general construction activity did not limit the survey effort.
Other Information: (use this space to provide any additional information or references to attached materials such as maps, reports, etc.)		

Caulerpa Survey Reporting Form (version 1.0, 9/18/01)

APPENDIX A

SUPPORTING INFORMATION

CONCEPTUAL DESIGN FOR QUAY WALL EXTENSION AND YARD IMPROVEMENT

Prepared by
Anchor Environmental CA LP
8788 Balboa Avenue
San Diego, California 92123

Prepared for
Southwest Marine Inc
San Diego, California 92170

May 2003

PROJECT DESCRIPTION

Southwest Marine, Inc. (SWM) is planning to reconfigure a portion of their shipyard area, currently occupied by two abandoned marine railways, to support ongoing business needs. The general location of the SWM shipyard is shown in Figure 1 (Location Map). The planned yard improvement will be accomplished by constructing a new section of bulkhead wall (quay wall extension) across the face of the abandoned railways and placing materials behind the wall to reach to the elevation of surrounding grade. Figure 2 identifies the general location of the proposed yard improvement relative to SWM's shipyard and facilities, and Figure 3 presents a detailed plan view of the yard improvement area. The area will ultimately be paved to support shipyard operations.

The project also provides an opportunity to confine chemically impacted sediments that currently are present within the proposed yard improvement area. These sediments, slated for remediation under California Regional Water Quality Control Board Resolution 99-12 (CRWQCB, San Diego Region, 1999), will be confined below as much as 14 feet of clean material topped by a relatively impervious asphalt layer.

DESIGN AND CONSTRUCTION OF QUAY WALL EXTENSION

Structural design documents (Triton Engineers, 2002) call for the new bulkhead wall to consist of steel sheet piling, driven about 20 to 25 feet below existing mud line elevation. The sheet piling is designed to resist loads imposed on the wall by the imported material. Additional structural support will be provided by a series of tie rods that extend behind the wall into the retained fill. The tie rods will be connected to an interior sheet pile anchor wall that will be anchored into the underlying sub grade and fully buried within the fill. Figure 4 presents a generalized cross-sectional representation of these structural elements.

Up to approximately 9,000 cubic yards (cy) of soil will be required to fill the area behind the new bulkhead wall to the elevation of surrounding grades (about +12 feet MLLW). The material will be placed atop existing shipway sediments, which, where soft bay muds are present, may be stabilized for construction purposes by the addition of rock; or, where sand is present, compacted to a relatively dense condition (Triton Engineers 2002).

The material will be placed in individually compacted lifts within the quay wall area. The initial stages of material placement will be staged to coincide with low tide cycles so that compaction can be accomplished "in the dry". During the backfilling process, the structural tie rods will be tensioned and locked off against the outer bulkhead sheet piling and the interior support sheet piling.

Engineering evaluations predict that, over time, the underlying Bay Muds will compress one-half to one foot under the weight of the placed material (Christian Wheeler, 2002). Settlements will occur slowly, as excess pore water pressures in the materials dissipate through drainage, so it is likely that development of the area (i.e., paving) will not be completed immediately, but rather will await the near completion of the settlement process. SWM may elect to accelerate the settlement process through the use of wick drains, which facilitate drainage of the excess pore water, and/or preloading, either using earth materials or heavy site equipment (such as cement "dry-dock blocks").

ENVIRONMENTAL CONSIDERATIONS

Environmental considerations associated with the planned construction of the Quay Wall Extension project include:

- The potential for short-term water quality exceedences during material placement behind the wall.
- The potential for long-term water quality exceedences after construction of the project.
- Confinement of existing chemically impacted sediments within (below) the project area.

Short-Term Water Quality Impacts During Construction

For this project, material placement will occur after the sheetpile wall has been constructed, so the sheetpiling will act as a barrier to turbidity escape from the project area. SWM's existing Waste Discharge Requirments, Order No. 99-14 (CRWQCB, 1999), stipulates turbidity monitoring during construction, and although the WDR is specifically applicable to dredging activities, the requirement for turbidity monitoring will be followed during construction of the quay wall extension. However, since turbidity release will be limited to the amount of water that escapes through the sheepiling, it is expected that turbidity losses to surrounding waters will be insignificant.

Long-Term Water Quality Impacts

The potential for long-term water quality exceedences after construction of the project is limited owing to the use of clean (non-contaminated) materials to achieve desired final grades.

Confinement of Existing Sediments Within the Quay Wall Extension

SWM is evaluating shipyard sediments which have elevated chemical concentrations and are likely unsuitable for unconfined ocean disposal, under California Regional Water Quality Control Board Resolution 99-12 (CRWQCB, San Diego Region, 1999). Although final sediment cleanup levels have not been established by the CRWQCB at the time of this permit application, it appears likely that sediments within the footprint of the proposed Quay Wall project will need to be addressed under Resolution 99-12.

The proposed project will cover existing chemically impacted sediments in the shipways area, thus confining them from the outside environment. This makes the project an opportunity for SWM to expedite a portion of a mandated shipyards cleanup.

The sediment that will be covered and confined by the yard improvement contains elevated metal and PAH concentrations, but, according to bioassay testing results by Exponent, does not exhibit significant toxicity. The sediments that would be covered and confined by the Quay Wall extension total about 3,000 to 3,500 cubic yards in volume.

Overall the project will prevent contact of these sediments with surface water and the surrounding environment. The project will result in covering these sediments with as much as 14 feet of clean material, topped off by base course and asphalt pavement. The asphalt paving will restrict infiltration of surface water into the underlying materials.

REFERENCES

California Regional Water Quality Control Board (CRWQCB), San Diego Region, 1999. Resolution No. 99-12, "A Resolution Establishing Interim Sediment Cleanup Levels for Southwest Marine, Inc." March 10, 1999.

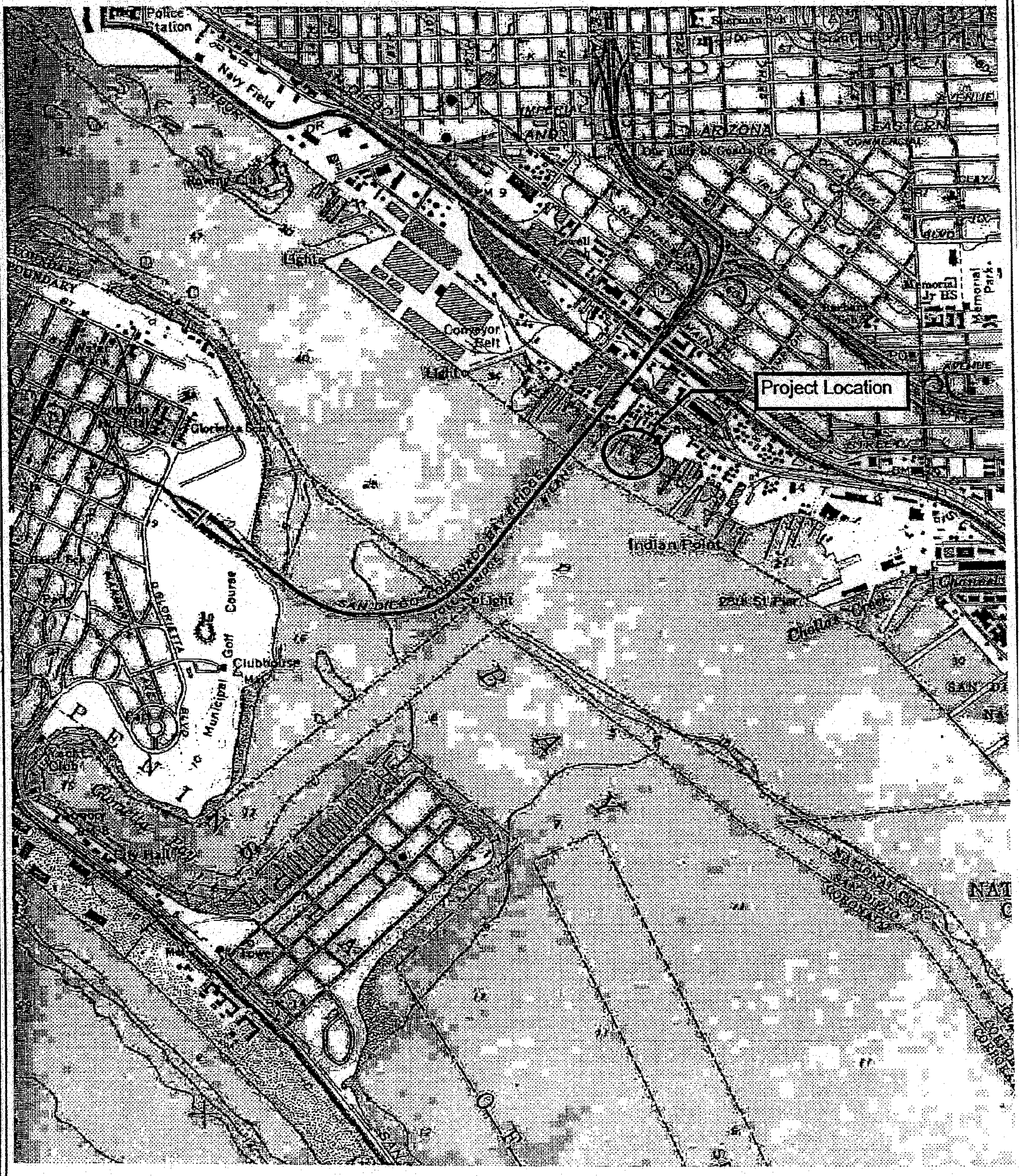
California Regional Water Quality Control Board (CRWQCB), San Diego Region, 1999. Order No. 99-14, "Waste Discharge Requirements for Southwest Marine, Inc. Sediment Remediation Project."

Christian Wheeler Engineering, April 4, 2002. Geotechnical Recommendations and Design Criteria, Proposed Quay Wall Construction Project, Southwest Marine Facilities, San Diego, California."

Exponent, 2003. Draft Phase 2 Results for NASSCO and Southwest Marine Sediment Investigation. (Conducted in 2002; not yet finalized or submitted to RWQCB at the time of this writing)

Triton Engineers, May 2002. Construction Plans Set, Issued for Bid, for Southwest Marine, Inc. – Quay Wall Extension, San Diego, California.

LIST OF FIGURES

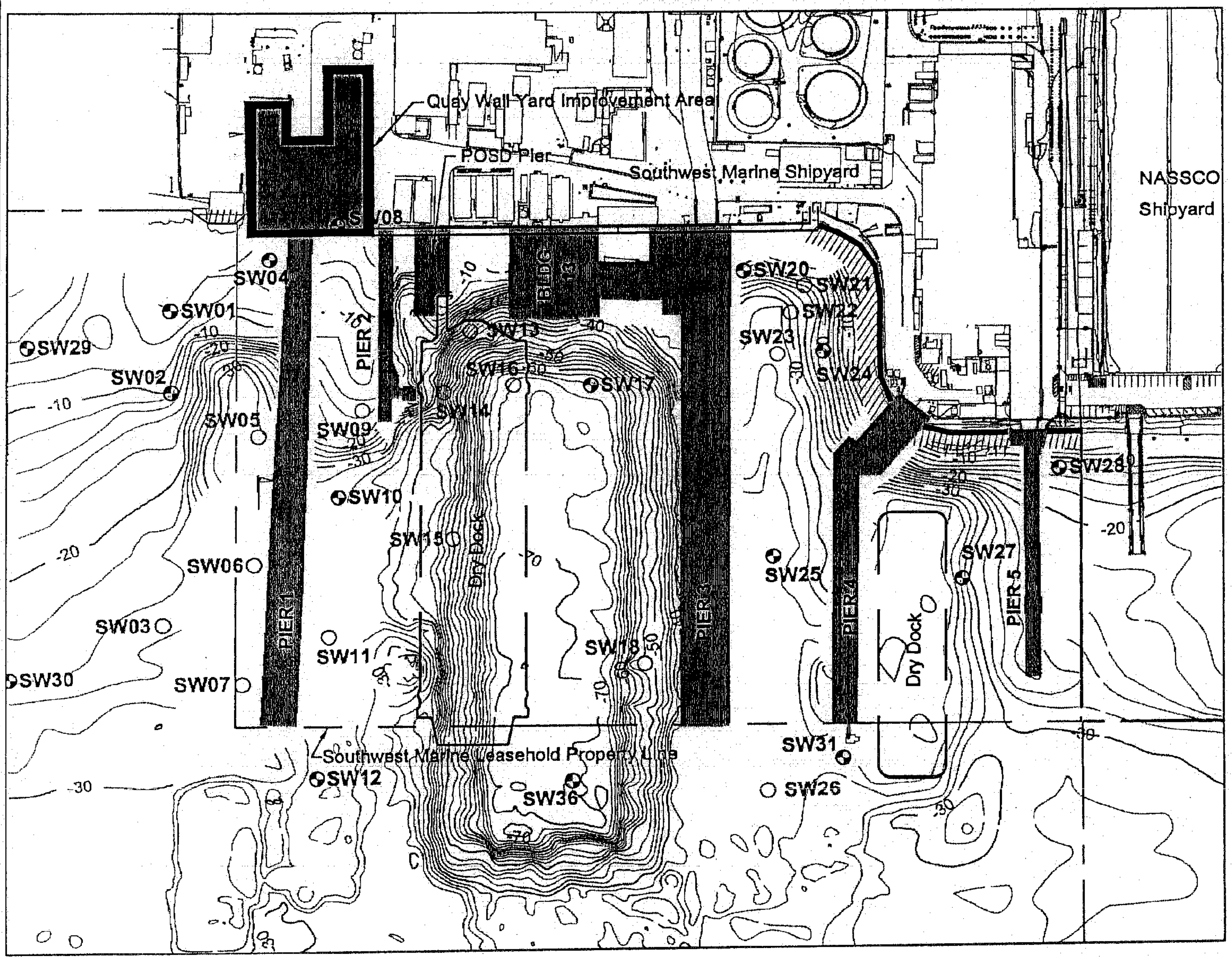


1" = 2,000'

Project Vicinity Map

Source: USGS 7.5' La Jolla, CA
Quadrangles

Figure
1



Shoreline Retention

- Bulkhead Wall
- Revetted Slope

Sample Location and Number

○ SW06 — Phase 1 Sample

● SW32 — Phase 2 Core

0 200
Scale in Feet

Notes:

1. Bathymetric contours from "Southwest Marine Bathymetric Survey" by Racal Pelagos, dated Janurary 25, 2000; and supplemented by neashore soundings by URS (2002)

2. 10 foot contours labeled. 2 foot contours also shown.

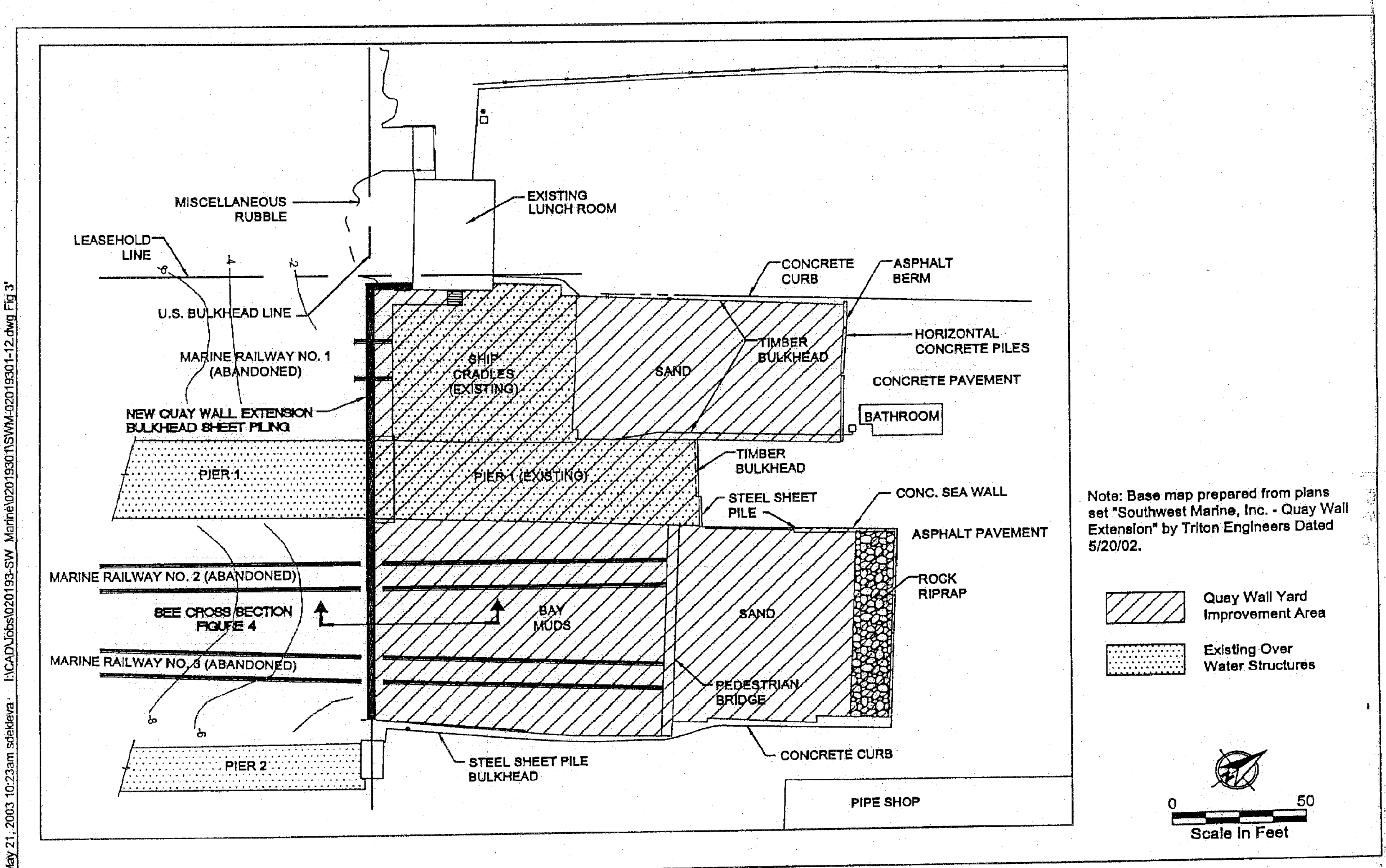
3. Horizontal Datum is UTM NAD83 Zone 11 North, Meters.

4. Vertical Datum is MLLW, Feet.

May 21, 2003 10:29am sdekleva I:\CAD\Jobs\020193-SW Marine\02019301\SWM-02019301-21.dwg Fig 2'

ANCHOR
ENVIRONMENTAL, L.L.C.

Figure 2
General Location of Planned Quay Wall
Southwest Marine Inc.
San Diego, CA

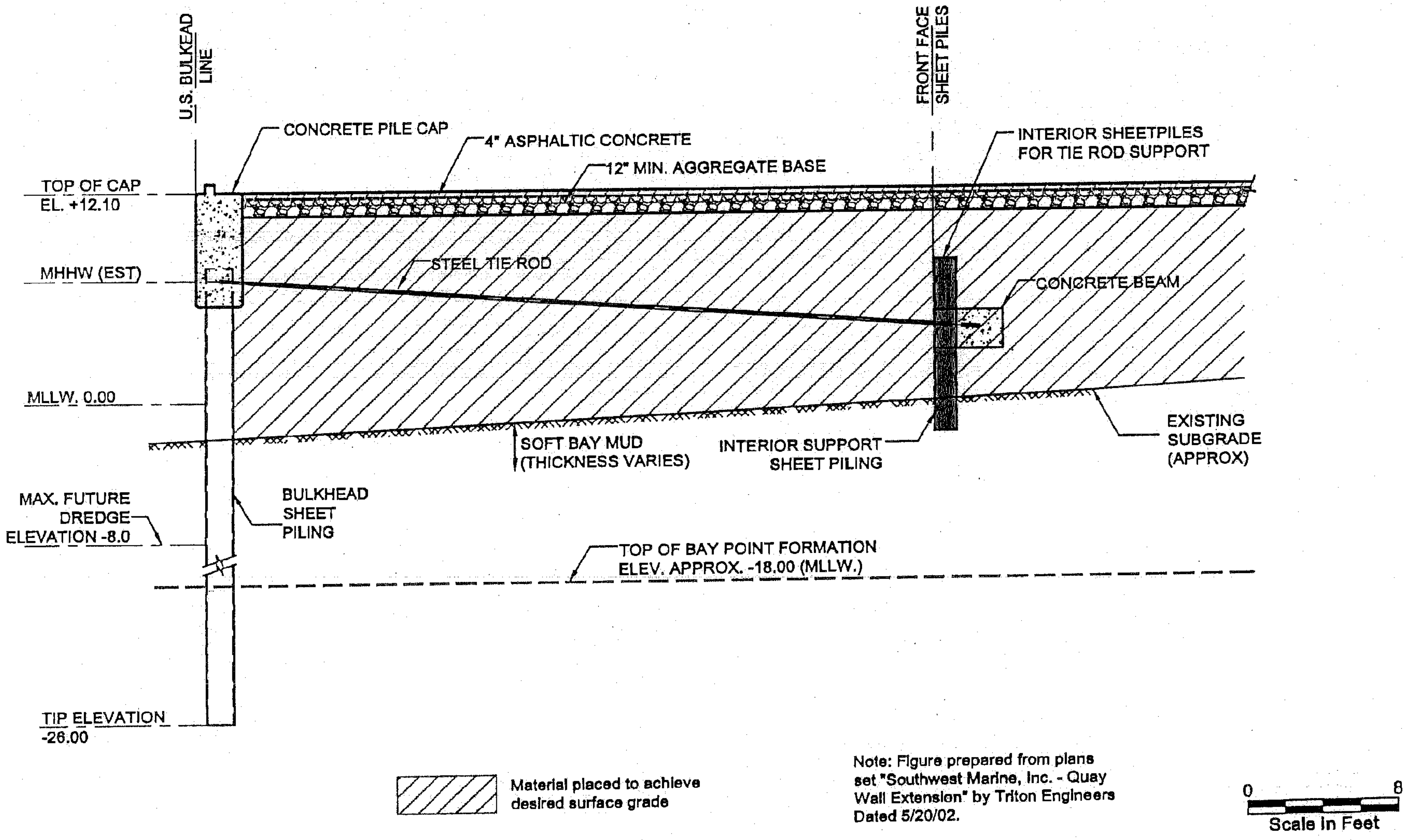


Note: Base map prepared from plans set "Southwest Marine, Inc. - Quay Wall Extension" by Triton Engineers Dated 5/20/02.

May 21, 2003 10:23am sdekleva I:\CAD\Jobs\020193-SW Marine\02019301\SWM-02019301-12.dwg Fig 3'

ANCHOR ENVIRONMENTAL, L.L.C.

Figure 3
Quay Wall Extension - Plan View
Southwest Marine, Inc.



▨ Material placed to achieve desired surface grade

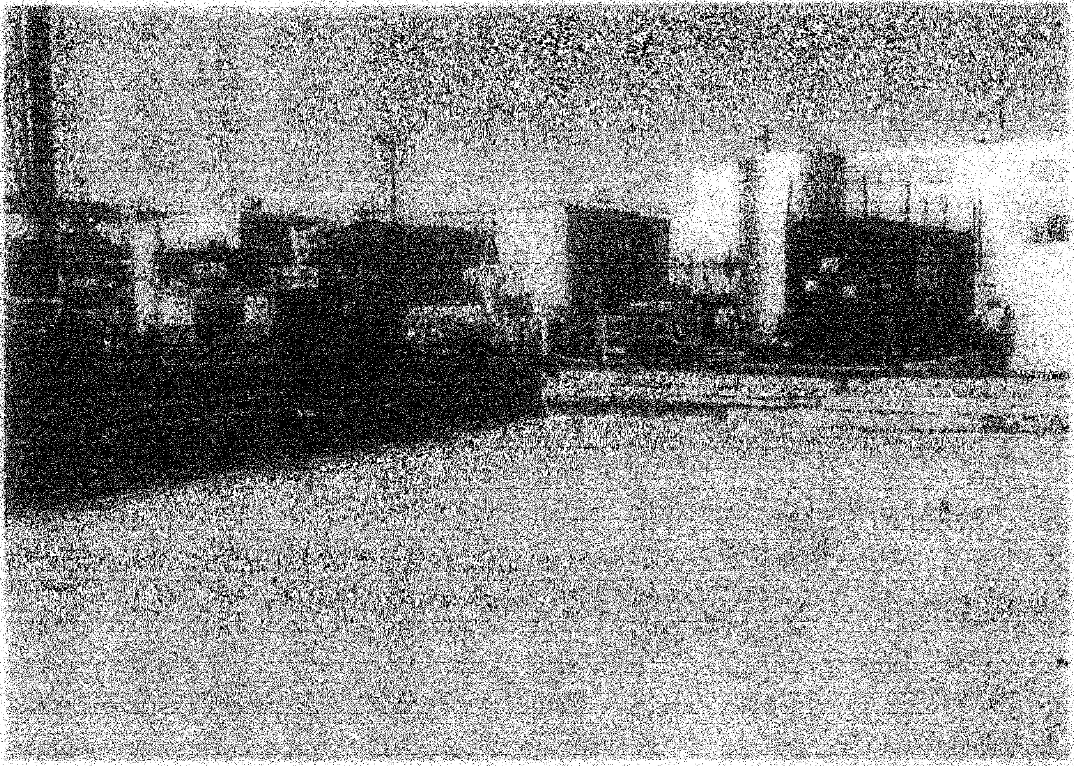
Note: Figure prepared from plans set "Southwest Marine, Inc. - Quay Wall Extension" by Triton Engineers Dated 5/20/02.

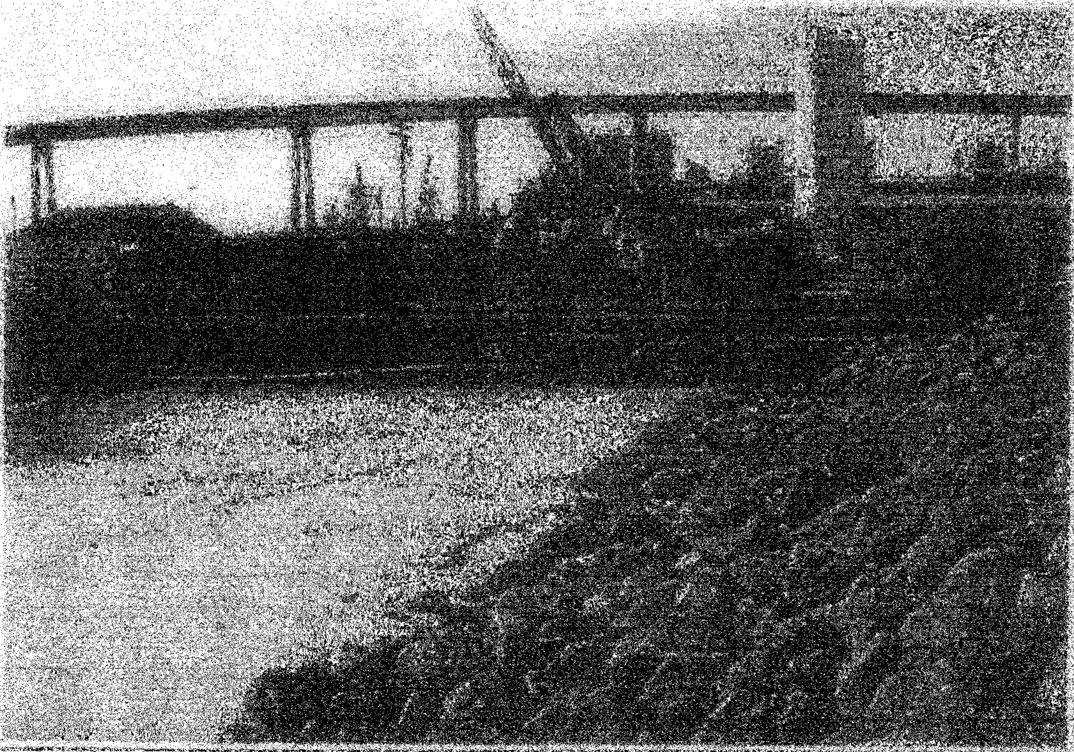
May 21, 2003 10:25am sdekleva I:\CAD\Jobs\020193-SW Marine\02019301\SWM-02019301-13.dwg Fig 4'

ANCHOR ENVIRONMENTAL, L.L.C.

Figure 4
Quay Wall Extension - Cross Sectional View
Southwest Marine, Inc.

Photograph No: P-1





Description: *Top Photo:* Former Ways #1 site backfilled with clean sand following remediation.

Bottom Photo: Looking northwest at site of former Ways #2 and #3. Note sand fill and shoreline riprap placed following remediation of site.

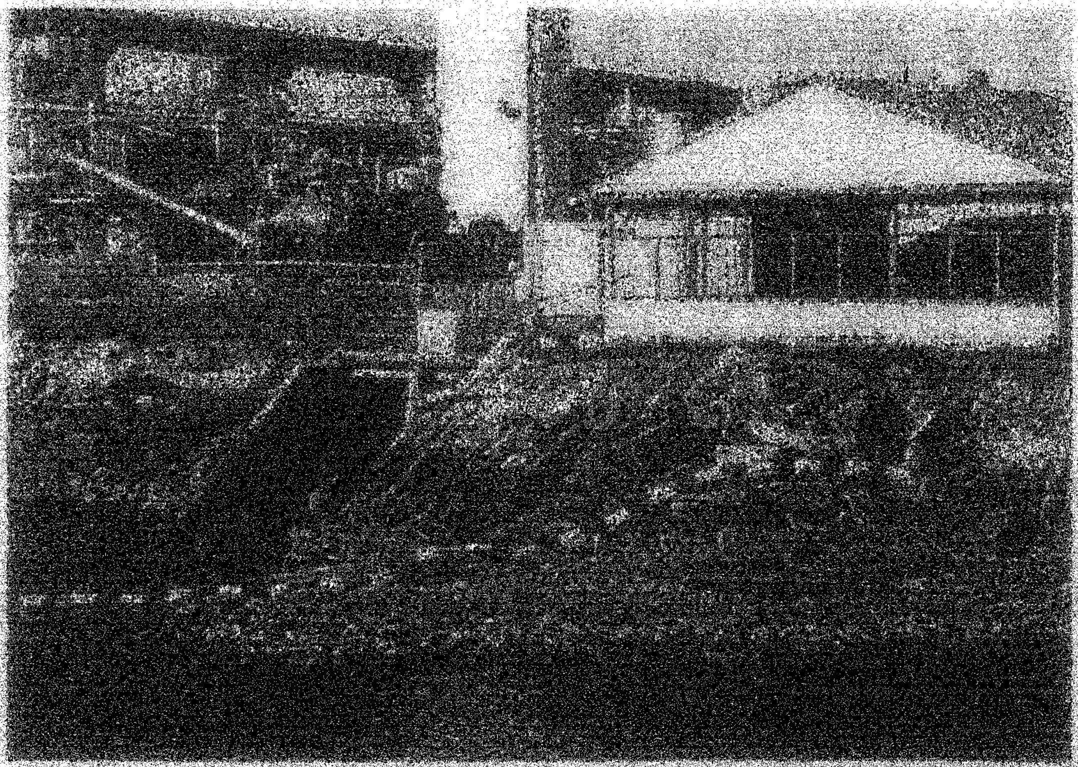
TRITON ENGINEERS, INC.

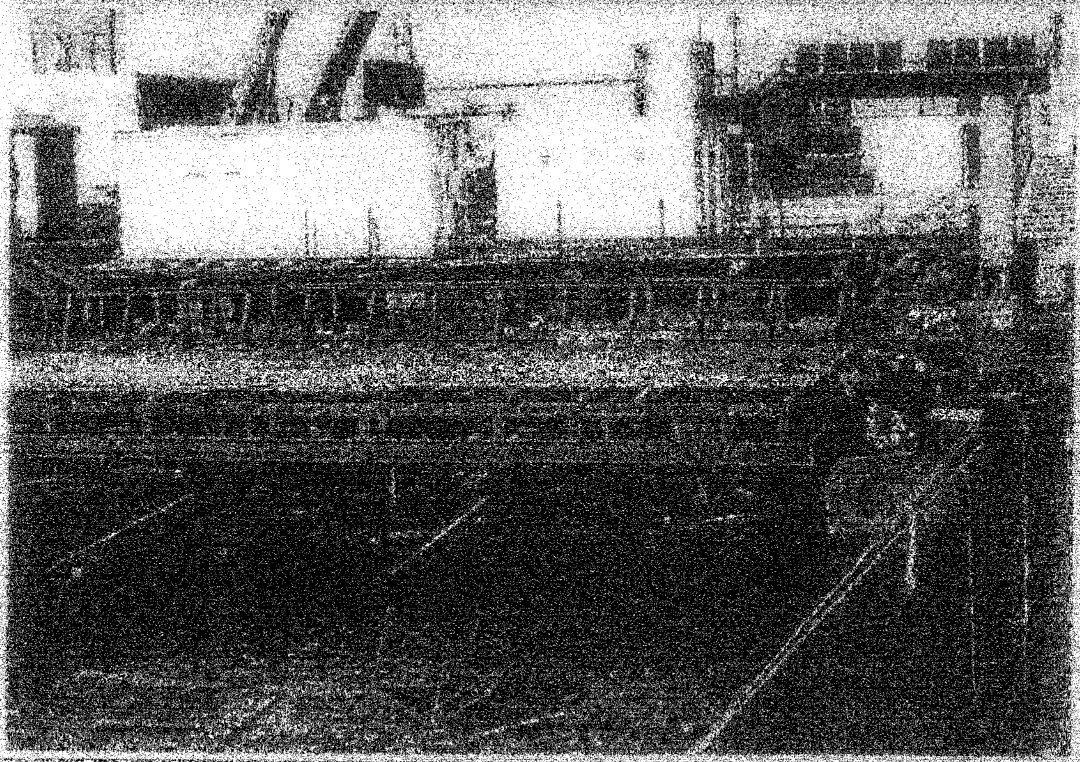
8315 Century Park Court, Suite 301
San Diego, California 92122
Tel: (619) 715-9732 Fax: (619) 874-2532

SOUTHWEST MARINE #33
QUAYWALL IMPROVEMENTS - PRELIMINARY ENGINEERING

INSPECTION PHOTOGRAPHS

Photograph No: P-2





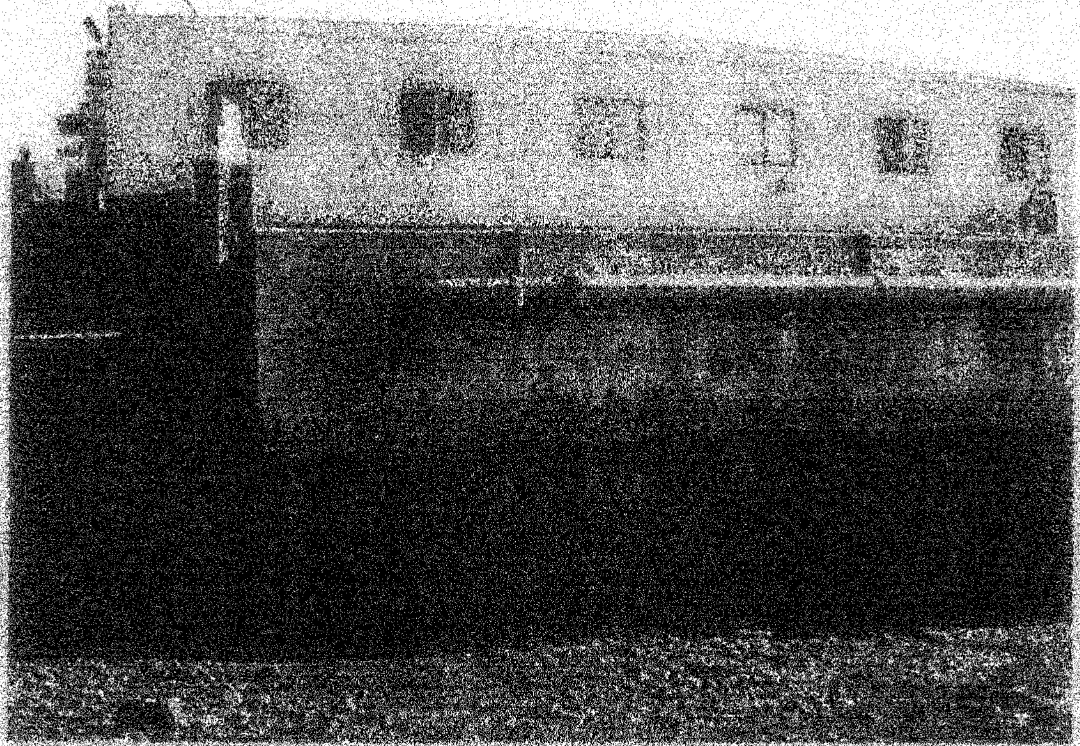
Description:	*Top Photo:*	SDG&E Power Plant cooling water outlet structure. SWM lunchroom to right. Note rubble at shoreline to be removed as part of development.
	Bottom Photo:	Remnants of abandoned ship cradles at Ways #1, low tide condition.

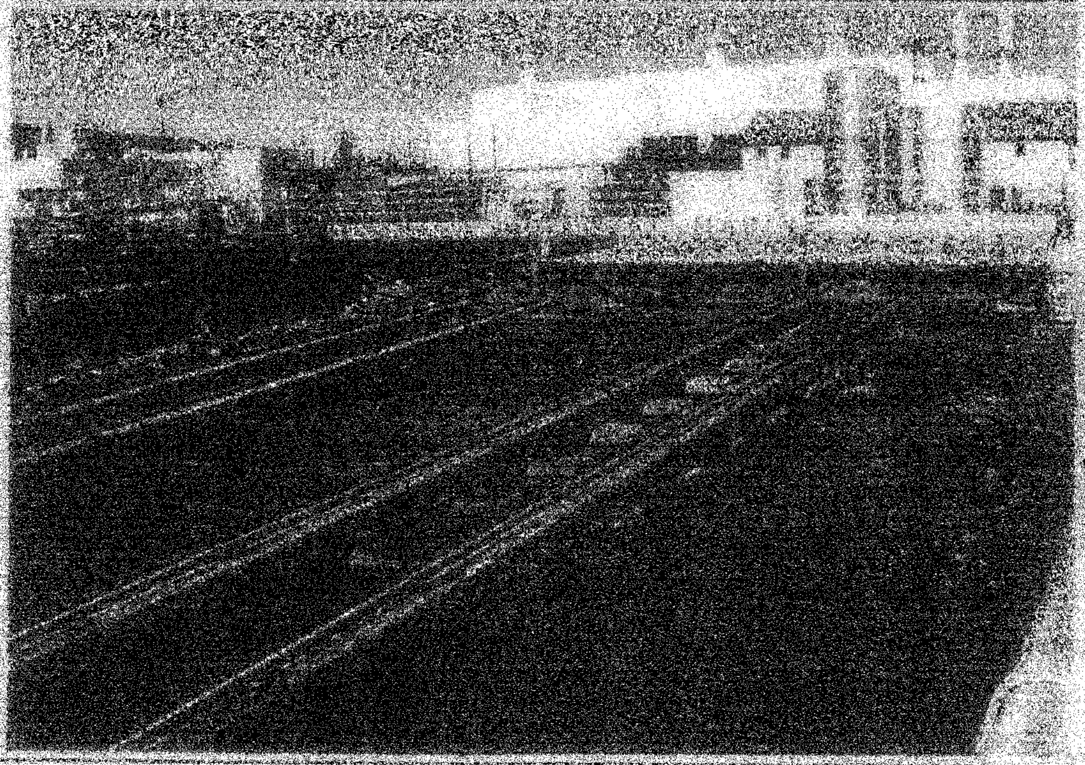
TRITON ENGINEERS, INC.
8315 Century Park Court, Suite 201
San Diego, California 92123
Tel: (619) 715-0722 Fax: (619) 874-2537

SOUTHWEST MARINE INC
QUAYWALL IMPROVEMENTS - PRELIMINARY ENGINEERING

INSPECTION PHOTOGRAPHS

Photograph No: P-3





Description: *Top Photo:* Bulkhead at south side of Way #3. Note 10 inch firemain attached to bulkhead which will require re-routing as part of development works.

Bottom Photo: Abandoned Marine Railways #2 (left) and #3 (right), at low tide. Note pedestrian bridge.

TRITON ENGINEERS, INC.

5515 Century Park Court, Suite 201
San Diego, California 92120
Tel: (619) 715-0722 Fax: (619) 874-2532

SOUTHWEST MARINE, INC.
QUAYWALL IMPROVEMENTS - PRELIMINARY ENGINEERING

INSPECTION PHOTOGRAPHS

ESSENTIAL FISH HABITAT ASSESSMENT
FOR THE
SOUTHWEST MARINE QUAY WALL EXTENSION PROJECT
SAN DIEGO BAY, SAN DIEGO, CALIFORNIA

Prepared for:

Southwest Marine, Inc.
Foot of Sampson Street
PO Box 13308
San Diego, CA 92170-3308
Phone: (619) 238-1000 x3900/2824
Attention: Scott McKay

Prepared by:

Merkel & Associates, Inc.
5434 Ruffin Road
San Diego, CA 92123
Phone: (858) 560-5465
Fax: (858) 560-7779

May 23, 2003

Keith W. Merkel
Keith Merkel, Principal Consultant

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ESSENTIAL FISH HABITAT ASSESSMENT
FOR THE
SOUTHWEST MARINE QUAY WALL EXTENSION PROJECT
San Diego Bay, San Diego, California

BACKGROUND

This assessment of Essential Fish Habitat (EFH) for the Southwest Marine, Inc Quay Wall Extension Project is provided in accordance with the 1996 amendments to the Magnuson-Stevens Fishery Management and Conservation Act (Federal Register 1997). The amendments require the delineation of "essential fish habitat" for all managed species. Federal action agencies which fund, permit, or carry out activities that may adversely impact EFH are required to consult with the National Marine Fisheries Service (NMFS) regarding the potential effects of their actions on EFH, and respond in writing to the NMFS's recommendations. The Southwest Region of the NMFS has requested an assessment of the potential effects of the Quay Wall Extension Project on EFH.

PROPOSED ACTION

Southwest Marine, Inc. (SWM) is planning to reconfigure a portion of their shipyard area currently occupied by two marine railways. This will be accomplished by constructing a new section of bulkhead (Quay Wall) across the face of the railways and placing materials behind the wall up to the elevation of surrounding grade. The placed materials will be a combination of imported fill aggregate and sediment removed from adjacent water areas of the shipyard.

The general location of the SWM shipyard is shown in Figure 1. To support ongoing business needs, SWM plans to reconfigure this area by constructing a new bulkhead wall (quay wall) across the face of two abandoned marine railways and placing material to bring the area up surrounding grade. The area will be paved to support shipyard operations. Additional design detail is found in the project description report (Anchor Environmental 2003).

Structural design documents (Triton Engineers, 2002) call for the new bulkhead wall to consist of steel or vinyl sheet piling, driven about 20 to 25 feet below existing mud line elevation. The sheet piling is designed to resist loads imposed on the wall by the imported material. Additional structural support will be provided by a series of tie rods that extend behind the wall into the retained fill. The tie rods will be connected to an interior sheet pile anchor wall that will be anchored into the underlying sub grade and fully buried within the fill. Figure 4 presents a generalized cross-sectional representation of these structural elements.

Approximately 9,000 cubic yards (cy) of imported soil will be required to fill the area behind the new bulkhead wall to the elevation of surrounding grades (about 12 feet MLLW). The material will be placed atop existing shipway sediments, which may be stabilized for construction purposes.

M&A#02-065-01

1" = 2,000'

Project Vicinity Map

Source: USGS 7.5' La Jolla, CA Quadrangles

Figure 1

Merkel & Associates, Inc.

EXISTING HABITAT CONDITIONS

SURVEY METHODS

On September 27, 2002 an in-water habitat investigation was conducted at Southwest Marine Shipyard site by Adam Behle and Megan Johnson of Merkel & Associates, Inc. The investigation consisted of an eelgrass density and areal coverage assessment, a survey of in-water fish habitats, a preliminary survey for *Caulerpa taxifolia*, as well as a compilation of marine fauna observed within the study areas.

To evaluate eelgrass coverage, baselines were established along the SWM shoreline. Transects were then spaced at 25-foot intervals along the baselines and were extended perpendicularly from the baselines into the bay. Eelgrass beds were measured using standard line-intercept transect methodology. A diver swam each transect line towing a fiberglass measuring tape and recorded the starting and ending points of each eelgrass bed. Measurements were taken until the diver reached a distance of approximately 150 feet away from the shipyard piers or until conditions were no longer appropriate for eelgrass growth.

During the course of the survey, eelgrass turion counts were conducted within a 1/16 m^2 quadrat in order to determine the density of actively growing turions within the eelgrass beds. The quadrat was randomly placed along each transect, within the eelgrass, to develop a mean density for the eelgrass beds of the entire study area.

The in-water habitat investigation was conducted by a diver who swam through the study area noting the various marine habitats present (*i.e.* eelgrass, unvegetated mud-bottom, and manmade structures (*i.e.* pier pilings, and bulkheads)). The diver then compiled a list of marine fauna observed within the different habitats during the investigation.

SURVEY RESULTS AND DISCUSSION

Survey results revealed total of three marine habitat types occurring within the SWM study area, including; eelgrass, unvegetated mud-bottom, and man made structures (*i.e.* pier pilings and bulkheads). Eelgrass was the predominant habitat found within the study area.

Study Area Eelgrass Beds

The eelgrass surveys revealed eelgrass beds extending from approximately –2 feet MLLW to as deep as approximately –15 feet MLLW. In total, 0.41 acres of eelgrass was found within study area. Most of the mapped eelgrass was found near the project site.

Eelgrass found within the survey area was separated into two distinct beds; a northern bed (approximately 14,462 square feet) and a southern bed (approximately 2,480 square feet) The beds were divided by the Pier 1 itself, which precluded eelgrass from growing directly underneath it due to continual shading. Eelgrass in this area formed mostly contiguous beds and appeared to be in relatively good health. The eelgrass shoots were green, tall in stature, and exhibited little epiphytic or sediment loading.

Shoot density within the study area eelgrass beds were calculated to be 109.3 ± 43.9 turions/m^2 (n=24) SD. This density is typical for this type of location, depth range, and season of the survey.

Study Area Caulerpa Surveys

No Caulerpa was detected during the site surveys. The well established *Sargassum muticum* and *Musculista senhousia* are common exotic species on site.

Unvegetated Mud-Bottom

The unvegetated mud-bottom habitat was characterized by a predominance of fine muds, and a lack of vegetation. This habitat showed some signs of burrowing invertebrate animals, like burrowing anemones. It is expected that the benthic invertebrate community within this area is similar to other non-vegetated areas of south-central San Diego Bay.

Man-Made Structures

The man-made structures found in the study areas included pier pilings and bulkheads associated with facilities utilized by Southwest Marine. These structures provided habitat to fouling communities dominated by encrusting sessile organisms, such as sponges, cnidarians, tunicates, hydroids, anemones, molluscs, and a suite of associated motile crustaceans. Fishes and macroinvertebrates observed in the study area included round stingrays, barred sandbass, and a horn shark. Man-made structures typically also support abundant and relatively diverse fish communities that may include, spotted sand bass, kelp bass, opaleye, staghorn sculpin, and topsmelt.

EFFECTS OF THE PROPOSED ACTION ON EFH

NMFS MANAGED ICHTHYOFAUNA PRESENT IN SAN DIEGO BAY

The ichthyofauna in the Port of San Diego has been previously studied (Merkel & Associates 2000a, Allen 1999, Hoffman 1994). These recent studies have identified 79 species of fish in San Diego Bay. The following analysis makes extensive use of Allen's (1999) data set because it is both recent and comprehensive (surveys were completed quarterly for five and a half years at four stations throughout San Diego Bay utilizing six sampling gear types). Survey results identified a total of 78 fish species. Other studies reviewed for this analysis are utilized to add support to the presence of fish species identified by Allen, and also to supplement to the species record for fishes not captured during the studies conducted by Allen.

Of the 79 species captured during surveys within San Diego Bay, 6 are managed by the NMFS under both of the Fishery Management Plans (FMPs); the Coastal Pelagics and Pacific Groundfish Management Plans (NMFS 1998a and b). Four of the five fishes managed under the Coastal Pelagics FMP are represented in San Diego Bay. Of these species, the northern anchovy and the pacific sardine are the most abundant pelagics identified by Allen; ranking 1st and 4th in abundance, and 3rd and 10th in biomass, respectively. Together, these two species accounted for 46.3% of the total abundance and 11.6% of the total biomass of fish enumerated by Allen (1999). The pacific mackerel and jack mackerel are the other two coastal pelagics of potential concern in the project area. These two species were much less abundant than the northern anchovy and pacific sardine, and were ranked by Allen as 32nd and 52nd in total abundance, and 24th and 73rd in total biomass, respectively. Together these two species accounted for less than 1% of total abundance and biomass of fish captured by Allen (1999).

Of the 81 species managed under the Pacific Groundfish FMP, two have been found in San Diego Bay during the studies analyzed for this assessment, including; the California scorpionfish and the English sole. These species were observed only rarely in San Diego Bay during the five and a half years of Allen's study, ranking 41st and 76th by abundance and 24th and 73rd by biomass, respectively. Together these two species accounted for less than 0.5% of the total abundance and biomass of fish captured (Allen 1999). The above listed information is summarized in Table 1 below.

Table 1. Table of NMFS managed fish species found in San Diego Bay.

Common Name	Scientific Name	Rank	
		Abundance	**Biomass**
Coastal Pelagics FMP			
Northern Anchovy	*Engraulis mordax*	1st	3rd
Pacific Sardine	*Sardinops sagax*	4th	10th
Pacific Mackerel	*Scomber japonicus*	32nd	17th
Jack Mackerel	*Trachurus symmetricus*	52nd	29th
Pacific Groundfish FMP			
California Scorpionfish	*Scorpaena gutatta*	41st	24th
English Sole	*Parophrys vetulus*	76th	73rd

* Rank refers to the relative rankings among the 78 fish species observed by Allen (1999). Ranks are total abundance and biomass, respectively.

POTENTIAL IMPACTS TO EFH AND NMFS MANAGED FISH SPECIES

Potential Impacts to EFH

Permanent Impacts

The primary permanent impact to EFH due to project implementation is the loss of shallow subtidal and intertidal water habitats. The filling of the shipway facilities will result in a loss of approximately 0.77 acres of intertidal and shallow subtidal water area. This increase in fill area will permanently impact all organisms within the fill site. Impacts due to support vessels on adjacent eelgrass habitat will be minimized through usage of an existing barge channel at the pier. Impacts to eelgrass are expected to result in the permanent loss of approximately 150 square feet of eelgrass from within the proposed fill footprint.

Temporary Impacts

Project activities that could temporarily affect the identified FMP species include shading from barges, bottom scouring from anchoring of barges and assist vessels, temporarily and localized increases in turbidity and sedimentation, dissolved oxygen depression associated with the disturbance of sulfidic anoxic sediments, and loss of fouling organisms from the shipways. Temporary impacts due to other construction impacts are considered to be short-term and would cease at, or shortly after, project construction completion.

Additional impacts to approximately 1,900 square feet of eelgrass may occur to eelgrass habitat occurring outside of the quay wall area as a result of barge positioning for sheetpile placement. This impact to eelgrass would be expected to be temporary.

Significant Impacts

Impacts to eelgrass habitat would be the only marine resource impacts considered significant due to project construction. A post-construction eelgrass survey will be conducted upon completion of the project to assess final impacts to eelgrass habitats and determine appropriate mitigation and/or restoration actions.

Potential Impacts to NMFS Managed Fish Species

In relation to the pelagic fish species listed in Table 1, impacts due to project implementation would be relatively minor. Coastal pelagic fishes by nature have low site fidelity, and given the small area of the project site, interruptions causing pelagic fishes to move into other areas would not cause biologically significant increases in competition due to habitat loss. In fact, the disturbance of invertebrate organisms residing on and around the current structures may provide for a transitory increase in availability of forage items for pelagic as well as other fish species. The proposed project would not impede the spawning success of the coastal pelagics, nor cause disturbances that increase predation.

The groundfish species in listed in Table 1 are comparatively uncommon in the project area. Only one English sole was recorded in the five years of data collected by Allen (1999). Moreover, this species was not observed during other fisheries studies within San Diego Bay (Emmett et al. 1991, Merkel & Associates 2000a, Hoffman 1994). As a result of the rarity of this species within the bay, project impacts on this species are not probable because fish are not likely to be present near the project site on a regular enough basis for impacts to be considered meaningful on a population level. California scorpionfish are rare compared to other pelagic species listed in Table 1; but, because of this species' high fidelity to structured habitats such as pile fields and reefs, it is likely under-represented in most fish sampling efforts. From the information available and the habitat characteristics of this species, impacts to California scorpionfish would be likely due to boat anchoring, and other construction activities that would likely cause fish to flee the immediate disturbance. However, this species would likely continue to remain in the area to capitalize on the exposure of forage resources due to construction disturbance. The spawning success of California scorpionfish would not be affected due to pelagic spawning of this species and buoyancy of the eggs.

LITERATURE CITED

Allen, L.G. 1999. Fisheries inventory and utilization of San Diego Bay, San Diego, California. Final report. Nearshore Marine Fish Research Program, Department of Biology, California State University, Northridge.

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Merkel & Associates. 2000. South Bay Power Plant cooling water discharge channel fish community characterization study. April 1997 through January 2000 final report. June 2000.

[NMFS] National Marine Fisheries Service. 1998a. Essential fish habitat: new marine fish habitat conservation mandate for federal agencies. National Marine Fisheries Service Southwest Regional Office.

[NMFS] National Marine Fisheries Service. 1998b. Essential fish habitat coastal pelagic species. Modified from: Coastal pelagics species fishery management plan [Amendment 8 to the northern anchovy fishery management plan]. See http://swr.ucsd.edu/

[US Navy] US Navy SWDIV Naval Facilities Engineering Command, Port of San Diego. 1994. San Diego Bay 1993 eelgrass survey.

Caulerpa Survey Reporting Form
(Version 1.0, September 18, 2001)

This form is required to be submitted for any surveys conducted for the invasive exotic alga *Caulerpa taxifolia* that are required to be conducted under federal or state permits and authorizations issued by the U.S. Army Corps of Engineers or Regional Water Quality Control Boards (Regions 8 & 9). The form has been designed to assist in controlling the costs of reporting while ensuring that the required information necessary to identify and control any potential impacts of the authorized actions on the spread of *Caulerpa*. Surveys required to be conducted for this species are subject to modification through publication of revisions to the *Caulerpa* survey policy. It is incumbent upon the authorized permittee to ensure that survey work is following the latest protocols. For further information on these protocols, please contact: Robert Hoffman, National Marine Fisheries Service, (562) 980-4043, or William Paznokas, California Department of Fish & Game, (858) 467-4218).

Site Name: (common reference)	Southwest Marine Piers 1 and 5, located at the foot of Sampson St., San Diego CA.
Survey Contact: (name, phone, e-mail)	Adam H. Behle, (858) 560 5465, abehle@merkelinc.com
Permit Reference: (ACOE Permit No., RWQCB Order or Cert. No.)	ACOE Application for Quay Wall Pending
Hydrographic System: (bay, estuary, lagoon, or harbor)	San Diego Bay
Specific Location: (UTM, Lat./Long., datum, accuracy level, attach electronic survey area map if possible)	UTM NAD 83 coordinates: Pier 1 N 3617188.6 E 486388.0 Pier 5 N 3616959.6 E 486604.2
Was *Caulerpa* Detected: (if *Caulerpa* is found, please immediately contact the permitting agency project staff and NMFS or CDFG personnel identified above)	____________ **Yes, Caulerpa was found at this site and** ____________ **has been contacted on** ________ **date.** _____X_____ **No, Caulerpa was not found at this site.**

Description of Permitted Work: (describe briefly the work to be conducted at the site under the permits identified above)	Construction will involve the demolition and removal of 185 linear feet of wooden pier and associated pilings, beams, and sub-structures and replacement with a new reinforced concrete section.	
Description of Site: (describe the physical and biological conditions within the survey area at the time of the survey and provide insight into variability, if known. Please provide units for all numerical information).	*Depth range:*	0-25 feet MLLW
	Substrate type:	mud, shell hash
	Temperature:	66 degrees Fahrenheit
	Salinity:	
	Dominant flora:	Eelgrass (*Zostera marina*)
	Dominant fauna:	Typical fauna included encrusting sessile organisms, such as sponges, cnidarians, tunicates, hydroids, anemones, molluscs, and crustaceans.
	Exotic species encountered:	Sargassum (*Sargassum muticum*) Musculista (*Musculista senhousia*)
	Other site description notes:	A deep channel is present on the north side of Pier 1 that gradually decreases in depth heading further north. Many remnants of man made structures and debris present throughout the site, including, wood piers, steel rails, bulkheads, and tires.
Description of Survey Effort: (please describe the surveys conducted including type of survey (SCUBA, remote video, etc.) and survey methods employed, date of work, and survey density (estimated percentage of the bottom actually viewed). Describe any limitations encountered during the survey efforts.	*Survey date and time period:*	September 27, 2002 from approximately 1200 to 1630.
	Horizontal visibility in water:	Ranged from 5-15 feet.
	Survey type and methods:	SCUBA was used to perform transects spaced 25 feet apart from a baseline established on the existing pier.

	Survey personnel:	Adam H. Behle, Megan R. Johnson
	Survey density:	60%
	Survey limitations:	While the survey location is present in an active ship yard, boats and general construction activity did not limit the survey effort.
Other Information: (use this space to provide any additional information or references to attached materials such as maps, reports, etc.)		

Caulerpa Survey Reporting Form (version 1.0, 9/18/01)

APPENDIX B

STANDARD OPERATING PROCEDURES FOR WELL-POINT SAMPLING

ANCHOR ENVIRONMENTAL, L.L.C.

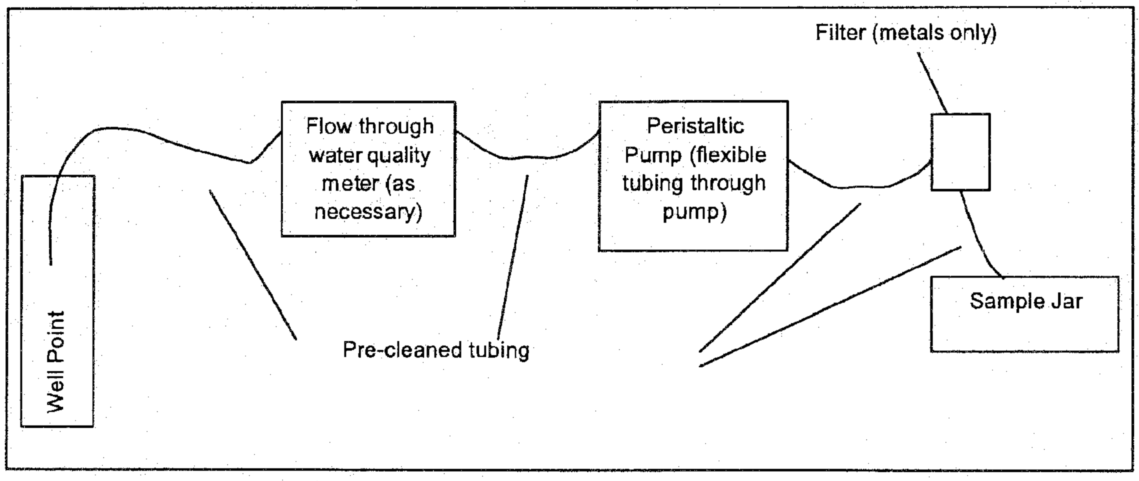
1423 3rd Avenue, Suite 300
Seattle, Washington 98101
Phone 206.287.9130
Fax 206.287-9131
www.anchorenv.com

STANDARD OPERATING PROCEDURES FOR WELL-POINT SAMPLING

SOUTHWEST MARINE BULKHEAD EXTENSION – JUNE 2004 SAMPLING EVENT

Groundwater sampling will be conducted at the Southwest Marine Bulkhead Extension site to determine the physical and chemical properties of groundwater within existing site sediments. The focus of this SOP is to document procedures that will be used to sample groundwater at the Bulkhead Extension site, which is adjacent to and tidally influenced by marine waters of San Diego Bay. Temporary well points will be used to obtain the groundwater samples, which will be analyzed to provide a measure of groundwater quality at the site. The temporary well points can be positioned in the field to intercept preferential groundwater flow pathways, and can be placed in positions that are most representative of sediments that will remain in-place after the bulkhead extension is constructed. The well point installation and sampling procedures described below will allow collection of representative low turbidity samples that are comparable to samples obtained from permanent groundwater sampling devices or wells.

A schematic to depict the basic chain of equipment through which the water sample passes from the well point to the sample jar is provided below.



Suggested Data Form

Water Collection Form: Water Quality Monitoring saved at I/administrative/forms/field documentation/Continuous_Water_Measure_Form2.doc

Equipment Needed

- Pre-cleaned well-point samplers (preferably acid washed at laboratory)
- Hand auger, shovel, or fence post driver
- Peristaltic pump with power source (e.g., car battery)
- Pre-cleaned flexible silicon tubing of adequate diameter to go through peristaltic pump (sufficient tubing should be purchased such that dedicated tubing is available for each well point sample collected)
- Pre-cleaned tubing (sufficient tubing should be purchased such that dedicated tubing is available for each well point sample collected)
- Connectors for attaching lengths of tubing, as necessary
- Gelman filters (for dissolved metals analysis)
- Hand-held pH and conductivity meter
- Container of known volume (preferably one liter or quart)
- Stop watch or wrist-watch with a second hand
- Waste containers if purge water needs to be collected
- Decon/cleanup equipment such as gloves, paper towels, etc.
- Cooler/ice/sample jars/ labels
- Site map to record measured sampling locations

Procedures

1. Equipment Decontamination: Well points should be sent to the laboratory for acid washing prior to sampling. In addition, all tubing should, at a minimum, be decontaminated with a phosphate-free detergent (e.g. Alconox) and rinsed thoroughly with distilled water prior to sampling.
2. Prior to sampling well points, it is recommended that distilled water and equipment/filter blanks be collected in order to document that clean tubing and Gelman filters were used. Equipment/filter blanks are prepared by pumping distilled water through the tubing and filter into a sample jar.
3. Well points are positioned by driving the point and any required risers with a fence-post driver into the sediment, or if conditions permit, hand pushing the well point into the

sediment. The well point, consisting of a 1-foot-long pre-cleaned stainless steel assembly with screen section, will be lowered into the hole, will be pushed into the sediment so that the top of the screen section is approximately 0.5 feet or more below the mudline surface.

4. Assemble the equipment as shown in the schematic. Pre-cleaned tubing should be long enough to extend from the base of the installed well point to the peristaltic pump. Lower the tubing into the well point to a depth that is under water but not at the very bottom (to avoid high turbidity). Connect the tubing to the flow through water quality meter and then to the peristaltic pump. The peristaltic pump will require a more flexible and larger diameter tubing. Another piece of tubing should be connected between the peristaltic pump and the sample jars. For collection of dissolved metals samples, a Gelman filter will be attached to the end of the tubing.
5. Prior to collecting the sample, each well point must be developed by lowering pre-cleaned tubing into the well point and withdrawing water using a peristaltic pump operated at a relatively low rate (determined in the field) to reduce turbidity. The peristaltic pump will remove at least three pore volumes from the well points prior to sampling or until the water runs clear of particulate matter (less than 50 nephelometric units [NTUs]), whichever is longer. The pore volume is the volume of the well point cylinder. If the well point becomes dry during removal of these initial three pore volumes, then the subsequent recharge water may be sampled. **Note:** If necessary, all purge water obtained from the well points should be collected, contained, and stored in PVC drums and then properly disposed of depending upon the chemical results.
   a. While developing the well point and removing pore volumes, record water quality parameters (pH and conductivity at a minimum) during at least every pore volume. Starting at time=0 when the well point is initially developed, take water quality readings every 2 to 3 minutes and record at least three rounds of readings before collecting the samples. Water quality parameters have stabilized when three consecutive readings meet the following criteria:
      - pH ± 0.1 unit
      - Conductivity ± 10 percent
   b. While developing the well point and removing pore volumes, measure and record how long it takes to fill a container of known volume in order to get the flow rate.

8. After developing the well point, fill sample jars and record observations of odor, sheen, discoloration, or floating materials.
9. Record the sampling location using either GPS coordinates or by measuring offset from existing, previously surveyed site features.
10. Remove the well points following sample collection.

APPENDIX C

ANALYSIS OF TIDAL MIXING BEHIND BULKHEAD

This appendix presents an analysis of mixing between sediment pore water and tidal surface waters from San Diego Bay at the Southwest Marine (SWM) Bulkhead Extension project site. This analysis applies specifically to a sand "buffer" that will be constructed along the interior side of the new bulkhead, between the bulkhead and chemically impacted sediments that are present within the project footprint. Existing impacted sediments will be relocated from immediately adjacent to the bulkhead, to a position farther shoreward within the project area; and imported sand backfill will be placed back in the area from which the sediment was removed. See the accompanying Data Evaluation Report for more detail on the construction of this sand buffer.

The analysis presented herein demonstrates that the sand buffer will prevent sediment pore water (and its associated chemical concentrations) from infiltrating directly into site surface waters. Rather, the sand buffer will cause the pore water to mix with San Diego Bay surface water as the surface water regularly flushes into and out of the sand buffer as a result of tidal forces. The volume of surface water entering the constructed sand buffer is expected to exceed the volume of infiltrating pore water by a factor of at least 400. The sand buffer is therefore expected to cause a proportionate 400-fold reduction in dissolved chemical concentrations from the pore water before it enters site surface waters. Because this analysis used several conservative assumptions, the actual degree of mixing and reduction is expected to more significant than predicted.

Pore water within existing impacted sediments at the SWM Bulkhead Extension will migrate bayward under the local groundwater flow gradient. This pore water will pass through a clean fill buffer that is constructed behind the sheetpile bulkead, and will then pass through and/or beneath the bulkhead sheetpiling, before reaching site surface waters (San Diego Bay). The clean fill buffer will be created by excavating existing impacted sediments to a depth of 6 feet along the length of the bulkhead. (See Figure 4 of the main body of this Report for an illustration of this buffer.) The excavated sediments will be moved further back (shoreward) from the bulkhead, and the excavated trench backfilled with free-draining, sand and gravel fill material. The full width of this trench will be approximately 20 to 25 feet, depending on the inclination of the side slope.

Sediment pore water will infiltrate the clean sand buffer on the shoreward edge of the buffer, and tidally-influenced surface water will infiltrate through its bayward (bulkhead) side. As such, both water sources will enter the sand buffer and undergo mixing. Chemical concentrations in the sediment pore water will be reduced as a result of this mixing, prior to flowing into the surface waters beyond the bulkhead.

The relative proportions of sediment pore water and tidally-influenced surface waters have been estimated as follows:

Rate of Sediment Pore Water Infiltration into Sand Buffer. Pore water volumetric flow rate (Q, in cubic square feet [cfs]) is calculated using the following formula:

$Q=kiA$

Where:

k = Horizontal hydraulic conductivity (feet/second)
i = Hydraulic groundwater gradient (feet vertical head change per feet lateral distance)
A = Area through which flow occurs (square feet)

At this site the following values are applied:

k = 1 x 10^{-5} feet/second, consistent with the sandy silt sediment through which groundwater flows (prior to its entry into the sand buffer).

i = 0.04, based on the vertical change in the groundwater level that is expected over the length of the filled yard improvement area. The local groundwater table has typically been observed at elevations ranging from 8.5 to 15 feet below current ground surface (ENV America, 2002, and Christian Wheeler, 2002), which, given current surface grades of about +12 feet MLLW, translates into elevations ranging from +3.5 feet to -3 feet. For the purposes of this analysis, a long-term average groundwater elevation of +2 feet MLLW is conservatively assumed. At low tide, the gradient is expected to be highest, so a tidal elevation of -2 feet MLLW has been conservatively used for this analysis. Thus the water surface elevation will undergo a 4-foot drop from elevation +2 feet to -2 feet. If this occurs over a 100-foot distance (half the length of the yard improvement area), the resulting hydraulic gradient would be 4 feet over a lateral distance of 100 feet, which equates to 0.04. Note that the presence of the newly installed sheetpile bulkhead across the project site will likely make the gradient even smaller, since it will restrict tidal inflow and outflow.

A = 6 square feet. This represents the cross-sectional area of a unit linear foot of the sand buffer, which measures 1 foot x 6 feet perpendicular to the direction of the pore water flow.

The resulting calculation of pore water inflow to the sand buffer is:

$Q = (1 \times 10^{-5}\ \text{feet/second})(0.04)(6\ \text{square feet}) = 2.4 \times 10^{-6}\ \text{cfs}$

Rate of Surface Water (Tidal) Inflow into Sand Buffer. This calculation assumes that the full pore volume of the sand buffer experiences full volume exchange in response to tidal action. Typically, this volume exchange would likely occur over a period of a few hours or less, given the relatively small pore volume of the sand buffer and its proximity to tidal waters. Factoring the newly installed, low-permeability sheetpile wall, the rate of tidal change inside the sand buffer will be lessened. A 6-hour period (the length of time between extreme tides) has been conservatively selected for this analysis as the duration of tidal exchange within the buffer. Hence, over the 6-hour period between low and high tides, the total pore volume of the sand buffer is assumed to undergo full water exchange. The volumetric flow rate is calculated using the formula:

$Q = V/t$

Where:

V = Pore volume of sand buffer. Assuming a unit linear foot of sand buffer, and the sand buffer geometry shown on Figure 4, the total buffer volume is 75 cubic feet. Furthermore, assuming a porosity of 0.3 (appropriate for free-draining sand fill), the pore volume is 0.3 x 75 = 22.5 cubic feet.

T = 6 hours, or 21,600 seconds.

The resulting calculation of tidal water inflow to the sand buffer is:

$Q = 22.5\ \text{cubic feet}/21{,}600\ \text{seconds} = 1.0 \times 10^{-3}\ \text{cfs}$

Quantitative Mixing of Sediment Pore Water and Tidal Surface Water. The relative inflow rates of tidal surface water and infiltrating sediment pore water are as follows:

Inflow rate of tidal surface water	1 x 10^{-3} cfs
Inflow rate of sediment pore water	2.4 x 10^{-6} cfs
Ratio between tidal surface water to sediment pore water	**416**

This is the degree by which tidal surface water influence in the sand buffer is predicted to exceed the influence of pore water infiltrating from adjacent sediment.

Again, it is expected that this number represents a lower bound on the true degree of mixing that will be experienced. Most significantly, this analysis likely overpredicts the groundwater flow gradient (thus overestimating pore water flow into the sand buffer), and underpredicts the rate at which the sand buffer will undergo tidal porewater exchange (thus underestimating the rate at which tidal water enters the sand buffer). Both of these assumptions lead to a lowered estimation of mixing ratio.

References

Christian Wheeler, 2002. Geotechnical Recommendations and Design Criteria, Proposed Quay Wall Construction Project, Southwest Marine Facilites, San Diego, California. Prepared for Triton Engineers. April 4, 2002.

ENV America, 2002. Work plan for Site Assessment, Former Wastewater Ponds, Silver Gate Power Plant. Prepared for San Diego Gas & Electric Company, August 21, 2002.

To: Shaun Hal...

US Army Corps of Engineers®

PUBLIC NOTICE

APPLICATION FOR PERMIT

LOS ANGELES DISTRICT

Public Notice/Application No.: 199915091-SKB
Comment Period: September 7 through September 28, 2000
Project Manager: Shannon K. Bryant (858) 674-6784 sbryant@spl.usace.army.mil

Applicant	**Contact**
Southwest Marine	Mr. Sandor Halvax
Attn: Mr. Sandor Halvax	(619) 238-1000 X2060
Foot of Sampson Street	
P.O. Box 13308	
San Diego, California 92170-3308	

Location
At the foot of Sampson Street west of Harbor Drive in San Diego Bay in the City of San Diego, San Diego County, California (see attached figures 1 and 2).

Activity
To remediate sediments contaminated with elements as indicated on pages 2 and 3 of this PN per Waste Discharge Requirements (WDR) approved by the California Regional Water Quality Control Board (RWQCB) including dredging approximately 25,000 cubic yards (cy) of sediment from several shipyard locations approximately 2.49 acres (ac), repairing riprap in dredge Area 1 and 2 if necessary, and upgrading of Pier 1 that incorporates the fill of 0.77 ac of the bay adjacent to Pier 1 on the north and south sides for additional upland service area (see attached drawings). For more information see page 3 of this notice.

Interested parties are hereby notified that an application has been received for a Department of the Army permit for the activity described herein and shown on the attached drawing(s). Interested parties are invited to provide their views on the proposed work, which will become a part of the record and will be considered in the decision. This permit will be issued or denied under Section 10 of the Rivers and Harbors Act of March 3, 1899 (33 U.S.C. 403) and Section 404 of the Clean Water Act of 1972 (33 U.S.C. 1344). Comments should be mailed to:

U.S. Army Corps of Engineers, Los Angeles District
Regulatory Branch
ATTN: CESPL-CO-R-199915091-SKB
P.O. Box 532711
Los Angeles, California 90053-2325

Alternatively, comments can be sent electronically to: sbryant@spl.usace.army.mil

Evaluation Factors

The decision whether to issue a permit will be based on an evaluation of the probable impact including cumulative impacts of the proposed activity on the public interest. That decision will reflect the national concern for both protection and utilization of important resources. The benefits that reasonably may be expected to accrue from the proposal must be balanced against its reasonably foreseeable detriments. All factors that may be relevant to the proposal will be considered including the cumulative effects thereof. Factors that will be considered include conservation, economics, aesthetics, general environmental concerns, wetlands, cultural values, fish and wildlife values, flood hazards, flood plain values, land use, navigation, shoreline erosion and accretion, recreation, water supply and conservation, water quality, energy needs, safety, food production and, in general, the needs and welfare of the people. In addition, if the proposal will discharge dredged or fill material, the evaluation of the activity will include application of the EPA Guidelines (40 CFR 230) as required by Section 404 (b)(1) of the Clean Water Act.

The Corps of Engineers is soliciting comments from the public; Federal, state, and local agencies and officials; Indian tribes; and other interested parties in order to consider and evaluate the impacts of this proposed activity. Any comments received will be considered by the Corps of Engineers to determine whether to issue, modify, condition or deny a permit for this proposal. To make this decision, comments are used to assess impacts on endangered species, historic properties, water quality, general environmental effects, and the other public interest factors listed above. Comments are used in the preparation of an Environmental Assessment and/or an Environmental Impact Statement pursuant to the National Environmental Policy Act. Comments are also used to determine the need for a public hearing and to determine the overall public interest of the proposed activity.

Preliminary Review of Selected Factors

EIS Determination- A preliminary determination has been made that an environmental impact statement is not required for the proposed work.

Water Quality- The applicant is required to obtain water quality certification, under Section 401 of the Clean Water Act, from the California Regional Water Quality Control Board (RWQCB). Section 401 requires that any applicant for an individual Section 404 permit provide proof of water quality certification to the Corps of Engineers prior to permit issuance. The applicant received a Section 401 waiver from the RWQCB on March 10, 2000. Only for the dredging

Additionally, the RWQCB directed Southwest Marine (SWM) to develop a site sediment characterization and remedial action work plan to address potentially elevated chemical concentrations in sediments adjacent to the facility. A preliminary sediment characterization of the proposed area identified copper, lead, mercury, zinc, and polychlorinated biphenyls (PCBs) as indicator chemicals of concern. An extensive assessment of these contaminants was initiated in 1998 and completed in 1999. As a result of the assessment, the RWQCB issued Resolution No. 99-12 on March 10, 2000, that requires SWM to remediate soil and sediments to interim specified shipyard sediment cleanup levels. As part of that remediation, as much as 25,000cy of contaminated sediment removal ~~is~~ may be required from San Diego Bay.

Coastal Zone Management- The applicant has certified that the proposed activity complies with and will be conducted in a manner that is consistent with the approved State Coastal Zone Management Program. This proposed project is located within the San Diego Unified Port District (SDUPD) tidelands and is subject to the SDUPD certified Coastal Zone Master Plan. The SDUPD issued a Coastal Development Notice of Exemption for the proposed project October 22, 1997.

portion of the project.

Cultural Resources- The latest version of the National Register of Historic Places has been consulted and this site is not listed. This review constitutes the extent of cultural resources investigations by the District Engineer, and he is otherwise unaware of the presence of such resources.

Endangered Species- Preliminary determinations indicate that the proposed activity would not affect federally-listed endangered or threatened species, or their critical habitat. Therefore, formal consultation under Section 7 of the Endangered Species Act does not appear to be required at this time.

Public Hearing- Any person may request, in writing, within the comment period specified in this notice, that a public hearing be held to consider this application. Requests for public hearing shall state with particularity the reasons for holding a public hearing.

Proposed Activity for Which a Permit is Required

210'

To dredge 25,000 cy of sediment from six separate shipyard locations (approximately 2.49 ac of the total leasehold water area of 17 ac with a 1 ft overdredge allowance), stabilize approximately 40 linear (lf) of riprap shoreline in dredge Area 1 and approximately 150 lf in dredge Area 2 as needed (only riprap that is inadvertently dredged or that slumps into space previously occupied by sediments will be replaced), and upgrade approximately 175 linear feet of Pier 1 which incorporate the fill of 0.77ac (7,500 cy of waters of the United States below the annual high tide line at +7.78 ft MLLW; 12,500 cy total) for additional upland service area at the base of Pier 1 in San Diego Bay (see attached figures).

Additional Project Information

?

Southwest Marine (SWM) has been a working shipyard since the early 1900's and provided ship repair, conversion, construction, and maintenance. To perform the dredging along the piers and under the dry dock, the ship berths must be empty. Therefore, SWM is limited on the times of year the proposed dredging may be performed.

The dredging of the remediation sites will be performed with a mechanical, clamshell bucket that has a tight seal to minimize turbidity in areas with no obstructions and high solids eddy-flow suction dredging will be used under piers or in the vicinity of underwater obstructions (e.g., marine railways). In addition, a silt curtain shall be employed and placed at a minimum distance of 25 ft from the dredging operations to limit turbidity to the immediate work area, potential impacts to foraging birds, and to minimize impacts to an area of patchy, low-density eelgrass (*Zostera marina*) located offsite approximately 50 ft north of the SWM leasehold. The proposed dredge locations range in bathymetry from intertidal to a depth of approximately 70 ft adjacent to the Southwest Marine drydock.

The dredged material shall be placed on a barge, and transferred onsite to a temporary dewatering facility at the corner of Sampson and Main Streets. In addition, the proposed facility shall be bermed and lined to prevent excess water from returning to the bay. When the sediment is sufficiently dry, the material will be hauled to an approved upland disposal site.

No

The depth of dredging will vary from location to location between 3 to 9 feet below the existing bay bottom based on the results of the chemical testing program conducted at the facility. The tip elevations of the pilings supporting structures vary from -54 to -89 ft MLLW. Therefore, the pilings appear to be driven to a sufficient depth to prevent failure due to the dredging operation. However, the southern area of the proposed project site has a rock revetment that may fail as a result of deepening the bay bottom. If failure occurs, the applicant proposes to place additional rock on the exposed area for a distance not anticipated to exceed 100 linear feet (lf).

The applicant proposes to dredge in phases to a maximum of 3 phases within each remediation area. Each phase will be completed to the bottom of a core- sampling stratum and followed by confirmation sampling. Phase 1 will consist of dredging the top 2 ft of sediment from all remediation areas. Phase 2 will consist of dredging the next 2 ft of sediment. Phase 3 will remove sediment down to 8 ft or to the Bay Point Formation. Confirmation sampling will follow each phase to verify that sediment exceeding the interim sediment cleanup levels established in WDR 99-12 has been removed.

NO!

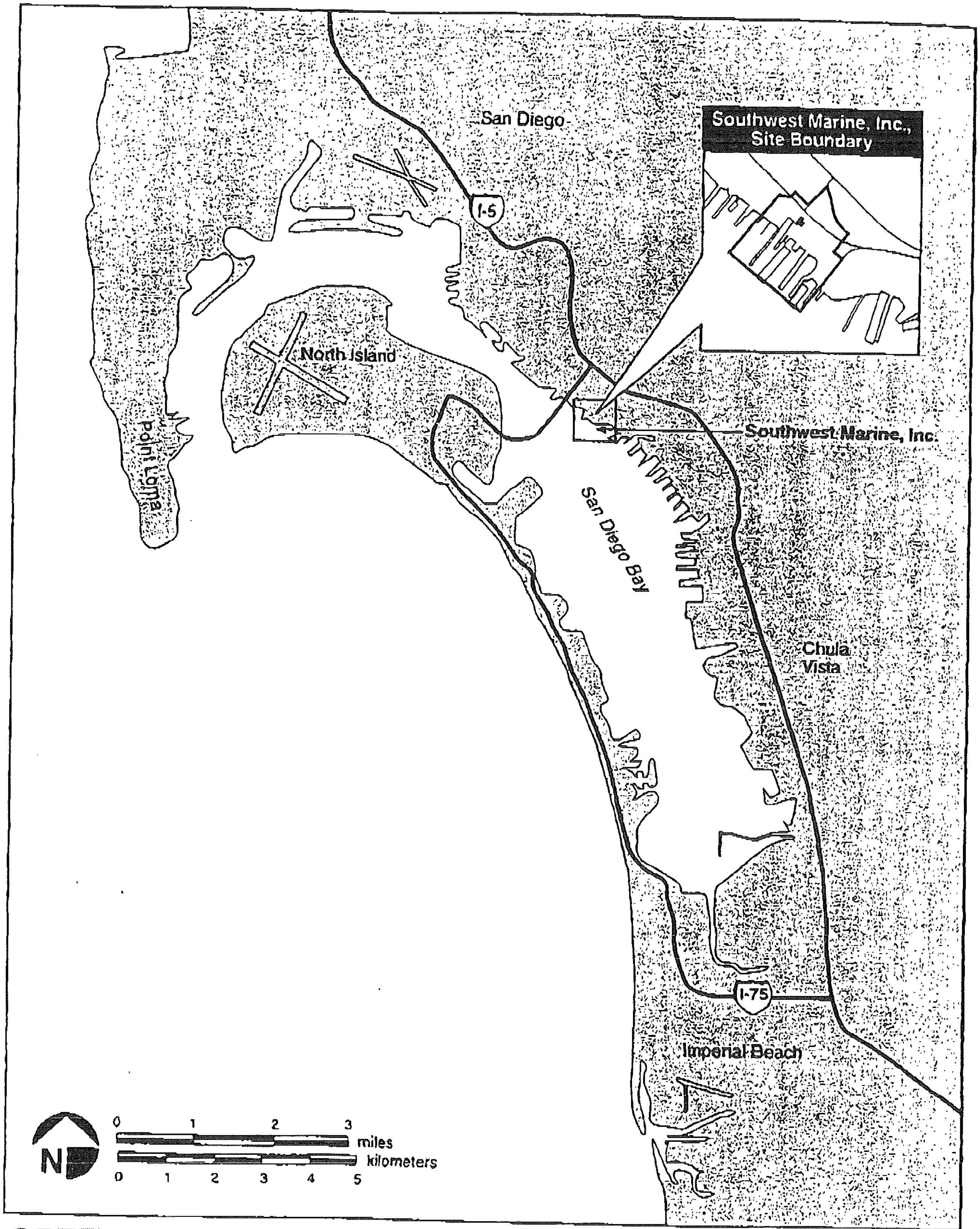
The proposed improvements to Pier 1 and fill to be placed in the nearshore water area on the north and south sides of Pier 1 shall be conducted after the dredging is completed. The improvements include demolition and removal of old, wood sections of the pier and approximately 90 piles (18 inch timber or 16 inch concrete), steel "H" beams and rail line, and replacement with a new concrete causeway, and addition of approximately 50 concrete, 20-inch piles. The fill material will be sand that the applicant proposes to get from the La Paz county Landfill in Arizona, which has been used as fill at SWM in the past. Also, the retrofit will include the construction of a storm water diversion system on the pier to divert storm water to an existing collection system at the facility.

The historical use of the area around Pier 1 is heavy marine industrial and similar uses are planned. The applicant requests comments for a wetlands development project to mitigate for the proposed impacts in this area. The applicant is considering the Tijuana Estuary Project.

Proposed Special Conditions

The permitee understands and agrees that, if future operations by the United States require the removal, relocation, or other alteration, of the structure or work herein authorized, or if, in the opinion of the Secretary of the Army or his authorized representative, said structure or work shall cause unreasonable obstruction to the free navigation of the navigable waters, the permittee shall be required, upon due notice from the Corps of Engineers, to remove, relocate, or alter the structural work or obstructions caused thereby, without expense to the United States. No claim shall be made against the United States on account of any such removal or alteration.

For additional information please call Ms. Shannon K. Bryant of my staff at (858) 674-6784. This public notice is issued by the Chief, Regulatory Branch.

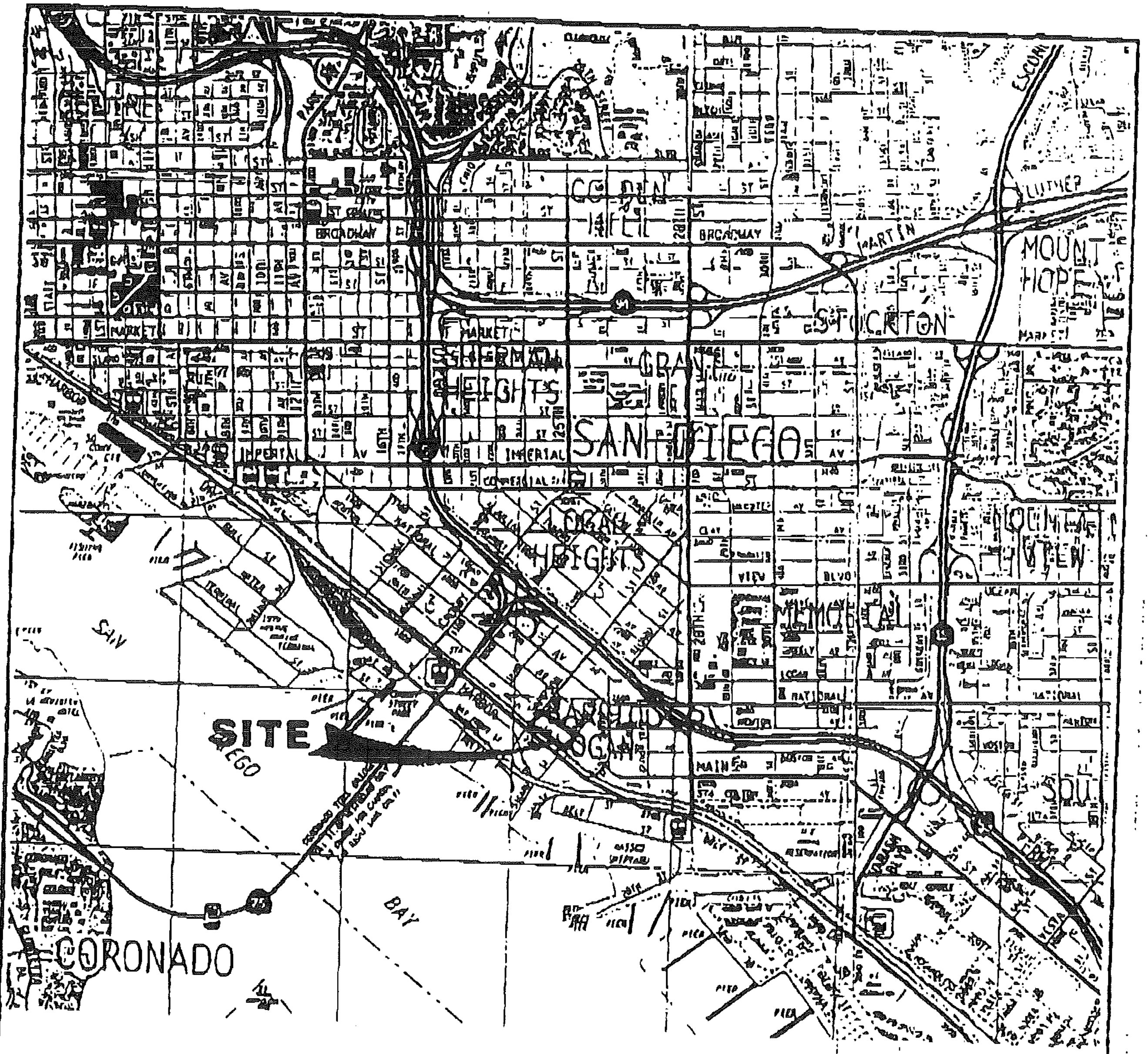


OGDEN

Regional Location of Project Site

FIGURE 1

Bioassay/SWM/Site Location Map.fh7



SOURCE: 1997 THOMAS BROTHERS MAP
SAN DIEGO COUNTY, CALIFORNIA

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N
NO SCALE

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GEOTECHNICAL CONSULTANTS
6960 FLANDERS DRIVE · SAN DIEGO, CALIFORNIA 92121-2974
PHONE 619 558-6900 · FAX 619 558-6159

VICINITY MAP

SOUTHWEST MARINE PARKING LOT
SAN DIEGO, CALIFORNIA

GWC / JS		DSK / E000D	DATE 12-29-97	PROJECT NO. 08023-22-01

1VICMAP

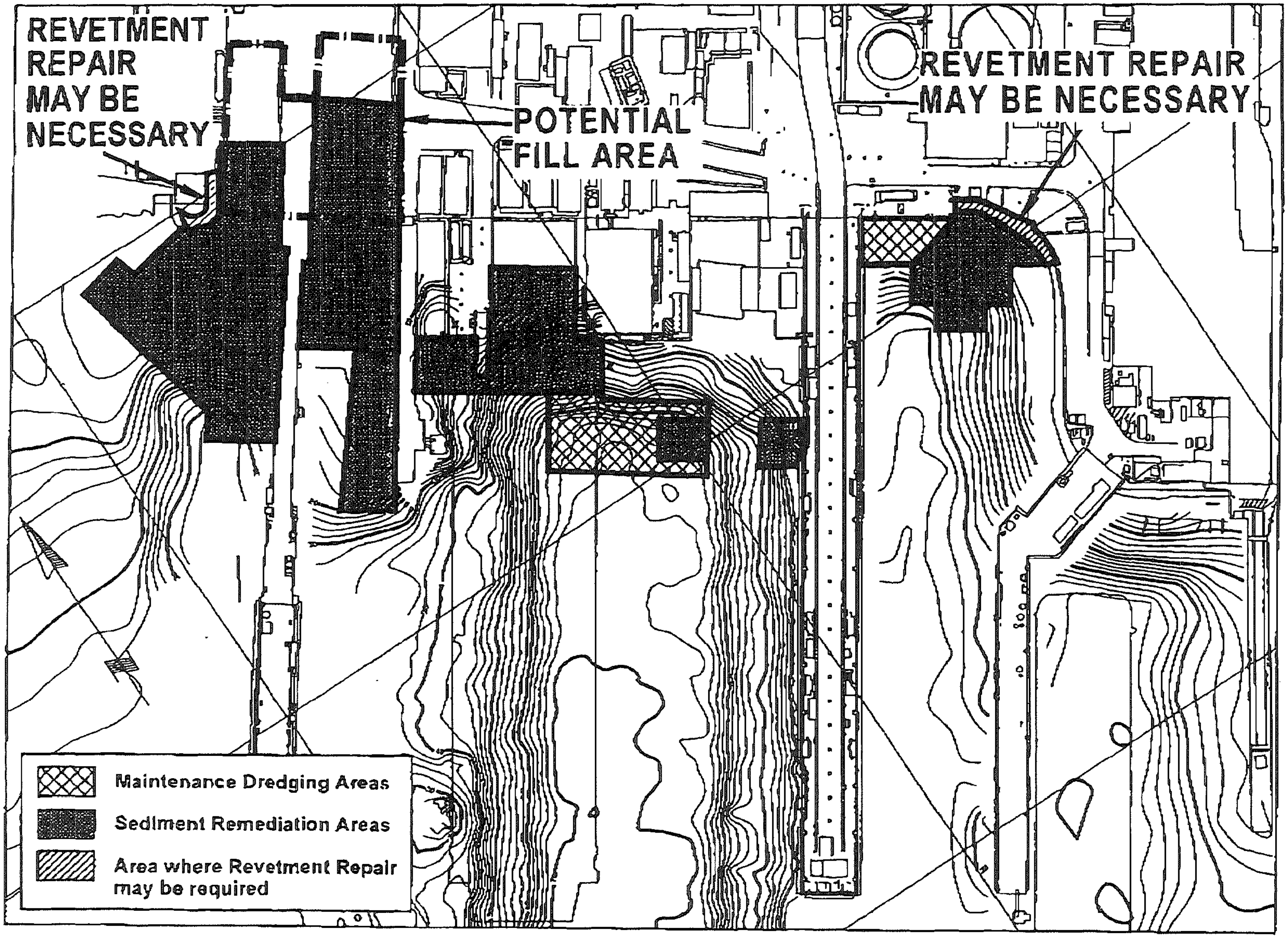


FIGURE 3

Southwest Marine Sediment Remediation and Maintenance Dredging Areas and Potential Fill Area

Southwest Marine Dredging
San Diego Bay
City of San Diego
County of San Diego, CA
June 2000

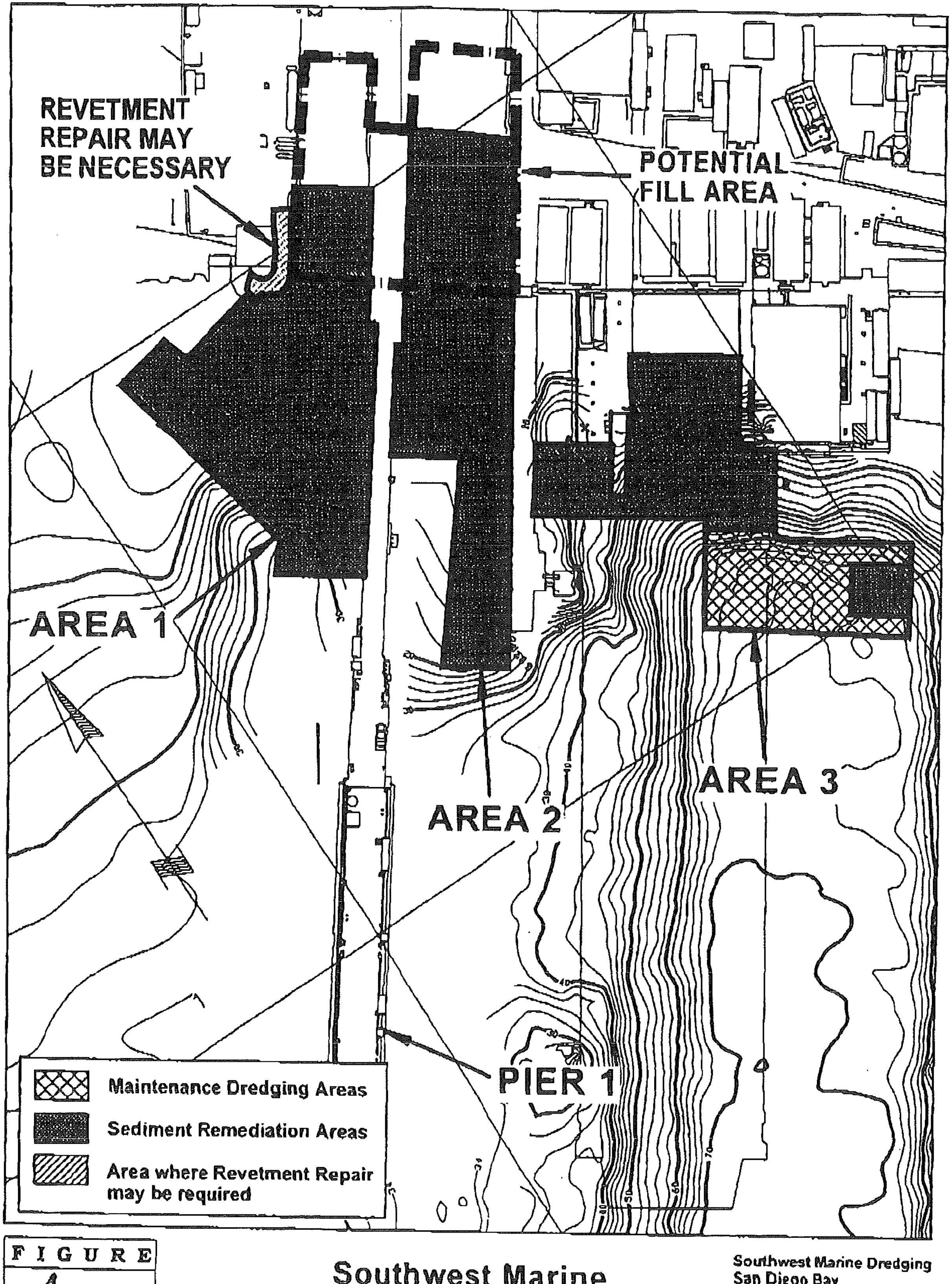


FIGURE 4

Southwest Marine Western Remediation Areas

Southwest Marine Dredging
San Diego Bay
City of San Diego
County of San Diego, CA
June 2000

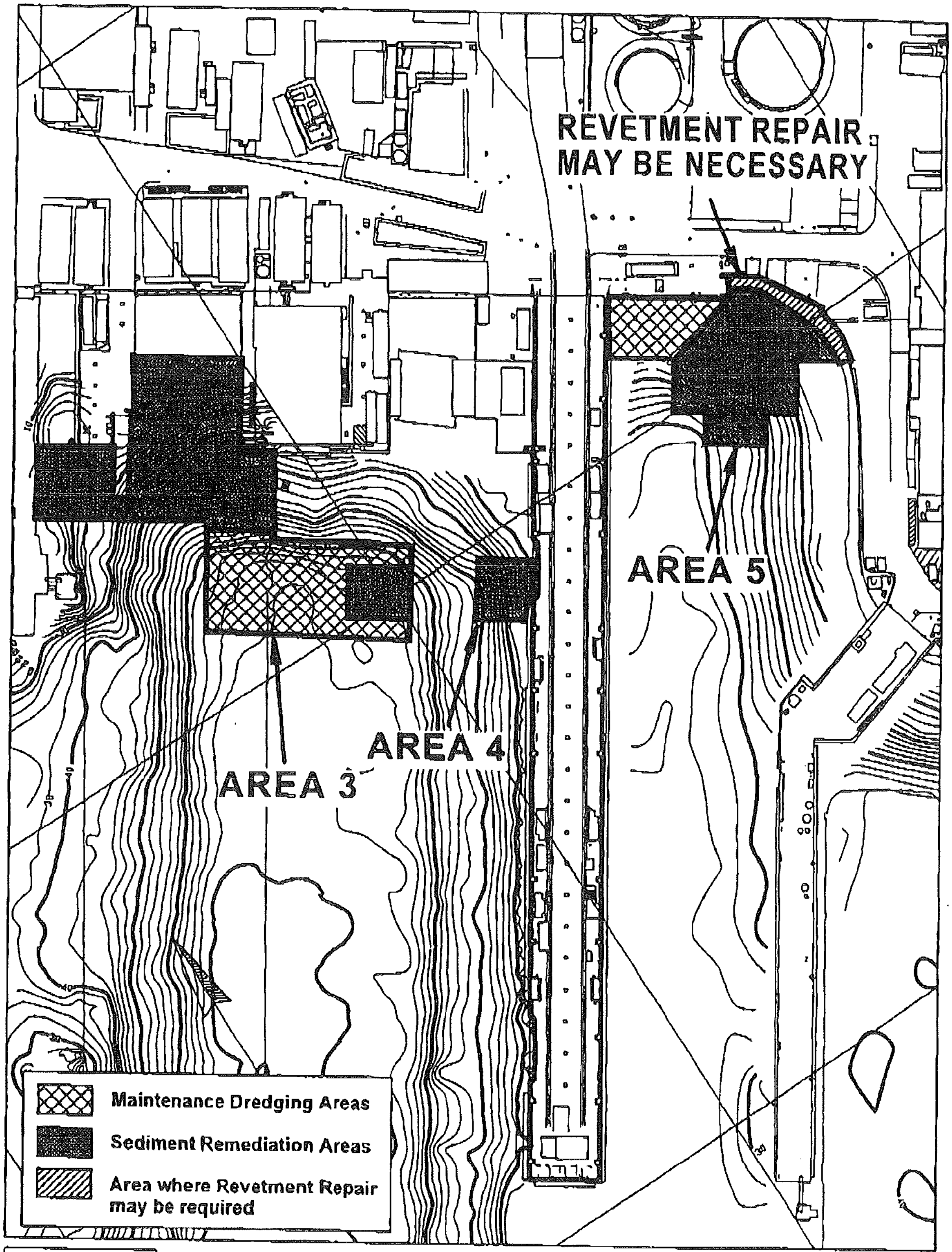


FIGURE 5

Southwest Marine
Eastern Remediation Areas

Southwest Marine Dredging
San Diego Bay
City of San Diego
County of San Diego, CA
June 2000

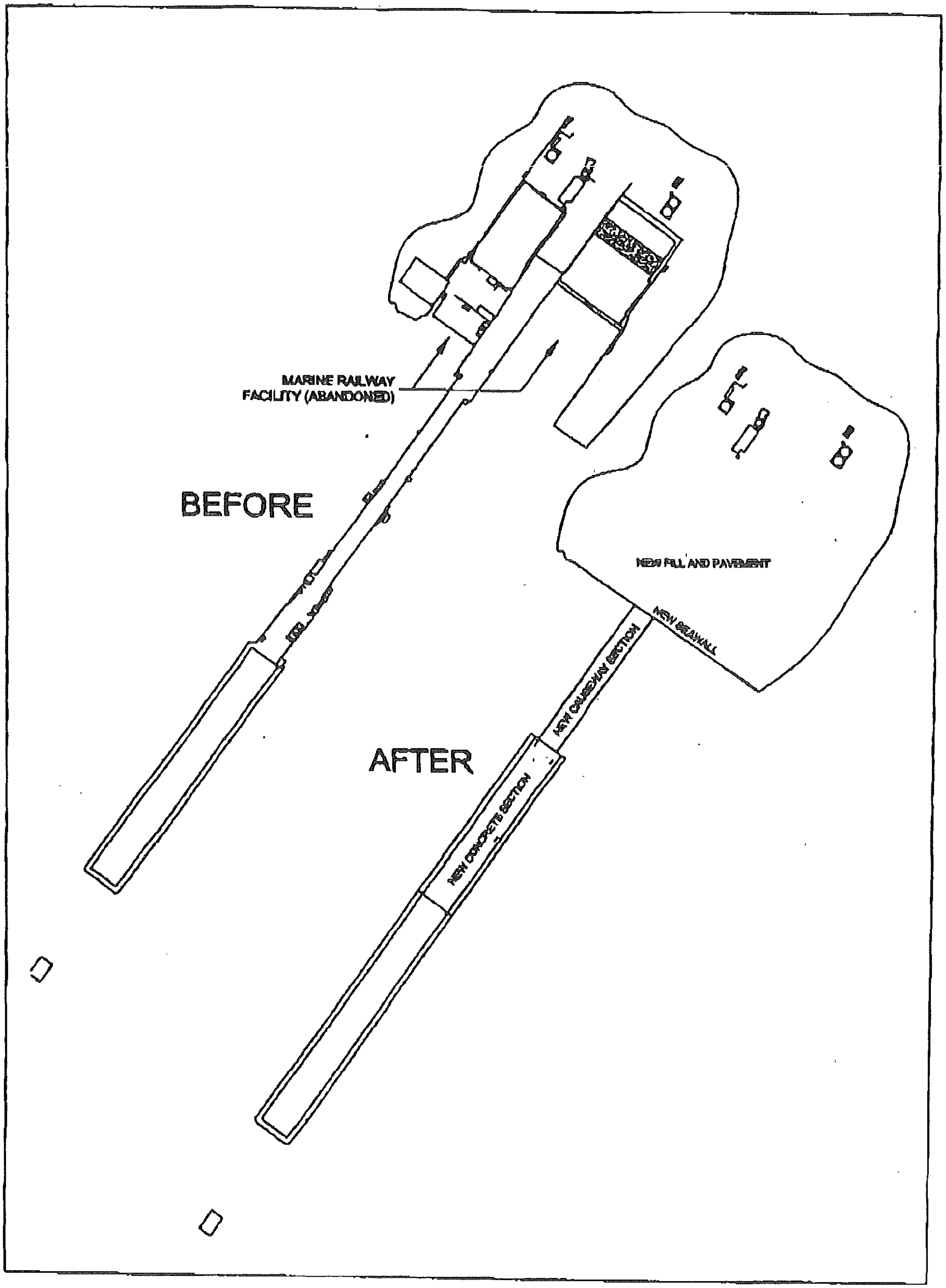
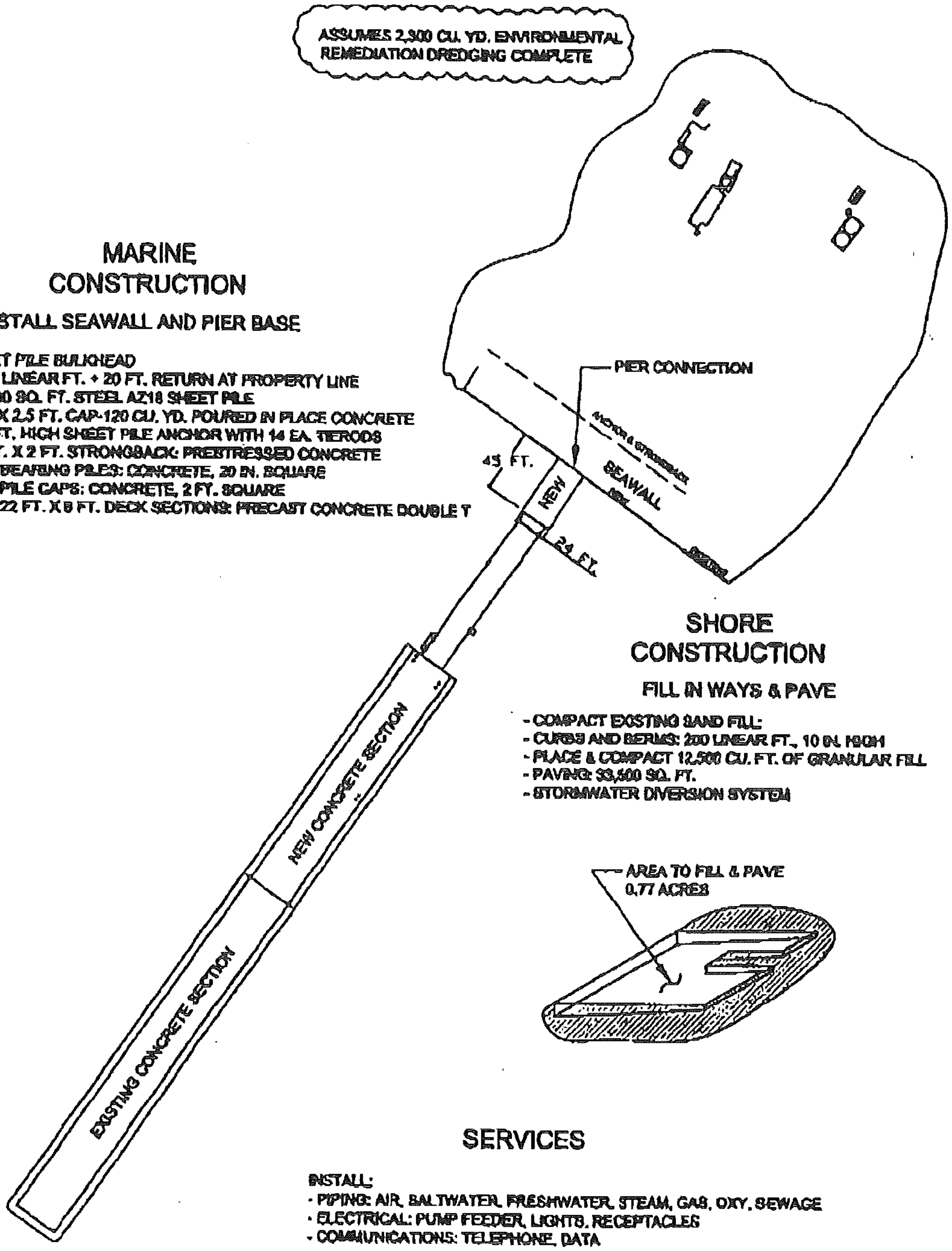


FIGURE 6

Quaywall Improvements
Pier 1 Improvement Plan

Southwest Marine Dredging
San Diego Bay
City of San Diego
County of San Diego, CA
June 2000



MARINE
CONSTRUCTION

INSTALL SEAWALL AND PIER BASE

- SHEET PILE BULKHEAD
  - 200 LINEAR FT. + 20 FT. RETURN AT PROPERTY LINE
  - 6,000 SQ. FT. STEEL AZ18 SHEET PILE
  - 6.5 X 2.5 FT. CAP-120 CU. YD. POURED IN PLACE CONCRETE
  - 10 FT. HIGH SHEET PILE ANCHOR WITH 14 EA. TIERODS
  - 2 FT. X 2 FT. STRONGBACK: PRESTRESSED CONCRETE
- 9 EA. BEARING PILES: CONCRETE, 20 IN. SQUARE
- 3 EA. PILE CAPS: CONCRETE, 2 FT. SQUARE
- 6 EA. 22 FT. X 8 FT. DECK SECTIONS: PRECAST CONCRETE DOUBLE T

SHORE
CONSTRUCTION

FILL IN WAYS & PAVE

- COMPACT EXISTING SAND FILL:
- CURBS AND BERMS: 200 LINEAR FT., 10 IN. HIGH
- PLACE & COMPACT 12,500 CU. FT. OF GRANULAR FILL
- PAVING: 33,500 SQ. FT.
- STORMWATER DIVERSION SYSTEM

SERVICES

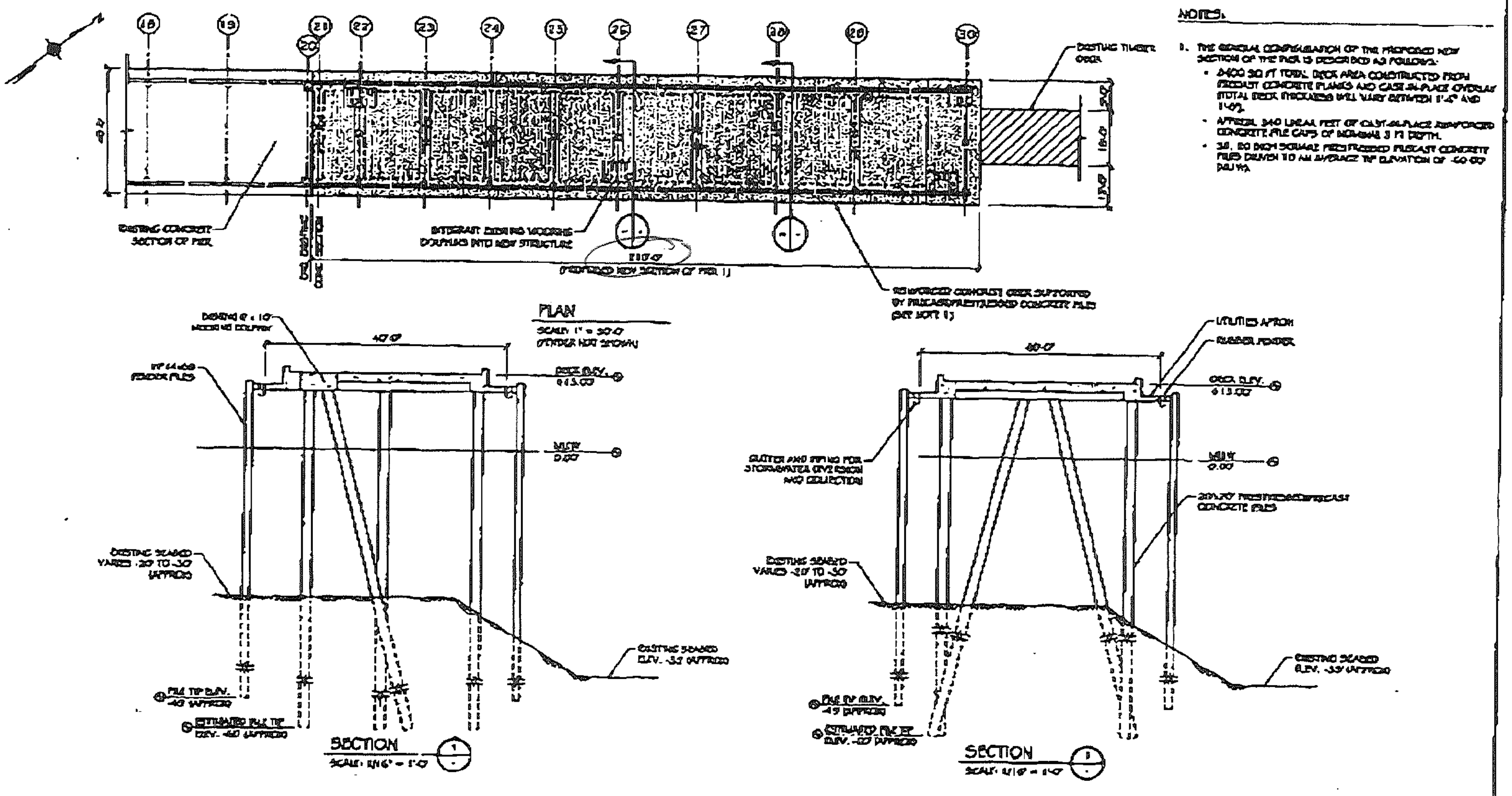
INSTALL:
- PIPING: AIR, SALTWATER, FRESHWATER, STEAM, GAS, OXY, SEWAGE
- ELECTRICAL: PUMP FEEDER, LIGHTS, RECEPTACLES
- COMMUNICATIONS: TELEPHONE, DATA

FOR ILLUSTRATIVE PURPOSES ONLY
NOT INCLUDED FOR AUTHORIZATION IN
THIS NOTICE

FIGURE
7

Quaywall Improvements
Marine Construction

Southwest Marine Dredging
San Diego Bay
City of San Diego
County of San Diego, CA
June 2000



NOTES:

1. THE GENERAL CONFIGURATION OF THE PROPOSED NEW SECTION OF THE PIER IS DESCRIBED AS FOLLOWS:
    - 2400 SQ FT TOTAL DECK AREA CONSTRUCTED FROM PRECAST CONCRETE PLANKS AND CAST-IN-PLACE OVERLAY (TOTAL DECK THICKNESS WILL VARY BETWEEN 1'-4" AND 1'-6").
    - APPROX. 340 LINEAR FEET OF CAST-IN-PLACE REINFORCED CONCRETE PILE CAPS OF NOMINAL 3 FT DEPTH.
    - 38, 20 INCH SQUARE PRESTRESSED PRECAST CONCRETE PILES DRIVEN TO AN AVERAGE TIP ELEVATION OF -60.00 MLLW.

FIGURE 8

Quaywall Improvements
Framing Plan

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