Discharge Elimination System (NPDES) permits of all shipyard and boatyard facilities within the San Diego Region. This report is filed in response to the above requirement. ***Ecosystems Management Associates Inc.*** is the contractor for the sediment sampling and monitoring program and has prepared this report for **Southwest Marine.**

2.0 DESCRIPTION OF SEDIMENT MONITORING PROGRAM

The requirements of the program (NPDES No. CAG039001; Order No. 97 - 36 Sec. G, pp. M-23 to M41), and the methods utilized to meet them are briefly described in this section.

2.1 REQUIREMENTS

The guidelines developed by the SDRWQCB for the Sediment Monitoring Program specify that "annual collection and analysis of surficial sediment samples" will be accomplished at specifically designated locations. Samples are to be collected in accordance with a detailed Sample Collection Plan which addresses all collection protocol. A new plan was submitted to the SDRWQCB in November 1997. They further declare that one of two sample collection methods will be selected and that methods shall not be changed once the selection has been made. The method of choice has been established as "collection by diver".

The specific sampling sites and the required analysis for each site are listed in **Table A**. In addition to the sites specified within the Yard there are three reference sites that must be sampled and referenced to the Yard samples. Reference site locations have been stipulated by the SDRWQCB and are also shown on Table A.

Analyses of collected samples are to be performed by a laboratory certified by the California Department of Health Services. All records pertaining to collection or analyses of samples are to be retained for five years beyond the date of analysis. All samples are to be retained in a frozen state for at least 45 days after the

SDRWQCB has received the analytical results.

Results are to be reported at the end of each annual sampling and are to include tables, graphs, and reference maps. Reporting is to also include trend curves and statistical analyses. If any significant increase in contaminant concentration is observed during this sampling program a report defining possible or suspected causes for any such increase, if any are known, is to be submitted. Sampling results are to be compared against historical data, the reference stations, and nearby storm drains. Paint chip and grain size analyses are also required.

TABLE A

SOUTHWEST MARINESAMPLING LOCATIONS AND REQUIRED ANALYSES

	CALIFORNIA COORDINATES		REQUIRED ANALYSES		
STATION ID	EASTING	NORTHING	INDICATORS ONLY	FULL ANALYSIS	PAINT CHIPS
SWM-01	1724820	192460	X		
SWM-02	1724750	192320		X	X
SWM-03	1724720	192220	X		
SWM-04	1724915	197400		X	X
SWM-05	1724975	192400	X		
SWM-06	1724960	192290		X	X

SWM-07	1725000	192240	X		
SWM-08	1725060	192210	X		
SWM-09	1724925	191975	X		
SWM-10	1725100	192020	X		
SWM-11	1725160	191820	X		
SWM-12	1725460	192115	X		
SWM-13	1725475	192000	X		
SWM-14	1725380	191760	X		
SWM-15	1725385	191680	X		
SWM-STD-01	1725400	192150		X	X

REF-01	1697300	196600		X	X
REF-02	1706085	204810		X	X
REF-03	1715225	201110		X	X

2.2 METHODS

This section describes the methods used to perform the work necessary to meet the stipulated requirements.

2.2.1 SAMPLING

Upon arriving by boat and utilizing navigation and positioning information assembled and/or installed when the Sampling Plans were prepared, each sampling location was relocated to within one meter. As appropriate and feasible, a diver guide line was lowered into the water at the sampling point to assure that the diver remained within the location parameters. The diver, wearing an isolation dry suit and face mask system and also wearing surgical latex gloves to prevent contamination of samples, would enter the water, with three one liter sterilized glass jars (that were slightly opened after the diver was submerged), and take three replicate samples from the upper approximately 7 cm of sediment. The latex gloves were changed at each sampling location. Prior to sampling, each one liter jar was labeled with the sampling station designator number. For each sampling station a sediment sampling field control form, an example of which is in the Sampling Plan, was filled out. This form contains all necessary information including a brief description of the sample. Once the sample has been described and the control form filled out, the sample is placed in a cooler with blue ice. After each sampling day the samples are delivered to the chemistry lab for analyses. At this point a chain of custody form is filled out and retained by the lab with a copy remaining with the field control book. All field forms are retained on file by ECO-M for future reference. GPS Satellite positions (NAD27) were taken for each sampling location and were reported in the Sampling Plan.

2.2.2 CHEMICAL ANALYSIS

Chemical analyses were provided by **Pacific Treatment Analytical Services, Inc.** of San Diego, a State of California Certified Laboratory. All analyses have been done in accordance with the methods specified in the technical orders and addenda issued to this Yard. The following is a brief synopsis of the methods, cleanup procedures and extraction methods used to analyze samples for this program.

Organochlorine Pesticides, Polychlorinated Biphenyls (PCBs) and Polychlorinated Terphenyls (PCTs) are analyzed according to EPA Method 8080, as described in the EPA's Solid Waste manual (SW-846). This method uses a gas chromatograph (Mw) with an Electron Capture Detector (ECD) for ppb level determination. The ECD is a universal detector for pesticide analysis. The method uses capillary columns with temperature programming to ensure proper elution and acceptable chromatography. The unit performs dual column chromatography for confirmation as required by the method. The analysis of PCTs requires extended analytical runs.

In general, 8080 extraction requires 40 grams of sample. Sonication extraction method 3550: is used. If interferences are present the samples may have to undergo cleanup procedures. Common cleanup methods are 3620: Florisil Cleanup and 3660: Sulphur Cleanup.

When extracting liquids, Method 3520 is used. A one liter aliquot of sample is extracted with methylene chloride followed by a concentration step and solvent exchange. To ensure quality and sample integrity, surrogate standards, e.g. 2,4,5,6 Tetra chloro-m-xylene (TCMX) is added at 50 ppb. Upon completion of the extraction and analysis, the extract should contain 50 ppb of TCMX. Method 3520 uses the continuous liquid-liquid extractor. The 3520 extraction takes from 16-24 hours. The sample extract goes through a concentrating step followed by a solvent exchange.

Sediments are extracted using Method 3550. Method 3550 is a sonication extraction. The apparatus used is a ultrasonic cell disrupter equipped with a sonicator horn. This method provides prolonged contact time between sample and extracting solvent. The procedure is based on the expected concentration of organics (semi-volatile and non-volatile). The low concentration method uses 30 grams of sample whereas the high concentration method uses 2 grams. Sample cleanup is done using methods 3620 and 3660. Method 3620 is a Florisil column/cartridge cleanup procedure. Florisil is widely used for cleaning up organochlorine pesticides, phthalate esters, nitrosamines, nitroaromatics, haloethers, and organophosphorus pesticides. Florisil is a magnesium silicate with acidic properties. A florisil cartridge is loaded with sample followed by elution with suitable solvents that will leave interfering compounds behind. The eluate is then concentrated in a similar fashion as to that already mentioned. Method 3660 is a sulphur cleanup procedure. When present, sulfur's solubility is similar to the organochlorine compounds; therefore causing interference. This interference is most evident in ECD and Flame Photometric Detectors (FPD). Even having performed a 3620 cleanup, sulfur removal by 3660 is a necessity.

Method 8270 is a Gas Chromatographic (GC)/Mass Spectrometric (MS) analysis for semi-volatile and non-volatile organics that utilizes a DB-5 capillary column. This allows for the quantitation of most base, neutral and acid organic compounds that are soluble in methylene chloride, specifically PAHs, chlorinated hydrocarbons and pesticides. The spectra generated result from using a quadrapole as the detector on the mass spectrometer. Extraction procedures are as described above and the protocol for this procedure is that described in SW-846.

TPH is analyzed using the Department of Health Services (DHS) method. The portions are separated using procedures mentioned above and analyzed with a GC equipped with a Flame Ionization Detector (FID) for medium molecular weight hydrocarbons. This method generally requires a separate extraction for each portion.

TBT analyses were accomplished using GC/FPD Stallard methodology. Samples are extracted with hexane/tropolone. Mono, di, and tributyltins can then be derivitized using a Grignard derivitization compound, pentylmagnesium bromide.

Most of the metals were analyzed using methods 3050/6010 based on Inductively Coupled Plasma (ICP) or GFAA for detection. Mercury was done using standard Method 7471, Cadmium by 3050/7131, and Arsenic by 3050/7060.

Paint chips are extracted from the sediments by wet sieving through a one millimeter mesh screen. Paint chips are then manually separated from the remaining materials. The collected paint chips are laid out on a ruled substrate and photographed. Analysis of the chips for metals and TBT is done using methods described above.

2.2.3 GRAIN SIZE ANALYSIS

Grain size analyses are performed according to the State Water Resources Control Board method published in "Chemistry, Toxicity and Benthic Community Condition in sediments of Selected Southern California Bays and Estuaries, May 1997" and are quoted here.

"Sample Splitting and Preparation

This procedure uses wet and dry sieve techniques to determine particle size of sediment samples. Methods follow those of Folk (1974). Samples were thawed and thoroughly homogenized by stirring with a spatula. Spatulas were rinsed of all adhering sediment between samples. Size of the sub-sample for analysis was determined by the sand/silt ratio of the sample. During splitting, the sand/silt ratio was estimated and an appropriate sample weight was calculated. Sub-samples were placed in clean, pre-weighed beakers. Debris was removed and any adhering *sediment was washed into the beaker.*

Wet Sieve Analysis (separation of coarse and fine fraction)

Beakers were placed in a drying oven and sediments were dried at less than 55° C until completely dry (approximately three days). Beakers were removed from drying oven and allowed to equilibrate to room temperature for a least a half - hour. Each beaker and its contents were weighed to the nearest 0.01 g. This weight, minus the empty beaker weight was the total sample weight. Sediments in beakers were disaggregated using 100ml of a dispersant solution in water (such as 50g Calgon/L water) and the sample was stirred until completely mixed and all lumps disappeared. The amount and concentration of dispersant used was recorded on the data sheet for each sample. Sample beakers were placed in an ultrasonic cleaner for 15 minutes for disaggregation. Sediment dispersant slurry was poured into a 63 (ASTM #230, 4 phi) stainless steel or brass sieve in a large glass funnel suspended over a 1L hydrometer cylinder by a ring stand. All fine sediments were washed through the sieve with water. Fine sediments were captured in a 1L hydrometer cylinder. Coarse sediments remaining in sieve were collected and returned to the original sample beaker for quantification.

Dry Sieve Analysis (coarse fraction)

The coarse fraction was placed into a pre-weighed beaker, dried at 55-65° C, allowed to acclimate, and then weighed to 0.01g. This weight, minus the empty beaker weight, was the coarse fraction weight. The coarse fraction was poured into the top sieve of a stack of ASTM sieves having the following sizes: No 10 (2.0 mm), 18 (1.0 mm), 45 (0.354 mm), 60 (0.25 mm), 80 (0.177 mm), 120 (0.125 mm), and 170 (0.088 mm). The stack was placed on a mechanical shaker and shaken at medium intensity for 15 minutes. After shaking, each sieve was inverted onto a large piece of paper and tapped 5 times to free stuck particles. The sieve fractions were added cumulatively to a pre-tared weighing dish, and the cumulative weight after each addition determined to 0.01g. The sample was returned to its original beaker, and saved until sample computations were completed and checked for errors.

Analytical Procedures

Fractional weights and percentages for various particle size fractions were calculated. If only wet sieve analysis was used, weight of fine fraction was computed *by subtracting coarse fraction from total sample weight, and percent fine composition was calculated using fine fraction and total sample weights. If dry sieve was employed as well, fractional weights and percentages for the sieve were calculated using custom software on a Macintosh computer. Calibration factors were stored in the computer.*

2.2.4 PAINT CHIPS SEPARATION METHOD

Samples collected for paint chip analyses are passed through a stack of sieves designed to separate the material into three broad size ranges, large, medium, and small. The size separation is performed to aid in the hand separation of paint chips from the other materials found in the samples.

The lid of the sieve stack provides a water spray bath to aid in the screening of the sediments by washing the fine sediments through the sieves. The stack is comprised of the following sieves: 6.7, 2.36, & .991 mm screen sizes.

The materials recovered are dried in a low temperature oven and then the size ranges are individually sorted by hand using a flourescent lamp with an included magnifying lens. When this sorting has been completed a review of the sorted materials is undertaken with a dissecting microscope. A final decision regarding whether the materials are paint or some other material is made.

The paint chips are weighed and photographed. At this point they are sent to the laboratory to be analyzed for metals and TBT.

2.2.5 REPORTING

This document contains Tables listing the locations of all stations, the required analyses for each location, and the results of each of those analyses. In addition, copies of the original laboratory report and quality control documents are provided. Maps are provided that show each sampling location and the concentration of each chemical variable. A diskette is provided containing this document in Word Perfect format and a copy of the analyses database in QPRO format (at RWQCB request copies are also provided in EXCEL format). The analyses database contains all necessary variables common to all sample sites, and is accompanied by an input file describing each variable.

3.0 RESULTS

The Southwest Marine facility was sampled on March 8 & April 28, 2000. Samples were collected at the sixteen designated locations. Reference stations were sampled on March 20, 2000.

3.1 CHEMICAL ANALYSIS

Values for chemical variables are provided as both dry and wet weight in accordance with SDRWQCB specifications. **Table B** provides the results in tabular form. The chemical variables plotted on the maps are dry weight figures. Attached to this document are the Laboratory Report and the Quality Control Data Report. The analytical methods utilized for each analysis are specified on these pages.

Results are provided both in **Table B** and as concentrations of each chemical variable on the attached maps of the Yard (<u>Appendix A</u>). One map is provided for each variable or for each related group of variables. Reference station data are provided in Table B, below the data from the Yard, or in the case of PAH, as Table B-8. Concentrations of each chemical variable or group of variables for the three Reference Stations are shown on one map. These maps follow those of the Yard in Appendix A. **Appendix B** provides the historical relationship between this sampling and the previous samplings. **Appendix C** contains the lab reports, analytical results, and related documents. **Appendix D** has the paint chip photos.

Paint chips collected for this report were screened from 9 liters of sediment taken from each of the type localities designated by the RWQCB. The weight of the paint chips recovered are listed below by type locality.

SWM - PC 0.05 g   SWM - STD - PC 0.49 g   REF - 0.00 g

TABLE B: DISCHARGE MONITORING REPORT FORM

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3.2 DISCUSSION

The larger than normal paint chip weight reported during this sampling period comes from the inclusion in the samples one large paint chip weighing 1.02 grams. This paint chip appeared to have been on the sea floor for a considerable period of time. The paint chips recovered in addition to this chip weighted 0.22 grams.

All sampling, analytical, and reporting activities proceeded normally, no unusual conditions or circumstances were noted.

3.3 PERMANENT NOTES

Beginning with this report, graphical representation of the Reference station data in **Table B** (Historical Trends Graphs) will be provided on a separate page for each chemical variable. This has been done to improve readability of the graphic representations.

In the data base established for this program all STD and other specially designated stations will be denoted in the following order; Yard designator: special designator: location number. This is in variance to the original designations established for these sites by the SDRWQCB but has been done in order to establish uniform location designations so that data in the data base can be readily manipulated in the future. All such locations have been listed in the tables in this format.

Because of the direct relationship between dry weight and wet weight values (Dry weight values are calculated from wet weight results using the formula: dry weight = (wet weight / % total solids) x 100), with SDRWQCB authorization only dry weights are now presented in the historical tables and graphs. This has been done to make the reports more understandable, less bulky, and to remove redundancy.

3.4 RECOMMENDATIONS

There are no recommendations to be made at this time.

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CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
SAN DIEGO REGION
1350 FRONT STREET, ROOM 2038
SAN DIEGO, CALIFORNIA 92101

WASTES ASSOCIATED WITH SHIPBUILDING AND REPAIR FACILITIES IN SAN DIEGO BAY

A STAFF REPORT TO THE EXECUTIVE OFFICER OF THE
SAN DIEGO REGIONAL WATER QUALITY CONTROL BOARD

PREPARED BY
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SENIOR WATER QUALITY CONTROL ENGINEER

JUNE 1972

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I. SUMMARY

A study was initiated to determine the amount and kinds of wastes that may enter San Diego Bay from the shipbuilding and repair industry, and the possible effects of these contaminants on marine life and beneficial uses of the water. In March 1972, all shipbuilding and repair facilities on San Diego Bay were visited. Interviews were conducted with owners and managers to determine how each facility operates and what wastes are associated with each. The contaminants were reviewed for possible effects on marine life and on the beneficial uses of San Diego Bay water.

It was concluded that shipbuilding and repair facilities do pose a threat to water quality; that these contaminants do enter the bay; and that some control of these facilities is necessary to protect water quality.

II. INTRODUCTION

San Diego Bay is situated in the extreme southwest corner of California. It is a crescent-shaped body of water, about 15 miles in length, varying in width from one-quarter to two and one-half miles, with a surface area of approximately 18.5 square miles. The depth of the bay varies from a few inches at the extreme southern end to in excess of 60 feet near the harbor entrance.

San Diego Bay is one of the three major bays of California and is considered to be one of the ten best natural harbors in the world. San Diego Bay is ideally suited for the shipbuilding and repair industry.

Building and repair of vessels in the San Diego Bay area has become one of the largest industries in San Diego. The industry has increased from $6.5 million in 1959, to $50 million in 1965, to over $105 million in 1970.

The wastes generated from this rapidly growing industry are a potential threat to the water quality of San Diego Bay. Wastes from these facilities include sandblasting sand and debris, paint, solvent, oil and metals. If these wastes are not properly handled, they could contribute to deterioration of water quality and impairment of the beneficial uses of San Diego Bay waters.

Conduct of Study

During the month of March 1972, all shipbuilding and repair facilities located on San Diego Bay were visited. Interviews were conducted with owners and managers of each facility. Information requested concerned the number of ships built or refinished; the cleaning methods employed; the amount and kinds of bottom paint used; and methods of disposing of trash, sand, paint and oil. In some cases, due to poor record keeping at the facility, estimates had to be obtained from individuals. The information was requested for the year 1971. The information in this report with respect to amounts of paint, primer and sand should be considered as estimates and not absolute figures. A survey was made of each facility and notes made on general operation.

A summary of all shipbuilding and repair facilities may be found in Appendix A and are listed below:

Bay City Marine Inc., 1860 Bay Front Street, San Diego
Campbell Industries Inc., 8th Street, San Diego
Driscoll Custom Boats, 2438 Shelter Island Drive, San Diego
Harbor Boat and Yacht, 4960 Harbor Drive, San Diego
Kettenburg Marine, 2810 Carleton Street, San Diego

KOEHLER KRAFT CO., 2_ ?2 SHELTER ISLAND DRIVE, SAN DIEGO
MAURICIO & SONS, 2420 SHELTER ISLAND DRIVE, SAN DIEGO
NATIONAL STEEL AND SHIPBUILDING, HARBOR DRIVE AND 26TH ST., SAN DIEGO
NELSON BOAT & YACHT, 2390 SHELTER ISLAND DRIVE, SAN DIEGO
RASK BOAT BUILDING, 1511 MARINE WAY, CORONADO
ROHR AIRCRAFT, G STRE T, CHULA VISTA
SAN DIEGO MARINE CONSTRUCTION, SAMPSON STREET, SAN DIEGO
SHELTER ISLAND YACHT WAYS, 2330 SHELTER ISLAND DRIVE, SAN DIEGO
TRIPLE A SOUTH, 3350 MAIN STREET, SAN DIEGO
WHITEMAN YACHTS, 980 F STREET, CHULA VISTA
U.S. NAVY FACILITIES
- U.S. NAVAL STATION, 32ND STREET AND HARBOR DRIVE
- AMPHIBIOUS BASE, CORONADO
- NORTH ISLAND CARRIER BASE, CORONADO
- BALLAST POINT SUBMARINE BASE, SAN DIEGO

AN ATTEMPT WAS MADE TO QUANTIFY THE AMOUNTS OF METALS IN BOTTOM SEDIMENTS AT VARIOUS SELECTED SITES WITHIN SAN DIEGO BAY. TWO REPLICATE CORE SAMPLES WERE OBTAINED FROM EACH STATION USING A STANDARD PHLEGER CORE SAMPLER. THE CORES WERE MEASURED AND NOTES MADE AS TO LITHOLOGICAL DESCRIPTION, PRESENCE OR ABSENCE OF SULFIDE ODORS, AND PRESENCE OF LIVING MACROSCOPIC MARINE ORGANISMS. THE TOP TWO INCHES OF EACH CORE WERE ANALYZED FOR ARSENIC, CHROMIUM, COPPER, LEAD, MERCURY, NICKEL AND ZINC.

III. CONCLUSIONS

1. Wastes from shipbuilding and repair facilities do enter San Diego Bay.

2. Approximately 30,000 gallons of antifouling paint containing 540,000 pounds of cuprous oxide were used in 1971.

3. Approximately 23,000 gallons of red lead primer containing 57,500 pounds of lead oxide were used in 1971.

4. Approximately 10,000 gallons of zinc chromate primer containing 20,000 pounds of zinc chromate were used in 1971.

5. Approximately 3,350 tons of sandblasting sand were used throughout San Diego Bay during 1971.

6. Approximately 5-10 percent of sandblasting sand and debris entered San Diego Bay in 1971.

7. Improper cleaning of dry docks and marine railways may be responsible for the greatest contamination of San Diego Bay waters and sediments.

8. The ship's crew remains aboard the larger military vessels during repair operations and continue to use sewage and water systems.

9. Sewage collection and disposal from dry docked ships was not provided at any ship yard.

10. Many ship yards have inadequate records of operations and use of materials.

11. The toxicity of copper from the slightly soluble cuprous oxide may be the greatest single chemical threat.

12. Heavy metal concentrations are higher near shipbuilding repair facilities than in other parts of San Diego Bay.

13. The area of highest concentration of heavy metals was in the Shelter Island Commercial Basin.

IV RECOMMENDATIONS

1. THE REGIONAL WATER QUALITY CONTROL BOARD SHOULD CONSIDER A RESOLUTION REQUIRING SHIPBUILDING AND REPAIR FACILITIES TO CLEAN ALL SAND AND DEBRIS FROM DRY DOCKS AND WAYS.

2. THE REGIONAL WATER QUALITY CONTROL BOARD SHOULD CONSIDER A RESOLUTION REQUIRING SHIPBUILDING AND REPAIR YARDS TO PROVIDE SEWAGE PUMP-OUT FACILITIES FOR ALL VESSELS USING ON-BOARD SEWAGE SYSTEMS.

3. THE REGIONAL WATER QUALITY CONTROL BOARD SHOULD CONSIDER A RESOLUTION REQUIRING ALL SHIPBUILDING AND REPAIR FACILITIES TO PROVIDE ACCURATE SUMMARIES OF OPERATIONS AND USE OF MATERIALS.

4. AN INVESTIGATION OF THE HIGH MERCURY CONTENT IN BOTTOM MUDS IN THE SHELTER ISLAND COMMERCIAL BASIN SHOULD BE INITIATED.

V. SHIPBUILDING AND REPAIR

Description

Shipbuilding and repair facilities in the San Diego Bay area vary greatly in size from small operations involving one boat per year to large operations involving several hundred vessels. They all have in common means of hauling or launching ships in dry docks or marine railways; cleaning of vessels by scraping, sandblasting or brushing; painting of vessels by sprayer, roller or brush; collection facilities for oil and solvents and methods for removing sand, trash and debris.

Hauling and Launching

Hauling and launching of vessels is usually accomplished by means of a graving dock, dry dock or marine railway. The only graving dock in San Diego Bay is located at the U.S. Naval Station at 32nd Street. The graving dock is similar to a lock in a canal connecting two bodies of water of different elevation. The dock site is flooded, then the door or gate is opened. The ship to be repaired is floated into the dock and positioned over preset blocks called shoring. The purpose of the shoring is to support the ship after the water is removed. The ship is secured in place, the door is closed, and the water pumped from the dock back to the bay. The ship is slowly lowered in this manner onto the support blocks. All water is removed from the dock. The ship, after drying, is ready for repairs. On large Navy vessels, the ships' crew remains aboard and necessary water for cooling and domestic use is pumped to the ship.

Sewage is removed through rubber pipes connected to small catch basins which are attached to each sewage outlet. The sewage is piped to a collection system in the bottom of the dock and pumped to a large holding tank. Periodically, by automotic or hand control, the holding tank contents are pumped to the bay. It was reported by Mr. William Wood of the Shipbuilding and Repair Facility, that construction will begin in late 1972 on a piping system that will connect this holding tank to the sanitary sewerage system.

The graving dock work area is kept relatively dry to facilitate cleaning after sandblasting. Cooling water is usually the only discharge in the dock. Most sandblasting sand and debris is picked up by skiploader, placed in large containers and removed by crane. The containers are emptied into trucks and hauled away. Perhaps 5-10 percent of the sand debris may get blown or washed into the water pump-out system and eventually reach the bay.

When necessary, oil and water from bilges are pumped to holding tanks near the dock. These holding tanks are pumped out periodically by a local tank cleaning service.

The grav ng dock is leased to the San Diego Por District who then subleases to one of the local shipyards. A list of contractors can be found in Table 1.

Dry docks are used by large ship and repair facilities such as National Steel and Shipbuilding, Campbell Industries and San Diego Marine Construction. Dry docks are large barge-like structures, open on e ch end with walls down each side. The dry docks are capable of being flooded and submerged. The ship to be repaired is floated into place over preset shoring blocks. The submerged dry dock is then surfaced by pumping water from the flooded compartments. The whole ship is floated free of the water in this manner. The ships' crew may remain aboard the larger vessels.

Necessary water and power are provided for cooling and domestic use. Sewage is generally discharged from the ship to the dock and eventually to the bay, or may enter the bay directly from the ship through rubber hoses.

Sandblasting is performed in the dry dock. Although most of the sand and debris are removed, some will be blown into the bay by wind, some washed into the bay by water and sewage, and some left behind from the cleaning operation. Some dry docks are submerged, the ship removed, resurfaced and then cleaned of sand and debris. Perhaps 10-20 percent of the fine material may be washed into the bay.

Oil and water from tanks and bilges are removed from ships before entering the dry dock. None of the dry docks have oil pump-out facilities, but could be provided with long hoses and tanks.

Marine railways are common at most repair facilities, especially the smaller ones. The railways will accommodate vessels from small pleasure craft to 100-foot ships. A special car is used which is flat, wide, has a framework for sides, and runs on small wheels along rails. The front and rear are open to permit the vessel to be pulled onto the car. The vessel is braced with shoring and car and vessel pulled from the water by cable and winch.

Fouling organisms scraped from the vessel, sandblasting sand and debris, usually remain on the railway and are only occasionally cleaned by some operators.

Oil from these smaller vessels can usually be removed in 5-55 gallon cans or drums.

Cleaning Methods

Many vessels are hauled out of the San Diego Bay each year for cleaning and refinishing. For large military vessels this haul-out cycle is 2-4 years, while smaller craft are hauled as often as every 6 months depending on use and quality of antifouling paint. Before the vessel is refinished it must

BE THOROUGHLY CLEANED DOWN TO BARE METAL OR TO A GOOD CLEAN SURFACE TO WHICH THE NEW PAINT WILL BOND. THE CLEANING METHODS USUALLY EMPLOYED ARE AIR SANDBLASTING, WATER SANDBLASTING, SCRAPING, SAND BRUSHING AND BRUSHING.

AIR SANDBLASTING IS THE MOST COMMON METHOD OF REMOVING LARGE QUANTITIES OF PAINT AND SCALE. IN PAST YEARS, AND TO SOME EXTENT TODAY, MOST SANDBLASTING WAS DONE WITH SILICA SAND. SILICA SAND IS CHEAP AND PLENTIFUL BUT DISINTEGRATES EASILY PRODUCING LARGE QUANTITIES OF DUST. IN RECENT YEARS, AIR POLLUTION AGENCIES HAVE RECOMMENDED THE USE OF BLACK SAND (TABLE 2). BLACK SAND IS MORE COSTLY BUT ALSO MORE ABRASIVE AND THEREFORE MORE EFFICIENT. THE USE OF BLACK SAND TENDS TO KEEP DUST TO A MINIMUM. GENERALLY ABOUT 3-10 LBS. OF SAND ARE REQUIRED TO CLEAN ONE SQUARE FOOT OF STEEL SHIP BOTTOM. FOR A SHIP OF 500 FEET IN LENGTH AND 35,000 SQUARE FEET OF BOTTOM, ABOUT 50-175 TONS OF SAND ARE REQUIRED DEPENDING ON AMOUNT OF FOULING GROWTH, CONDITION AND TYPE OF PAINT.

WATER SANDBLASTING IS GENERALLY LIMITED TO SMALLER REPAIR FACILITIES TO MINIMIZE ALL DUST. THE SMALLER YARDS HAVE MANY BOATS IN CLOSE PROXIMITY TO ONE ANOTHER AND IN VARIOUS STAGES OF REPAIR. FINISH PAINTING AND AIR SANDBLASTING ARE NOT COMPATIBLE FOR OBVIOUS REASONS. IN WATER SANDBLASTING, THE SAND IS FORCED THROUGH THE NOZZLE BY WATER PRESSURE ALONE. THE HIGH WATER PRESSURE AND ABRASIVE ACTION OF THE SAND COMBINE TO CUT OLD PAINT AND SCALE AWAY. THE SAND AND DEBRIS ARE USUALLY WASHED INTO THE BAY BY THE LARGE VOLUMES OF WATER REQUIRED.

WOOD AND FIBERGLASS VESSELS, BECAUSE OF THE SOFTER MATERIAL, ARE USUALLY NOT SANDBLASTED. THESE VESSELS ARE SCRAPED FREE OF FOULING ORGANISMS BY A LARGE WIDE METAL BLADE. AFTER REMOVAL OF THE FOULING ORGANISMS, THE BOAT IS BRUSHED WITH WET SAND TO REMOVE LOOSE PAINT AND REMAINING ORGANISMS. THE BOTTOM IS RINSED WITH WATER, DRIED AND THEN REFINISHED.

MANY OF THE LARGER REPAIR YARDS IN SAN DIEGO BAY FIND THAT IT IS MORE ECONOMICAL TO KEEP THE SAND AND DEBRIS CLEANED FROM AROUND DRY DOCKS AND WAYS. IF THE LARGE VOLUMES OF SAND WERE WASHED INTO THE BAY, IT WOULD SOON FILL, THEN DREDGING WOULD BE REQUIRED TO REMOVE THE SAND. DREDGING IS COSTLY AND DREDGE PERMITS MAY BE MORE DIFFICULT TO OBTAIN IN THE FUTURE.

PRIMER AND PAINT APPLICATION

PRIMERS AND PAINTS ARE USED ON VESSLES PRIMARILY TO PROTECT THE SURFACE AGAINST THE CORROSIVE ACTION OF SEAWATER, TO PROTECT AGAINST FOULING ORGANISMS AND TO IMPROVE APPEARANCE AND PERFORMANCE. SEVERAL METHODS OF PAINT APPLICATION ARE AVAILABLE. PRIMERS AND PAINTS ARE APPLIED TO VESSELS BY AIRLESS SPRAY GUN, AIR SPRAY GUN, ROLLERS AND BRUSHES.

THE MOST EFFECTIVE METHOD OF APPLYING PRIMERS AND PAINT IS BY AIRLESS SPRAY GUN. PAINT IS FORCED OUT OF A NOZZLE BY PRESSURE ALONE. AIR IS NOT USED TO DISPERSE THE PAINT. THIS METHOD REDUCES SOME OF THE VERY FINE SPRAY WHICH CAN BE BLOWN AWAY BY AIR PRESSURE AND WIND. THE SMALL PAINT PARTICLES ARE SPRAYED ONTO A SURFACE UNTIL THEY FUSE WITH ONE ANOTHER AND COVER THE SURFACE. AIRLESS SPRAY GUNS ARE USED BY ALL LARGE REPAIR FACILITIES.

AIR SPRAY GUNS USE AIR PRESSURE TO TRANSFER THE PAINT FROM THE CONTAINER TO THE SHIPS SURFACE. AIR ALSO HELPS DISPERSE SPRAY INTO A FAN SHAPE FOR BETTER COVERAGE. AIR SPRAY GUNS ARE LESS EFFICIENT THAN AIRLESS GUNS BECAUSE SOME PAINT IS BLOWN AWAY BY THE AIR PRESSURE. AIR SPRAY GUNS ARE USED ONLY ON A LIMITED BASIS AT SOME OF THE SMALLER FACILITIES.

ROLLERS AND BRUSHES ARE USED QUITE EXTENSIVELY ESPECIALLY BY THE SMALLER FACILITIES. THE ROLLER IS THE STANDARD PAINT ROLLER WITH SOME MODIFICATIONS, SUCH AS HOSES TO TRANSFER PAINT TO THE ROLLER. LARGE AREAS CAN BE COVERED QUITE RAPIDLY IN THIS MANNER. THE PAINT BRUSH IS STILL USED IN HARD TO REACH AREAS.

PAINT AND PRIMER COVERAGE IS DEPENDENT ON TYPE OF BOTTOM MATERIAL TO WHICH APPLIED, THE TYPE OF PAINT OR PRIMER USED, AND THE MEANS OF APPLICATION. AS A GENERAL RULE ABOUT 200-250 SQUARE FEET OF BOTTOM CAN BE COVERED PER GALLON PER COAT.

PAINTS AND PRIMERS

IT IS BEYOND THE SCOPE OF THIS REPORT TO DISCUSS ALL TYPES OF PAINTS AND PRIMERS; INSTEAD, THE DISCUSSION SHALL BE LIMITED TO THE MORE COMMON TYPES USED ON VESSELS IN SAN DIEGO BAY.

PRIMERS ARE USED AS A FIRST COAT IN REFINISHING OF VESSEL SURFACES. PRIMERS MUST BE COMPATIBLE WITH THE TYPE OF SURFACE TO BE COVERED; THEY SERVE TO FILL MINUTE CRACKS AND VOIDS; THEY MUST RESIST CORROSION AND PROVIDE A BASE FOR THE FINISH COATING. THE TWO MOST WIDELY USED PRIMERS ARE ZINC CHROMATE AND RED LEAD. AFTER PROPER PRIMER APPLICATION, THE SURFACE IS READY FOR THE FINISH COATING.

MOST VESSEL BOTTOMS ARE PROTECTED WITH SOME KIND OF ANTIFOULING PAINT. ANTI-FOULING PAINTS DISCOURAGE THE GROWTH OR ATTACHMENT OF MARINE ORGANISMS BY THE USE OF TOXIC COMPOUNDS. THE MOST COMMONLY USED TOXIC SUBSTANCES ARE COPPER OXIDES, ORGANO-TIN, MERCURY AND ARSENIC COMPOUNDS (TABLE 3).

COPPER OXIDE (CUPROUS OXIDE) IS BY FAR THE MOST EXTENSIVELY USED TOXIC MATERIAL IN ANTIFOULING PAINTS. COATINGS WITH HIGH PERCENTAGES OF COPPER ARE THE MOST EXPENSIVE, BUT ALSO SEEM TO BE THE MOST EFFECTIVE. THE ADVANTAGES OF COPPER OXIDES ARE THAT THEY ARE TOXIC AND ONLY SLIGHTLY SOLUBLE IN WATER, THEREFORE LASTING FOR A LONGER PERIOD. THE DISADVANTAGES OF COPPER ARE THE REQUIREMENT

OF AN ANTICORROSION BARRIER COAT ON STEEL AND ESPECIALLY ALUMINUM HULLED VESSELS TO PREVENT ELECTROLYSIS, AND THE RESISTANCE OF COPPER TO TINTING. GENERALLY COPPER OXIDE BOTTOM PAINT IS OBTAINABLE ONLY IN DARK RED, DARK BLUE OR DARK GREEN.

TIN TOXIN PAINTS SUCH AS BIS (TRI-N-BUTYLTIN) OXIDE (TBTO) AND BIS (TRI-N-BUTYLTIN) FLUORIDE (TBTF) WERE DEVELOPED TO PROTECT AGAINST ELECTROLYSIS ON STEEL AND ALUMINUM SHIPS, AND TO PROVIDE A CHOICE OF A BROAD SPECTRUM OF COLORS. TIN TOXIN PAINTS ARE PRACTICALLY ELECTROLYSIS FREE AND, BECAUSE THEY ARE COLORLESS, ARE VERY EASY TO TINT. TIN TOXINS ARE EFFECTIVE AGAINST SOME KINDS OF MARINE GROWTH, BUT NOT AS EFFECTIVE AS COPPER TO OTHERS.

MERCURY AND ARSENIC COMPOUNDS HAVE HAD SOME SUCCESS IN THE PAST AS ANTI-FOULANTS, BUT BECAUSE OF THE EXTREME TOXICITY TO WORKERS, THEY HAVE BECOME LESS IN DEMAND AND ARE USED VERY LITTLE.

BINDERS ARE USED TO HOLD THE TOXIC MATERIAL TOGETHER AND PROVIDE THE ADHESIVE FOR STICKING TO THE SHIP SURFACES. TWO GENERAL TYPES OF BINDERS ARE USED IN ANTIFOULING PAINTS, THE INSOLUBLE HARD VINYLS AND EPOXIES, AND THE SOLUBLE SOFT ROSIN-COAL TAR OR ROSIN-FISH OIL COMPOUNDS. THE HARD MATRIX TYPE USUALLY REQUIRE MORE TOXIC MATERIAL TO BE EFFECTIVE, BUT LAST FOR LONG PERIODS. THE SOFT MATRIX TYPE USE LESS TOXIC SUBSTANCES AND RELY ON A CONTROLLED RATE OF DISSOLVING OR "SLOUGHING OFF" TO EXPOSE NEW TOXINS. THE SOFT MATRIX TYPES ARE EASILY APPLIED, ARE CHEAPER, BUT LAST ONLY SIX MONTHS TO A YEAR. THE HARD MATRIX TYPES ARE MORE COSTLY, RESIST ABRASION, AND MAY LAST FOR A YEAR OR MORE.

TABLE 4 SHOWS A LIST OF THE MORE COMMONLY USED PAINTS AND PRIMERS SHOWING THE CONCENTRATIONS OF METALS IN GRAMS PER LITER (GM/L). THE INFORMATION CAME FROM PAINT MANUFACTURERS, PAINT CAN LABELS AND FROM MILITARY SPECIFICATIONS. AS CAN BE SEEN, COPPER AS CUPROUS OXIDE HAS HAD THE MOST EXTENSIVE USE.

THE ACTUAL AMOUNT OF ANTIFOULING PAINT, RED LEAD PRIMER, AND ZINC CHROMATE PRIMER WAS IMPOSSIBLE TO ASCERTAIN ACCURATELY. SOME SHIPYARDS ONLY KEPT TOTALS OF GALLONS USED WITH NO REGARD AS TO KIND. AS NEARLY AS COULD BE DETERMINED, ABOUT 63,000 GALLONS OF PAINT WERE USED ON BOTTOMS OF VESSELS. OF THE TOTAL, 30,000 GALLONS WERE ANTIFOULING, 23,000 GALLONS RED LEAD PRIMER AND 10,000 GALLONS OF ZINC CHROMATE PRIMER. PAINT USAGE, WEIGHT PER GALLON, WEIGHT OF COMPOUNDS, AND PERCENT COMPOSITION ARE GIVEN IN TABLE 5.

TAKING INTO ACCOUNT THE VARIOUS SANDBLASTING OPERATIONS IT HAS BEEN ESTIMATED, BY WORKERS, MANAGERS AND PERSONAL OBSERVATIONS, THAT 5 TO 10 PERCENT OF THE SANDBLASTING SAND AND DEBRIS ENTERS SAN DIEGO BAY. CONSIDERING THE WORST CONDITION OF 10 PERCENT, THEN 335 TONS OF SAND, 27 TONS OF COPPER OXIDE, 3 TONS LEAD OXIDE AND 1 TON OF ZINC CHROMATE ENTERED THE BAY DURING 1971 FROM SANDBLASTING ALONE, (ASSUMING ALL PAINT USED IS ALSO REMOVED EACH YEAR, AN OVER SIMPLIFICATION).

O. AND SOLVENTS FROM SHIPYAR... ARE GENERALLY PUMPED TO BARRELS OR H... DING TANK. WHICH ARE EVENTUALLY HAULED AWAY. NO EVIDENCE WAS FOUND WHERE OIL AND SOLVENTS WERE PERMITTED TO ENTER THE BAY.

Core Sample Analyses

On March 7, 1972, core samples were obtained at eleven selected sites within San Diego Bay (Figure 1). A standard Phleger Corer was used to obtain two replicate cores from each station. A description of each station as well as the lithological description of each core is given in Table 6.

The analyses for metals in each core sample were performed by the Regional Board's contract laboratory, Environmental Engineering Laboratory. The results of the analyses are shown in Table 7.

Results of the core sampling indicate that concentrations of metals were higher near shipbuilding and repair facilities than those from the center of the bay. All stations were ranked in order of total metal concentrations. The five stations exhibiting the highest total concentrations of metals are: Station 3, Mothball Fleet, Mole Pier; Station 9, Shelter Island Commercial Basin, Kettenburg Marine; Station 2, National Steel and Shipbuilding, south dry dock; Station 10, Shelter Island Commercial Basin, Harbor Boat; and Station 1, San Diego Marine Construction, south dry dock. The greatest concentrations of copper, mercury and arsenic were found in the Shelter Island Commercial Basin. The stations ranked in order of highest concentrations are given in Table 8. The results from the lead and chromium analyses were inconclusive. For these elements values of less than 2.0 milligrams per liter (mg/L) were given for all stations. The data for these elements are questionable.

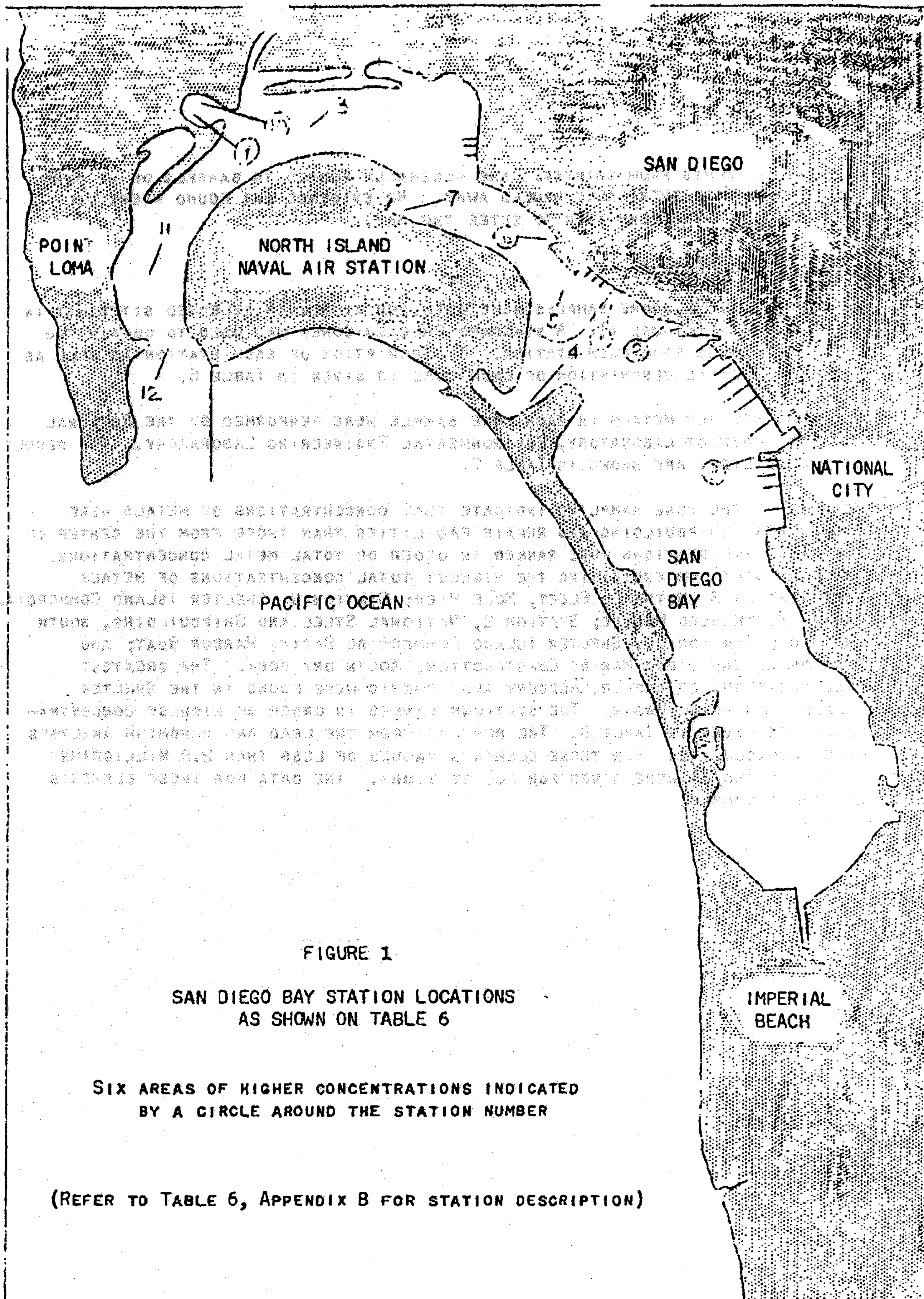

FIGURE 1

SAN DIEGO BAY STATION LOCATIONS
AS SHOWN ON TABLE 6

SIX AREAS OF HIGHER CONCENTRATIONS INDICATED
BY A CIRCLE AROUND THE STATION NUMBER

(REFER TO TABLE 6, APPENDIX B FOR STATION DESCRIPTION)

VI. TOXICITY

Variable Factors

The toxic effects of heavy metals or their salts are highly complicated because of variable factors, both physiological and environmental, that can alter the responses of fish and marine organisms to specific constituents. Some of the most significant of these variables shall be considered.

The effects of harmful substances on marine organisms vary with species, age, and physiological condition of the individuals. Water favorable for some species may not necessarily be adequate for others that have been adapted to different conditions. Some organisms may be acclimated to some toxicants over a long period of time and may survive higher concentrations than normal.

The effects of deleterious substances on marine organisms may vary with the physical and chemical composition of the water; for example, the damaging effects of toxic materials are greater in soft water than in hard water. Decreased oxygen concentrations and increased temperature tend to increase the susceptibility of some organisms to toxicants. Interrelationships between the dissolved constituents of the water are extremely important. By synergistic action, the combined influence of several substances simultaneously may result in greater damage to organisms than the sum of the individual effects taken independently. For example, a combination of cadmium and zinc, or nickel and cobalt salts are additive in effect, but combinations of copper and zinc, or copper and cadmium, or nickel and zinc salts can produce up to five times the reaction that would be expected if the effect were simply additive /1/. On the other hand, certain combinations of salts act antagonistically to reduce the injurious effects of each. For example, mixtures of salts have become progressively less toxic when calcium chloride, then potassium chloride, and finally magnesium chloride, have been added to a sodium chloride solution.

Many references to toxicity of metals give the concentration of the metal cation with no mention of the anion. Since the concentration of metals in solution is dependent on the solubility of the metal salt, the anionic constituent becomes very important. The solubility of metallic salts will vary greatly. Some general solubility rules may be found in Table 9.

Copper

Copper is found in ocean waters in concentrations from 0.003 mg/l to 0.05 mg/l /2/.

Metallic copper is used in many alloys, extensively in the electrical industry, for pipes and tubing, and for many purposes where its conductivity or corrosion resistance are important. Copper salts are used in electroplating, photography,

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/1/ McKee and Wolf, Water Quality Criteria, Publication No. 3-A, State Water Resources Control Board, California, 1963

/2/ Goldberg, E. D., "The Oceans as a Chemical System," The Sea, Vol. 2, pp. 4-5

PESTICIDES, PIGMENTATION AND OTHER INDUSTRIAL PROCESSES. METALLIC COPPER IS INSOLUBLE IN WATER, BUT MANY COPPER SALTS ARE HIGHLY SOLUBLE AS CUPRIC OR CUPROUS IONS. COPPER OXIDES ARE ONLY SLIGHTLY SOLUBLE IN WATER.

COPPER MAY BE BENEFICIAL OR EVEN ESSENTIAL FOR THE GROWTH OF LIVING ORGANISMS, IN EXCESSIVE QUANTITIES IT HAS BEEN FOUND TO BE TOXIC. COPPER IS CONCENTRATED BY MARINE ORGANISMS FROM THE SURROUNDING WATER. CONCENTRATION FACTORS ARE THE NUMBER OF TIMES THE METAL IS CONCENTRATED OVER THAT EXISTING IN THE WATER. FOR EXAMPLE, A FACTOR OF 5000 FOR MARINE INVERTEBRATES IN NATURAL SEAWATER WITH A CONCENTRATION OF 0.05 MG/L WOULD GIVE 250 MG/L IN THE ASH OF THE ORGANISMS.

ORGANISM	CONCENTRATION FACTOR
ALGAE	1,840-3,040
MARINE BACTERIA	990
MARINE INVERTEBRATES	5,000

IT HAS BEEN SHOWN THAT COPPER CONCENTRATIONS OF 10-30 MG/L KILLED BARNACLES IN 2 HOURS AND 0.22-1.0 MG/L KILLED BARNACLES IN 2-10 DAYS.

THE MOSQUITO-FISH GAMBUSIA AFFINIS WAS FOUND TO TOLERATE CUPRIC OXIDE CONCENTRATION OF 56,000 MG/L FOR 96 HOURS /3/.

SYNERGISTIC EFFECTS HAVE BEEN DEMONSTRATED BETWEEN COPPER AND ZINC AND BETWEEN COPPER AND MERCURY.

LEAD

LEAD IS FOUND IN OCEAN WATERS IN CONCENTRATIONS OF 0.00003 MG/L /4/. SOURCES OF LEAD POLLUTION IN THE MARINE ENVIRONMENT INCLUDE LEAD FROM WATER CRAFT, INDUSTRIAL DISCHARGE, NATURALLY OCCURRING LEAD DEPOSITS, LEAD-BASED PESTICIDES, FROM AIR POLLUTANTS THROUGH PRECIPITATION, AND LEAD PIPES AND CONTAINERS. LEAD, LIKE OTHER HEAVY METAL COMPOUNDS, IS RELATIVELY INSOLUBLE IN WATER BUT DOES OCCUR AND CAN BE BIOLOGICALLY CONCENTRATED BY MARINE ORGANISMS. TOWNMAN ET AL (1970) FOUND THE FOLLOWING:

ORGANISM	CONCENTRATION FACTOR
BENTHIC ALGAE	700
PHYTOPLANKTON	40,000
ZOOPLANKTON	3,000
MOLLUSC (WHOLE ANIMAL)	4,000
MOLLUSC (MUSCLE ONLY)	40

/3/ MCKEE AND WOLF, OP CIT

/4/ GOLDBERG, E. D., OP CIT

WALLEN ET AL (1957) TESTED THE TOXICITY OF INSOLUBLE LEAD OXIDE (PbO) TOWARD THE MOSQUITO FISH (Gambusia affinis) IN WATER WITH A pH RANGE OF 7.1 TO 7.2 AND TEMPERATURE RANGE OF 18 TO 20° C. HE FOUND THAT THE 96-HOUR TOLERANCE LIMIT WAS GREATER THAN 56,000 MG/L. APPARENTLY INSOLUBLE LEAD IS NOT TOXIC TO THIS FISH.

ZINC

ZINC HAS BEEN FOUND IN SEA WATER IN CONCENTRATIONS OF 0.01 MG/L /5/.

ZINC OCCURS ABUNDANTLY IN ROCKS AND ORES AND IS READILY REFINED INTO A STABLE PURE METAL WHICH IS USED EXTENSIVELY FOR GALVANIZING, IN ALLOYS, PRINTING PLATES, DYE MANUFACTURING AND OTHER INDUSTRIAL USES. ZINC SALTS ARE USED IN PAINT, PIGMENTS, DYES AND INSECTICIDES. ZINC CHLORIDE AND ZINC SULFATE ARE HIGHLY SOLUBLE IN WATER BUT ZINC CARBONATE, ZINC OXIDE, ZINC SULFIDE AND ZINC CHROMATE ARE INSOLUBLE. ZINC FROM SOME SALTS MAY PRECIPITATE AND SETTLE TO THE BOTTOM IN THE MARINE ENVIRONMENT.

ZINC IS CONCENTRATED FROM THE SURROUNDING WATER IN SOME MARINE ORGANISMS BY THE FOLLOWING FACTORS:

ORGANISM	CONCENTRATION FACTOR
ALGAE	312- 67,800
BROWN ALGAE	400- 1,400
MARINE BACTERIA	290
MARINE INVERTEBRATES	5,000
OYSTERS (WHOLE)	200,000
OYSTERS (MEAT ONLY)	1,400

CONCENTRATIONS OF 0.1 TO 1.0 MG/L HAVE BEEN REPORTED TO BE LETHAL TO SOME FISH AND AQUATIC ORGANISMS.

COPPER APPEARS TO HAVE A SYNERGISTIC EFFECT ON THE TOXICITY OF ZINC.

ARSENIC

ARSENIC IN SEA WATER IS HIGHLY VARIABLE BUT GENERALLY FALLS IN THE RANGE 0.003 TO 0.050 MG/L. SOURCES OF ARSENIC IN THE MARINE ENVIRONMENT INCLUDE NATURAL DEPOSITS, INDUSTRIAL DISCHARGES, PESTICIDES, COMBUSTION OF SULFUR-BEARING COALS, DETERGENTS, SMELTING OF ORES AND IN ANTIFOULING PAINTS.

/5/ GOLDBERG, IBID

ARSENIC LIKE MANY OTHER TOXIC SUBSTANCES CAN BE BIOLOGICALLY CONCENTRATED AND MAGNIFIED THROUGH FOOD CHAINS. LOWMAN ET AL (1970) SUMMARIZED CONCENTRATION FACTORS FOR ARSENIC IN THE MARINE ENVIRONMENT.

ORGANISM	CONCENTRATION FACTOR
BENTHIC ALGAE	2,000
MOLLUSC (MUSCLE ONLY)	650
CRUSTACEA (MUSCLE ONLY)	400
FISH (MUSCLE ONLY)	700

CONCENTRATIONS OF 1-18 MG/L HAVE BEEN REPORTED AS TOXIC TO FISH AND CRUSTACEA (MCKEE AND WOLF, 1963).

MERCURY

MERCURY HAS BEEN FOUND IN SEA WATER IN CONCENTRATIONS OF 0.00003 MG/L.

ELEMENTAL MERCURY IS RATHER INERT CHEMICALLY AND INSOLUBLE IN WATER AND IS NOT LIKELY TO OCCUR AS A WATER POLLUTANT. MERCURIC SALTS OCCUR IN NATURE USUALLY AS THE SULFIDE. NUMEROUS SYNTHETIC ORGANIC AND INORGANIC SALTS OF MERCURY ARE USED COMMERCIALLY AND INDUSTRIALLY AS MEDICINAL PRODUCTS, DISINFECTANTS, PHOTOENGRAVING, PIGMENTS, HERBICIDES, FUNGICIDES AND IN SOME ANTI-FOULING PAINTS. MANY OF THE MERCURIC AND MERCUROUS SALTS ARE HIGHLY SOLUBLE IN WATER.

MERCURY IS CONCENTRATED IN THE FOOD CHAIN, AS HAS BEEN DESMONSTRATED BY CONCENTRATIONS 0.5 PART PER MILLION (PPM) IN TUNA AND UP TO 1.5 PPM IN SWORDFISH FOUND IN LOCALLY CAUGHT FISH.

COPPER HAS A SYNERGISTIC EFFECT ON THE TOXICITY OF MERCURY SOLUTIONS. MERCURY WAS FOUND TO BE MORE TOXIC TO KELP THAN COPPER, HEXAVALENT CHROMIUM, ZINC, NICKEL AND LEAD /6/.

NICKEL

NICKEL IS FOUND IN SEA WATER IN CONCENTRATIONS OF 0.002 MG/L /7/.

ELEMENTAL NICKEL SELDOM OCCURS IN NATURE, BUT NICKEL COMPOUNDS ARE FOUND IN MANY ORES AND COMPOUNDS. AS A PURE METAL IT IS NOT A PROBLEM IN WATER POLLUTION BECAUSE IT IS NOT AFFECTED BY, OR SOLUABLE IN, WATER. MANY NICKEL SALTS, HOWEVER, ARE HIGHLY SOLUABLE IN WATER AND ARE USED IN METAL-PLATING FACILITIES WHICH MAY DISCHARGE TO THE MARINE ENVIRONMENT. NICKEL APPEARS TO BE LESS TOXIC TO FISH AND WILDLIFE THAN COPPER, ZINC OR IRON. NICKEL CHLORIDE SEEMS TO BE LESS TOXIC TO FISH IN SALT WATER THAN IN FRESH WATER.

/6/ CLENDENNING, K. A. AND NORTH, W. S., "EFFECTS OF WASTES ON THE GIANT KELP, MARCOCYSTIS PYRIFERA." PROCEEDINGS, FIRST INTERNATIONAL CONFERENCE ON WASTE DISPOSAL IN THE MARINE ENVIRONMENT, P. 82, PERGAMON PRESS, N.Y. (1960)

/7/ GOLDBERG, OP CIT

Clendenning and North /8/ measured the effects of many heavy metals on the rate of photosynthesis by the giant kelp, <u>Marcocystis pyrifera</u>. They found that nickel sulfate showed no appreciable effect at 1.31 mg/l as nickel, but gave a 50 percent reduction in photosynthesis in 4 days at 13.1 mg/l.

<u>Chromium</u>

Chromium has been found in natural ocean waters in concentrations of 0.00005 mg/l to 0.00025 mg/l.

Hexavalent chromium salts are used extensively in metal pickling and plating operations, in anodizing aluminum, in the leather industry as a tanning agent, in the manufacture of paints, dyes, explosives, ceramics, paper and other substances. Hexavalent chromium as chromate ion ($CrO_4^{=}$) is used extensively in zinc chromate primers. Of the hexavalent chromate salts, only sodium, potassium, and ammonium chromates are soluble while zinc chromate is insoluble.

Fish have been found to be relatively tolerant of chromium salts, but lower forms of aquatic life are extremely sensitive. Some algae may concentrate chromium from the surrounding water by factors of 500-1400 /9/.

/8/ Clendenning and North, op cit
/9/ Abbott, W., "Metallurgical Mariculture—Fiction or Foresight?," <u>Ocean Industry</u>, pp. 43-44 (June 1971)

BAY CITY MARINE INC.
1860 BAY FRONT STREET
SAN DIEGO, CALIFORNIA

ACTIVITY: SHIPBUILDING AND REPAIR

FACILITY: ONE MARINE RAILWAY, 76 FT. CAPACITY

APPROXIMATE WORK PERFORMED DURING 1971:

20 BOATS, 30-76 FT., AVERAGE 50 FT.
ALL REQUIRE PAINTING
10 BOATS SANDBLASTED—AIR BLASTING
40 GAL. PAINT, PROLINE, DEVOE, BENTON

GENERAL OBSERVATIONS:

THIS SMALL BOAT YARDCAN ACCOMMODATE BOATS TO 76 FEET IN LENGTH. FOULING ORGANISMS ARE SCRAPED WHILE BOAT IS ON WAYS AND THE ORGANISMS REMAIN ON SHORE. AIR SANDBLASTING IS USED ON SOME SHIPS; THE SAND AND DEBRIS REMAIN AROUND WAYS OR IS USED AS FILL ALONG EDGE OF THE BAY. SOME SANDBLASTING IS DONE IN A SHED ON PREMISES.

PAINTING IS BY BRUSH, ROLLER OR AIR GUN. SOME BOATS REQUIRE A 5 COAT SYSTEM.

OIL IS PUMPED TO BARRELS AND HAULED AWAY TO A DISPOSAL SITE BY PERSONNEL OR BY A TANK CLEANING SERVICE.

CAMPBELL INDUSTRIES
8TH AVENUE
SAN DIEGO, CALIFORNIA

ACTIVITY: SHIPBUILDING AND REPAIR

FACILITY: FOUR DRY DOCKS (3000 TON, TWO 1500 TON, 300 TON CAPACITY)
THREE MARINE RAILWAYS

APPROXIMATE WORK PERFORMED DURING 1971:

81 SHIPS, 100 FT. TO OVER 400 FT.
ALL HAULED FOR PAINTING
- 46 STEEL
- 1 ALUMINUM
- 34 WOOD

28 SHIPS SANDBLASTED, AVERAGE 5-10 TON SAND EACH
12,000 GAL. PAINT, DEVOE, PROLINE, CAPE COD
4,000 OF THE TOTAL (APPROXIMATELY) WAS ANTIFOULING PAINT

GENERAL OBSERVATIONS:

THIS IS ONE OF THE LARGER SHIPYARDS IN SAN DIEGO. SANDBLASTING IS DONE IN THE DRY DOCKS AND TO A LIMITED EXTENT ON THE MARINE RAILWAYS. PERHAPS 200 TON OF SAND WERE USED AT THIS FACILITY. MOST OF THE SAND IS CLEANED FROM DRY DOCKS AND WAYS. AS MUCH AS 10 PERCENT OF THE SAND AND DEBRIS MAY BE LOST TO THE BAY. THERE ARE NO FACILITIES FOR REMOVAL OF SEWAGE OR OIL AFTER THE SHIP IS DRY DOCKED. OIL FROM TANKS AND BILGES IS REMOVED PRIOR TO DRY DOCKING.

ALL METHODS OF PAINTING ARE USED AT THIS FACILITY. MILITARY VESSELS REQUIRE A 5 COAT SYSTEM; OTHER SHIPS MAY GET ONLY ONE COAT.

DRISCOLL CUSTOM BOAT
2438 SHELTER ISLAND DRIVE
SAN DIEGO, CALIFORNIA

ACTIVITY: BOAT BUILDING AND REPAIR

FACILITY: ONE MARINE RAILWAY, 50 FT. CAPACITY
ONE LARGE CRANE, 80 FT. CAPACITY

APPROXIMATE WORK PERFORMED DURING 1971:

260 BOATS, 20-80 FT., AVERAGE 40-50 FT.
ALL REQUIRE PAINTING
6 BOATS WET SANDBLASTED
400 GAL. PAINT, INTERNATIONAL, WOOLSEYS

GENERAL OBSERVATIONS:

THIS SMALL BOAT YARD CAN ACCOMMODATE BOATS TO 80 FT. LONG, MOSTLY SAILBOATS. MOST SAILBOATS REQUIRE SANDBRUSHING TO CLEAN THE BOTTOM BEFORE PAINTING. ABOUT 6 BOATS ARE WET BLASTED; THE MATERIAL REMAINS ON THE PREMISES. MOST BOATS ARE OF WOOD AND FIBERGLASS MATERIAL. THE PAINTING IS ACCOMPLISHED BY BRUSH OR ROLLER.

NO OIL IS REMOVED FROM THE VESSELS; ALL OIL CHANGES ARE DONE AT FUEL DOCKS.

HARBOR BOAT AND YACHT
4960 HARBOR DRIVE
SAN DIEGO, CALIFORNIA

ACTIVITY: SHIP REPAIR AND PAINTING

FACILITY: TWO MARINE RAILWAYS, 160 FT. CAPACITY

APPROXIMATE WORK PERFORMED DURING 1971:

100 BOATS, 45-160 FT. IN LENGTH
80 BOATS FOR PAINTING AND CLEANING
10 BOATS REQUIRED AIR SANDBLASTING, 100-120 FT. IN LENGTH
3,600 GAL. OF PAINT AND PRIMER, PROLINE, INTERNATIONAL
1,200 GAL. ANTIFOULING

GENERAL OBSERVATIONS:

THIS MEDIUM SIZED YARD CAN ACCOMMODATE SEVERAL VESSELS AT ONE TIME. MOST BOATS ARE STEEL-HULL NAVY OR FISHING CRAFT. THE BOATS ARE SCRAPED ON THE WAYS; THE FOULING ORGANISMS ARE WASHED INTO THE BAY. SANDBLASTING OPERATIONS ARE SUBCONTRACTED TO R. W. LITTLE COMPANY. THE BOATS ARE AIR SANDBLASTED AND THE SAND AND DEBRIS REMAIN ON THE PREMISES, BUT ARE CLEANED EVERY 4-5 YEARS.

THE BOATS ARE PAINTED BY BRUSH, ROLLER OR AIRLESS SPRAY GUN. MILITARY VESSELS REQUIRE A 5 COAT SYSTEM.

OIL FROM ENGINES OR BILGES IS PUMPED TO 55 GAL. DRUMS AND HAULED AWAY BY YARD PERSONNEL.

KETTENBURG MARINE
2810 CARLETON STREET
SAN DIEGO, CALIFORNIA

ACTIVITY: BOAT BUILDING, REPAIR, PAINTING

FACILITY: ONE MARINE RAILWAY, 30 TON, 20-45 FT. CAPACITY
ONE MARINE RAILWAY, 70 TON, 50-75 FT. CAPACITY
ONE STRADDLE SLING, 20 TON, 18-40 FT. CAPACITY

APPROXIMATELY WORK PERFORMED DURING 1971:

1,880 BOATS, 20-75 FT. MOSTLY WOOD AND FIBERGLASS
99 PERCENT ARE FOR BOTTOM PAINT
10 BOATS REQUIRE WATER SANDBLASTING
3,300 GAL. OF AF PAINTS INTERNATIONAL, BROLITE, PETTIT

GENERAL OBSERVATIONS:

THIS MEDIUM SIZED YARD CAN ACCOMMODATE 20-30 VESSELS AT ONE TIME. MOST BOATS ARE WOOD OR FIBERGLASS PLEASURE CRAFT. THE BOATS ARE SCRAPED ON THE WAYS OR ON CRADLES. THE FOULING ORGANISMS ARE SWEPT OR WASHED INTO THE BAY; SOME ARE PICKED UP AND PLACED IN TRASH CONTAINERS. SANDBLASTING BY WET BLASTING CAN BE DONE ANYWHERE IN THE YARD. ALL SANDBLASTED MATERIAL IS WASHED INTO THE BAY.

PAINTING IS ACCOMPLISHED BY BRUSH, ROLLER OR AIRLESS GUN.

OIL FROM ENGINES IS PUMPED TO 55 GAL. DRUMS AND HAULED AWAY.

KOEHLER KRAFT CO.
2302 SHELTER ISLAND DRIVE
SAN DIEGO, CALIFORNIA

ACTIVITY: SMALL BOAT REPAIR AND PAINTING

FACILITY: ONE MARINE RAILWAY, 50 FT. BOAT CAPACITY

APPROXIMATE WORK PERFORMED DURING 1971:

50 BOATS AVERAGE 25 FT. IN LENGTH
ALL BOATS FOR BOTTOM PAINTING AND REFINISHING
6 BOATS REQUIRED SANDBLASTING BY WET BLASTING METHOD
25 GAL. OF BOTTOM PAINT ARE USED, USUALLY PETTIT OR INTERNATIONAL

GENERAL OBSERVATIONS:

THIS SMALL BOAT YARD CAN ACCOMMODATE ONLY 3–4 BOATS AT ONE TIME. MOST BOATS ARE WOOD OR FIBERGLASS CONSTRUCTION. THESE BOATS ARE GENERALLY SCRAPED CLEAN WHILE ON THE WAYS; THE ORGANISMS REMAIN ON SHORE OR ARE SWEPT TO THE BAY. THE BOTTOM IS THEN BRUSHED WITH WET SAND TO REMOVE LOOSE PAINT. WHEN SANDBLASTING IS REQUIRED, THE SAND AND DEBRIS REMAIN ON THE PREMISES.

THE BOATS ARE PAINTED BY ROLLER OR BRUSH AND REQUIRE ONLY ONE COAT.

MAURICIO AND SON, INC. (OWNED BY CAMPBELL INDUSTRIES)
2420 SHELTER ISLAND DRIVE
SAN DIEGO, CALIFORNIA

ACTIVITY: BOAT BUILDING AND REPAIR

FACILITY: ONE MARINE RAILWAY WITH SEVERAL STALLS, 50 FT. CAPACITY

APPROXIMATE WORK PERFORMED DURING 1971:

230 BOATS, 25-50 FT., AVERAGE 35 FT.
ALL REQUIRE PAINTING
SANDBLAST 18 FISHING SKIFFS ONLY
300 GAL. PAINT, TRIPLE C, INTERNATIONAL, PROLINE

GENERAL OBSERVATIONS:

THIS SMALL BOAT YARD CAN ACCOMMODATE BOATS TO 50 FT. LONG AND ABOUT 15 AT ONE TIME. THE BOATS ARE SCRAPED ON THE WAYS OR ON CRADLES. THE FOULING ORGANISMS ARE WASHED INTO THE BAY; SOME ARE CLEANED UP AND PLACED IN TRASH CONTAINERS. THE SANDBLASTING IS DONE IN A BUILDING AND ONLY ON NEW STEEL SKIFFS. NONE OF THE SANDBLASTING MATERIAL ENTERS THE BAY. THE BUILDING IS CLEANED ABOUT ONCE A YEAR.

PAINTING IS ACCOMPLISHED BY BRUSH, ROLLER OR SPRAY GUN.

OIL AND SOLVENTS ARE PLACED IN 55 GAL. DRUMS AND HAULED AWAY.

NATIONAL STEEL AND SHIPBUILDING
HARBOR DRIVE AND 28TH STREET
SAN DIEGO, CALIFORNIA 92112

ACTIVITY: SHIPBUILDING AND REPAIR

FACILITY: ONE 2,800 TON DRY DOCK
FIVE MARINE RAILWAYS TO 900 FT. CAPACITY

APPROXIMATELY WORK PERFORMED DURING 1971:

7 NEW SHIPS BUILT, 510 FT., STEEL
58 SHIPS HAULED AND PAINTED, STEEL HULLS
55 SHIPS OF THE 58 WERE SANDBLASTED
1,750 TON OF MONTEREY BEACH SAND WERE USED
15,000 GAL. OF RED LEAD PRIMER (VINYL), FORMULA 119
9,000 GAL. OF ANTIFOULING, RED (VINYL), FORMULA 121

GENERAL OBSERVATIONS:

THIS IS THE LARGEST SHIPBUILDING AND REPAIR FACILITY IN SAN DIEGO BAY. MOST OF THE SHIPS ARE BETWEEN 200 FT. AND 500 FT. IN LENGTH. MOST OF THE SHIPS ARE SANDBLASTED BEFORE PAINTING. IT WAS REPORTED BY S. W. SMITH, THAT MONTEREY BEACH SAND IS USED FOR SANDBLASTING. SANDBLASTING IS DONE IN DRY DOCKS AND ON WAYS. MOST OF THE SAND AND DEBRIS ARE REMOVED BY TRUCK AND HAULED TO A DUMP.

ALL METHODS OF PAINTING ARE EMPLOYED AT THIS YARD. MILITARY VESSELS GENERALLY REQUIRE A 5 COAT SYSTEM OF PAINTING.

OIL FROM TANKS AND BILGES IS PUMPED TO HOLDING TANKS.

SEWAGE IS DISCHARGED FROM SHIPS THROUGH SCUPPERS AND HOSES THE THE BAY. ON MOST MILITARY VESSELS, THE CREW REMAINS ABOARD DURING REPAIR.

NELSON BOAT AND YACHT COMPANY
2390 SHELTER ISLAND DRIVE
SAN DIEGO, CALIFORNIA

ACTIVITY: SMALL BOAT BUILDING AND REPAIR

FACILITY: ONE MARINE RAILWAY LEADING TO SEVERAL STALLS, 65 FT. CAPACITY

APPROXIMATE WORK PERFORMED DURING 1971:

392 BOATS, AVERAGE 35-40 FT. IN LENGTH
ALL BOATS FOR BOTTOM PAINTING AND REFINISHING
8 BOATS REQUIRED WET SANDBLASTING
784 GAL. OF PAINT ARE USED, USUALLY BROLITE AND INTERNATIONAL

GENERAL OBSERVATIONS:

THIS SMALL BOAT YARD CAN ACCOMMODATE SEVERAL BOATS AT ONE TIME DEPENDING ON SIZE. MOST BOATS ARE WOOD OR FIBERGLASS WITH A FEW METAL HULLS. THE BOATS ARE SCRAPED CLEAN OF FOULING ORGANISMS ON THE WAYS. THE ORGANISMS ARE LEFT ON THE WAYS OR SWEPT INTO THE BAY. WHEN SANDBLASTING IS REQUIRED, THE SAND AND DEBRIS REMAIN ON THE PREMISES.

THE BOATS ARE PAINTED BY BRUSH OR ROLLER AND USUALLY REQUIRE ONLY ONE COAT.

ENGINE OIL IS PLACED IN 55 GAL. DRUMS AND HAULED AWAY FOR DISPOSAL.

RASK BOAT BUILDING
1511 . 'RINE WAY
CORONADO, CALIFORNIA

ACTIVITY: BOAT REPAIR

FACILITY: ONE MARINE RAILWAY, 40 FT. CAPACITY

APPROXIMATE WORK PERFORMED DURING 1971:

60 BOATS, AVERAGE 30-40 FT.
30 FOR PAINTING
NO SANDBLASTING
250 GAL. ANTIFOULING PAINT, TRIPLE C, AMERICAN MARINE

GENERAL OBSERVATIONS:

ABOUT 70 PERCENT OF THE WORK IS MILITARY AND 30 PERCENT PRIVATE VESSELS. NONE ARE SANDBLASTED BUT ARE CLEANED BY WET SAND BRUSHING.

MOST PAINTING IS DONE BY BRUSH AND ROLLER.

BILGES ARE NOT CLEANED AND NO OIL CHANGES ON ANY VESSELS.

ROHR AIRCRAFT
G STREET
CHULA VISTA, CALIFORNIA

ACTIVITY: SHIPBUILDING (LCM-8)

FACILITY: CRANE TO LIFT BOATS IN AND OUT OF WATER

APPROXIMATE WORK PERFORMED DURING 1971:

25 LANDING CRAFT BUILT, 84 FT. BY 21 FT.
ALL WERE COMPLETELY PAINTED
115 GAL. PER BOAT, OF WHICH 40 GAL. WERE AF
2,875 GAL. TOTAL, INTERNATIONAL, DEVOE

GENERAL OBSERVATIONS:

THIS YARD IS INVOLVED IN NEW CONSTRUCTION ONLY. ALL BOATS ARE AIR SANDBLASTED BEFORE PAINTING. SAND AND DEBRIS ARE SWEPT, SCOOPED UP, THEN HAULED AWAY.

THE BOATS ARE PAINTED BY SPRAY GUN.

SAN DIEGO MARINE CONSTRUCTION (STAR AND CRESCENT COMPANY)
SAMPSON STREET
SAN DIEGO, CALIFORNIA

ACTIVITY: SHIPBUILDING AND REPAIR

FACILITY: TWO DRY DOCKS, 360 FT. AND 220 FT. CAPACITY
THREE MARINE RAILWAYS TO 100 FT. CAPACITY

APPROXIMATE WORK PERFORMED DURING 1971:

76 SHIPS, 50-390 FT., AVERAGE 125 FT.
6 NEW SHIPS, 70 REFINISHED
20-50 PERCENT ARE SANDBLASTED
8,000 GAL. OF PAINT AND PRIMER, PROLINE

GENERAL OBSERVATIONS:

THIS LARGE SHIPYARD CAN ACCOMMODATE SHIPS TO 390 FT. IN LENGTH. ABOUT 80 PERCENT ARE CONSTRUCTED FROM STEEL, 15 PERCENT FROM WOOD AND 5 PERCENT FROM FIBERGLASS. AIR SANDBLASTING WITH BLACK SAND IS USED TO STRIP VESSELS TO BARE METAL. SANDBLASTING IS CARRIED OUT IN DRY DOCKS AND ON WAYS. SAND AND DEBRIS ARE USED AS A LANDFILL OR ARE SPREAD OVER THE YARD. MOST OF THE SAND IS REMOVED, BUT IT WAS ESTIMATED THAT 5-10 PERCENT MAY BE LOST TO THE BAY.

ALL METHODS OF PAINTING ARE EMPLOYED AT THIS FACILITY. MILITARY SHIPS GENERALLY REQUIRE A 5 COAT SYSTEM IN PAINTING.

OIL FROM BILGES AND TANKS IS PUMPED BY PEPPER TANK CLEANING SERVICE AND HAULED AWAY.

NO SEWAGE PUMP-OUT FACILITIES ARE PROVIDED AT THIS YARD.

SHELTER ISLAND YACHT WAYS
2330 SHELTER ISLAND DRIVE
SAN DIEGO, CALIFORNIA

ACTIVITY: BOAT REPAIR AND PAINTING

FACILITY: ONE MARINE RAILWAY, 40 FT. CAPACITY

APPROXIMATE WORK PERFORMED DURING 1971:

500-600 BOATS, AVERAGE 25-30 FT., WOOD AND FIBERGLASS
ALL REQUIRE BOTTOM PAINT
NO SANDBLASTING
400 GAL. AF PAINT INTERNATIONAL, BROLITE, PETTIT

GENERAL OBSERVATIONS:

THIS SMALL BOAT YARD CAN ACCOMMODATE BOATS TO 40 FT. AND ABOUT 15 AT ONE TIME. THE BOATS ARE SCRAPED, AND THE FOULING ORGAMISMS REMAIN ON THE WAYS.

PAINTING IS DONE BY BRUSH OR ROLLER.

OIL FROM ENGINES IS REMOVED IN 5 GAL. CANS AND PLACED IN TRASH CONTAINERS.

TRIPLE A SOUTH
3350 MAIN STREET
SAN DIEGO, CALIFORNIA

ACTIVITY: SHIP REPAIR

FACILITY: BOATS DELIVERED BY TRUCK

APPROXIMATE WORK PERFORMED DURING 1971:

12 BOATS, 26-73 FT., AVERAGE 56 FT.
ALL FOR REFINISHING
5 COAT SYSTEM
12-15 GAL. PAINT PER CRAFT
144 GAL. PAINT

GENERAL OBSERVATIONS:

THIS REPAIR FACILITY IS NOT LOCATED ON THE BAY.

WHITEMAN YACHTS
980 F STREET
CHULA VISTA, CALIFORNIA

THIS BOAT YARD IS NOT LOCATED DIRECTLY ON SAN DIEGO BAY AND PRODUCES ONE 90 FT. BOAT PER YEAR CONSTRUCTED OF ALUMINUM.

U. S. NAVAL STATION, SAN DIEGO
32ND STREET AND HARBOR DRIVE
SAN DIEGO, CALIFORNIA

ACTIVITY: SHIP REPAIR, SANDBLASTING, PAINTING, TANK CLEANING

FACILITY: ONE GRAVING DOCK, 17,000 TON CAPACITY (687 FT. LONG BY 82 FT. WIDE)

APPROXIMATE WORK PERFORMED DURING 1971:

21 SHIPS, AVERAGE LENGTH 500 FT.
5 SHIPS HAD COMPLETE BOTTOM REFINISHED (35,000 SQ.FT. EACH)
SANDBLASTING: 5 LB. SAND PER SQ.FT.
500 TON SAND PER YEAR
PAINTING: 100 SQ.FT. PER GALLON PER COAT
5 COAT SYSTEM:
1 COAT PRETREATMENT COATING, FORMULA 117
2 COATS PRIMER, FORMULA 120
2 COATS ANTIFOULING, FORMULA 121/63
4,500 GAL. TOTAL ALL COATS
2,000 GAL. ANTIFOULING CONTAINS 12.8 LB. ELEMENTAL COPPER/GAL.

GENERAL OBSERVATIONS:

THE U.S. NAVAL STATION HAS THE LARGEST SHIP HANDLING FACILITY IN SAN DIEGO BAY. THE NAVY LEASES THE FACILITY TO THE SAN DIEGO PORT DISTRICT, WHO THEN LEASES TO ONE OF THE LOCAL SHIPBUILDING AND REPAIR COMPANIES (TABLE 1). THE CONTRACTOR IS RESPONSIBLE FOR ALL ACTIVITIES WITHIN THE GRAVING DOCK SUCH AS OPERATION AND CLEANUP OF FACILITY AFTER EACH USE. THE NATURE OF WORK PERFORMED INCLUDES SONAR DOME CLEANING, PROPELLER AND RUDDER REPAIR, REPLACING ZINC ELECTROLYSIS PLATES, AND COMPLETELY REFINISHING BY SANDBLASTING AND PAINTING.

SANDBLASTING BY AIR AND BLACK SAND (BLACK BEAUTY, ANALYSIS IN TABLE 2). THE SAND, OLD FINISH AND DEBRIS IS SCOOPED UP INTO TUBS AND REMOVED FROM THE GRAVING DOCK. THE TUBS ARE DUMPED INTO TRUCKS AND THE MATERIAL HAULED TO A SANITARY FILL AREA. PERHAPS 5 PERCENT OF THE SAND AND DEBRIS IS LOST IN THE GRAVING DOCK PUMP-OUT SYSTEM AND EVENTUALLY ENTERS THE BAY.

OIL FROM TANKS AND BILGES, WHEN NECESSARY, ARE PUMPED TO A HOLDING TANK FOR STORAGE. THIS TANK IS PUMPED PERIODICALLY BY PEPPER TANK CLEANING SERVICE.

SEWAGE FROM DRY-DOCKED SHIPS IS PUMPED TO A HOLDING TANK AND THEN TO THE BAY. THE NAVY HAS PLANS TO CONNECT THIS HOLDING TANK TO THE SANITARY SEWER SOMETIME IN 1972-1973.

NAVAL AMPHIBIOUS BASE
CORONADO, CALIFORNIA

ACTIVITY: LANDING CRAFT TRAINING AND REPAIR

FACILITY: SEVERAL LARGE CRANES CAPABLE OF LIFTING LANDING CRAFT AND MOVING TO ANY LOCATION

APPROXIMATE WORK PERFORMED DURING 1971:

50-100 LANDING CRAFT ARE PAINTED EACH YEAR
20 LANDING CRAFT (48 FT. BY 15 FT.) WERE SANDBLASTED AND REPAINTED
1,000 GAL. PAINT, PRIMER AND ANTIFOULING

GENERAL OBSERVATIONS:

SAND BLASTING IS LIMITED TO TWO AREAS, ONE AT THE NORTHWEST CORNER AND ONE AT THE SOUTHEAST CORNER OF THE BASE. AIR SANDBLASTING IS THE METHOD USED. APPROXIMATELY 633 TON OF #16 SILICA SAND WERE USED THROUGHOUT THE BASE. THE SANDBLAST AREAS ARE LOCATED ABOUT 50 YARDS FROM THE BAY; THE SAND AND DEBRIS REMAIN ON THE PREMISES.

MOST BOATS THAT ARE PAINTED REQUIRE VERY LITTLE CLEANING. SAND BRUSHING IS USED TO CLEAN SOFT SPOTS. PAINTING IS ACCOMPLISHED BY BRUSH AND ROLLER.

OIL AND BILGE WATER ARE VACUUMED FROM BOATS AT THE PIER WHILE REFUELING. THE WATER AND OIL ARE PUMPED TO A HOLDING TANK TRAILER.

NORTH ISLAND CARRIER BASE
CORONADO, CALIFORNIA

It was reported by Capt. Morin, the maintenance officer of the Naval Air Station that no sandblasting or scraping of carriers is performed at North Island. Painting over existing paint and replacing of zinc plates are the only jobs performed. All major carrier work is done at San Francisco, California or Bremerton, Washington.

APPENDIX B

TABLE 1

MASTER SHIP REPAIR CONTRACT HOLDERS
ELEVENTH NAVAL DISTRICT

1. CAMPBELL INDUSTRIES N62791-72-C-0039 REP: FRED MACGURN	FOOT OF EIGHTH AVENUE SAN DIEGO, CA. 92112 PHONE: 233-7115
2. KETTENBURG MARINE, INC. N62791-70-C-0031 REP: JIM LAMM	2810 CARLETON STREET SAN DIEGO, CA. 92106 PHONE: 224-8211
3. NATIONAL STEEL & SHIPBUILDING CO. N62791-70-C-0032 REP: VIRGIL RIGGS	HARBOR DRIVE AT 28TH STREET SAN DIEGO, CA. 92112 PHONE: 232-4011, X-220
4. RASK BOATBUILDING COMPANY N62791-70-C-0033 REP: PETER RASK, JR.	1511 MARINE WAY CORONADO, CA. 92118 PHONE: 435-4181
5. SAN DIEGO MARINE CONSTRUCTION CO. N62791-70-C-0034 REP: HOWARD PRICE	FOOT OF SAMPSON STREET SAN DIEGO, CA. 92112 PHONE: 239-8051
6. TRIPLE A SOUTH N62798-70-C011 REP: ARTHUR ENGLE	3350 MAIN STREET SAN DIEGO, CA. 92113 PHONE: 234-7281
7. NELSON BOAT & YACHT CO. N62791-70-C-0036 REP: MRS. NELSON	2390 SHELTER ISLAND DRIVE SAN DIEGO, CA. 92106 PHONE: 222-0455
8. HARBOR BOAT & YACHT CO. N62791-70-C-0037 REP: PETE WOLD	4960 HARBOR DRIVE SAN DIEGO, CA. 92106 PHONE: 223-3133
9. BAY CITY MARINE, INC. N62791-72-C-0040 REP: FRANK MEDINA	1860 BAY FRONT STREET SAN DIEGO, CA. 92113 PHONE: 234-7400

TABLE 2

CHEMICAL COMPOSITION OF SANDBLASTING SAND

BLACK SAND (STATE OF INDIANA, DEPARTMENT OF PUBLIC HEALTH)

CONSTITUENT	PERCENT BY WEIGHT
CARBON	0.06
TITANIUM OXIDE	0.95
IRON OXIDE (FEO)	23.05
IRON (FE_2O_3)	4.45
PHOSPHORUS	0.11
SILICA (BOUND)	42.66 (NO FREE SILICA)
MANGANESE	0.04
ALUMINUM OXIDE	20.97
CALCIUM OXIDE	6.41
MAGNESIUM OXIDE	1.11
SULFATE	0.15
MOISTURE	0.04

TABLE 3

ACTIVE INGREDIENTS AND PERCENT BY WEIGHT
IN ANTIFOULING PAINTS AND PRIMERS

PAINTS

COMPOUND	PERCENT BY WEIGHT
Cuprous Oxide (Cu_2O)	up to 75.8
Bis (Tri-n-butyltin) Oxide	" " 10.0
Bis (Tri-n-butyltin) Fluoride	" " 22.0
Mercury Phenate	" " 6.5
Mercury Oxide	" " 1.4
Phenarsazine Chloride (Arsenic)	" " 6.4

PRIMERS

Zinc Chromate (16-19% CrO_3, 67-72% ZnO)	
Zinc (ZnO)	" " 45
Chromium (CrO_3)	" " 12
Red Lead (Pb_3O_4)	" " 25

TABLE 4

APPROXIMATE CONCENTRATIONS OF METALS
IN SOME PAINTS AND PRIMERS
(GRAMS PER LITER)*

MANUFACTURER	COPPER	ZINC	MERCURY	CHROMIUM	LEAD	ARSENIC	TBTF
INTERNATIONAL PAINT CO.							
No. 49	692						
62	420					26	
339	465						
340	449						
350	641						
449	734						
559	733						
669	733						
693	294		114				
694	560		129				
696	270		105				
1611	420					26	
3210	301						
3211	301						
5329	612						
39							120
41							120
43							120
44							120
BROLITE Z-SPAR							
No. P32	945						
P33	760						
P34	760						
B50	560						
B51	635						
B40							133
NAVICOTE							
No. M-078	820						
PETTIT							
No. AF-75	2000						
TRIPLE C	392						(TBTO) 34

*FOR PARTS PER MILLION (PPM) MULTIPLY BY 1000

TABLE 4
(CONT'D)

MANUFACTURER	COPPER	ZINC	MERCURY	CHROMIUM	LEAD	ARSENIC	TBTF
PROLINE (NO PRODUCT NUMBER)							
1	420						
2	120						
3	746						
4	623						
5	1160						
6	725						408
7							336
8							336
9							336
10							336
MILITARY SPECIFICATIONS							
FORMULA 20		120					
84		216		72			
116					415		
117		35		5			
119					274		
120		50		8			
121/63	1540						
129/63	940						

TABLE 5

USAGE, WEIGHT AND COVERAGE OF PAINT AND PERCENTAGES OF ELEMENTS IN COMPOUNDS

Approximate Paint Usage

63,000 gallons (minimum)
- 30,000 gallons antifouling
- 23,000 " red lead primer
- 10,000 " zinc chromate primer

Weight Per Gallon (approximate)

Antifouling paint	18–20 pounds per gallon
Red lead primer	10–13 " " "
Zinc chromate	9 " " "

Weight of Metal Compounds Calculated From Gallons Used

Cuprous oxide	540,000 lb.
Lead oxide (red lead)	57,500 "
Zinc chromate	20,000 "

Coverage of Paint (average)

200 square feet per gallon per coat
5 coats required on some ships

Elemental Metals in Compounds	Element	Percent
Cuprous oxide Cu_2O	Cu	89
Mercury phenate $Hg(C_6H_5O)_2$	Hg	52
Mercuric oxide HgO	Hg	93
Phenarsazine chloride	As	27
Zinc chromate		
16–19 percent CrO_3	Cr	10
67–72 " ZnO	Zn	58
Red lead Pb_3O_4	Pb	90

TABLE

SAN DIEGO BAY
CORE SAMPLING ANALYSES

SAMPLING DATE: 3-7-72 (ALL STATIONS)

STATION NUMBER	LOCATION AND DESCRIPTION OF CORES
1	SAN DIEGO MARINE CONSTRUCTION, SOUTH DRY DOCK (SDMC) A. 6 INCH CORE, BLACK SANDY SILT, STRONG SULFIDE ODORS B. 3 INCH CORE, BLACK SANDY SILT, STRONG SULFIDE ODORS NO ORGANISMS FOUND IN EITHER CORE.
2	NATIONAL STEEL AND SHIPBUILDING, SOUTH DRY DOCK (NASSCO) A. 16 INCH CORE, BLACK SILT, VERY STRONG SULFIDE ODOR B. 15 INCH CORE, BLACK SILT, VERY STRONG SULFIDE ODOR NO ORGANISMS FOUND IN EITHER CORE.
3	U.S. NAVAL STATION, 7TH STREET MOLE PIER (USNS) A. 4 INCH CORE, BROWN SANDY SILT, NO SULFIDE ODORS B. 4 INCH CORE, BROWN SANDY SILT, NO SULFIDE ODORS NO ORGANISMS FOUND IN EITHER CORE.
4	U.S. NAVAL AMPHIBIOUS BASE, CORONADO, NORTHWEST CORNER (USNAB) A. 7 INCH CORE, BROWN SANDY SILT, NO SULFIDE ODORS B. 7 INCH CORE, BROWN SANDY SILT, NO SULFIDE ODORS FEW POLYCHAETE WORMS IN BOTH CORES.
5	10TH AVENUE MARINE TERMINAL, MID-CHANNEL A. 1 INCH CORE, HARD BROWN SAND, NO SULFIDE ODORS B. 3 INCH CORE, HARD BROWN SAND AND DETRITUS, NO SULFIDE ODORS FEW POLYCHAETES IN CORE B.
6	CAMPBELL INDUSTRIES A. 16 INCH CORE, BLACK SANDY SILT, SLIGHT SULFIDE ODOR B. 16 INCH CORE, BLACK SANDY SILT, SLIGHT SULFIDE ODOR NO ORGANISMS FOUND IN EITHER CORE.
7	NORTH ISLAND CARRIER BASE (NICB) A. 14 INCH CORE, BLACK SILT, STRONG SULFIDE ODORS B. 13 INCH CORE, BLACK SILT, STRONG SULFIDE ODORS NO ORGANISMS FOUND IN EITHER CORE.

TABLE 6
(CONT'D)

STATION NUMBER	LOCATION AND DESCRIPTION OF CORES
8	SAN DIEGO BAY, BUOY 20 A. 5 INCH CORE, BROWN SAND, NO SULFIDE ODORS B. 4 INCH CORE, BROWN SAND, NO SULFIDE ODORS FEW POLYCHAETE WORMS IN BOTH CORES.
9	SHELTER ISLAND COMMERCIAL BASIN, KETTENBURG (SICB-K) A. 24 INCH CORE, BLACK SILT, STRONG SULFIDE ODORS B. 22 INCH CORE, BLACK SILT, STRONG SULFIDE ODORS NO ORGANISMS FOUND IN EITHER CORE.
10	SHELTER ISLAND COMMERCIAL BASIN, HARBOR BOAT (SICB-HB) A. 7 INCH CORE, BLACK SILT, SLIGHT SULFIDE ODOR B. 6 INCH CORE, BLACK SILT, SLIGHT SULFIDE ODOR NO ORGANISMS FOUND IN EITHER CORE.
11	SAN DIEGO BAY, BUOY 14 A. 2 INCH CORE, COARSE BROWN SAND, NO SULFIDE ODOR B. SEVERAL ATTEMPTS FOR A SECOND CORE ALL FAILED FEW POLYCHAETE WORMS IN CORE A.
12	SAN DIEGO BAY, BUOY 12 ROCKY, HARD BOTTOM, NO CORES POSSIBLE

TABLE 7

SAN DIEGO BAY
CORE SAMPLE ANALYSES

SAMPLING DATE: 3-7-72 (ALL STATIONS)
(PARTS PER MILLION DRY WEIGHT)

STATION NUMBER	ARSENIC	CHROMIUM	COPPER	LEAD	MERCURY	NICKEL	ZINC
1 SDMC							
A.	7.6	<2.0	37	<2.0	1.5	63	140
B.	1.1	"	130	"	2.4	60	140
2 NASSCO							
A.	3.9	"	150	"	1.9	62	300
B.	9.6	"	62	"	1.9	58	190
3 USNS							
A.	9.5	"	57	"	.96	57	140
B.	2.9	"	170	"	5.9	66	310
4 USNAB							
A.	8.4	"	9.8	"	1.1	35	37
B.	2.9	"	11	"	0.72	59	38
5 10TH AVENUE							
A.	0.26	"	14	"	0.44	43	69
B.	1.1	"	11	"	0.76	30	41
6 CAMPBELL							
A.	1.2	"	110	"	2.1	56	190
B.	0.70	"	29	"	1.9	67	93
7 NICB							
A.	<0.10	"	25	"	1.1	50	83
B.	0.94	"	23	"	1.1	40	77
8 BUOY 20							
A.	1.3	"	11	"	0.70	25	36
B.	<0.10	"	22	"	1.1	42	88
9 SICB-K							
A.	6.0	"	140	"	11.1	40	150
B.	10.0	"	130	"	8.5	42	140
10 SICB-HB							
A.	13.0	"	70	"	4.8	53	100
B.	6.9	"	100	"	6.7	55	130
11 BUOY 14							
A.	3.5	"	8.8	"	0.49	43	16

TABLE 8

SAN DIEGO BAY
CORE SAMPLE ANALYSES

ELEMENTS WITH STATION NUMBERS RANKED IN DESCENDING ORDER OF CONCENTRATION

	Rank										
Element	1	2	3	4	5	6	7	8	9	10	11
Zinc	2	3	9	6	1	10	7	8	5	4	11
Copper	9	3	2	10	1	6	7	8	5	4	11
Nickel	1	3	6	2	10	4	7	11	9	5	8
Arsenic	10	9	2	3	4	1	11	6	7	8	5
Mercury	9	10	3	6	1	2	7	4	8	5	11
Lead	All even										
Chromium	All even										

STATIONS OCCURRING IN THE FIVE HIGHEST CONCENTRATIONS FOR ALL METALS.

Station	Occurred	
Station 3	occurred 5	times in top five concentrations.
9	4	
2	4	
10	4	
1	4	
6	3	

TABLE 9

GENERAL RULES OF SOLUBILITY

	Chromium	Copper	Lead	Mercury	Nickel	Zinc
Acetate	+	+	+	+	+	+
Carbonate	–	–	–	–	–	–
Chloride	+	+	S	–	+	+
Chlorate	+	+	+	+	+	+
Chromate		–	–	–	–	–
Hydroxide	–	–	–	–	–	–
Nitrates	+	+	+	+	+	+
Oxides		S	–			–
Sulfate	+	+	–	+	+	+
Sulfide	–	–	–	–	–	–

+=Soluble
–=Not Soluble
S=Slightly Soluble

APPENDIX C

RL "RENCES

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CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
SAN DIEGO REGION

ERRATA SHEET
FOR

"STAFF REPORT ON WASTES ASSOCIATED WITH SHIPBUILDING AND REPAIR FACILITIES IN SAN DIEGO BAY"

CORRECTIONS:

PAGE	LINE	CHANGE
4	2	540,000 TO READ 450,000
10	38	27 TONS TO READ 23 TONS
11	24	PER LITER (MG/L) TO READ PER KILOGRAM (MG/KG.)
38	LAST	PARTS PER MILLION (PPM) TO MILLIGRAMS PER LITER (MG/L)
40	11	540,000 TO READ 450,000

DATED: AUGUST 10, 1972

1014

THE CITY OF SAN DIEGO

October 14, 2005

Lloyd A. Schwartz
BAE Systems San Diego Ship Repair Inc.
P.O. Box 13308
San Diego, CA 92186-5278

Dear Mr. Schwartz:

Subject: Unauthorized Discharge of Toxic Pollutants into the Municipal Storm Drain System

On October 3, 2005, Ruth Kolb, City of San Diego Storm Water Specialist, conducted an investigation and observed evidence of an illegal discharge into the storm water conveyance system catch basin on the north side of Sampson Street between Belt Street and Harbor Drive, approximately 10 feet east of the railroad line that runs parallel with Belt Street. Specifically, the catch basin is located immediately to the east of the BAE parking lot and the SDG&E Silvergate Power Plant which is adjacent to parking lot. During the investigation, three sediment samples were collected and analyzed for PCBs and PAHs (see attachment). The first sample was collected from inside and at the base of a six-inch lateral entering the catch basin from the east. The second sample was collected from inside and at the base of the 12-inch lateral entering the catch basin from the north. The third sample was collected from the 18-inch pipe exiting the catch basin. The results of theses three samples indicate the presence of both PCBs and PAHs entering and exiting the municipal storm drain system catch basin.

It appears that this unauthorized discharge into the municipal storm drain system originates from your facility. We would appreciate your assistance by complying with the attached Notice of Violation.

Storm Water Pollution Prevention Program
1970 B Street, MS 27A • San Diego, CA 92102
Hotline (619) 235-1000 Fax (619) 525-8641

2pgs
Δπ EXHIBIT 1014
Deponent Carlisle
Date 2-10-11 Rptr. [illegible]
WWW.DEPOBOOK.COM

Failure to provide the above information **within 10 business days from the date of this letter** may result in you being held liable for the illegal discharge and the penalties associated with it.

If you have any questions, please contact Ruth Kolb, Storm Water Specialist, at (619) 525-8636.

Sincerely,

Chris Zirkle
Deputy Director

CZ/rk

Enclosure: Calscience Environmental Laboratories, Inc Analytical Results

cc: File
Tim Miller, City of San Diego Deputy City Attorney

THE CITY OF SAN DIEGO

November 8, 2005

Lloyd A. Schwartz
BAE Systems San Diego Ship Repair Inc.
P.O. Box 13308
San Diego, CA 92186-5278

Dear Mr. Schwartz:

Subject: Rescind Notice of Violation Number 5409 Regarding Unauthorized Discharge of Toxic Pollutants into the Municipal Storm Drain System

The City of San Diego wishes to express our appreciation for your investigation of unauthorized discharge of wastes from your employee parking lot into the City's storm drain on the easterly side on the BNSF Railroad and the northerly side of Sampson Street. Based upon the information you provided, the Notice of Violation (NOV) Number 5409 dated October 14, 2005 is hereby rescinded. The City of San Diego will continue to investigate to find the source(s) of pollutants found in the storm drain. Thank you for your prompt response and helping to keep our beaches and bays clean.

If you have any questions, please contact Ruth Kolb, Storm Water Specialist, at 619.525.8636 or at rkolb@sandiego.gov.

Sincerely,

Chris Zirkle
Deputy Director

CZ/rk

cc: File
Tim Miller
Ruth Kolb

EXHIBIT 1015
Deponent Carlisle
Date 2-10-11 Rptr.
WWW.DEPOBOOK.COM

1016

From: "Ruth Kolb" <RKolb@sandiego.gov>
To: <LHonma@waterboards.ca.gov>
Date: 11/21/2005 7:35:51 AM
Subject: Re: Questions regarding catch basin near SWM

Good Morning Lisa,
SDG&E was issued a NOV. A collegue and I met with SDG&E representatives on site. SDG&E cleaned the catch basin and are in the process of trying to determmine the orgination of the 6-inch and 12-inch storm drains that enter the City's catch basin. R

Ruth Kolb
Storm Water Program
City of San Diego
1970 B Street, MS 27A
San Diego, CA 92102
(619) 525-8636 office
(619) 525-8641 fax
rkolb@sandiego.gov

>>> "Lisa Honma" <LHonma@waterboards.ca.gov> 11/17/2005 3:42 PM >>>
Ruth, I was just speaking with Shaun Halvax at SWM and he mentioned that the City had issued and then rescinded an NOV based on elevated sediment levels in a catch basin near their site. He said that the catch basin drained off of SDG&E. I was wondering whether you followed up with SDG&E about it and what was the result?

I'm trying to put together a record regarding SDG&E's role in the Shipyard CAO. Any information would be appreciated. Thanks a bunch. Lisa

CC: "Chris Zirkle" <CZirkle@sandiego.gov>, "Tim Miller" <MillerT@sandiego.gov>

Exponent®

NASSCO and Southwest Marine Detailed Sediment Investigation

Volume I

Prepared for

NASSCO and Southwest Marine
San Diego, California

87 pgs
Δπ EXHIBIT 1017
Deponent Carlisle
Date 2-10-11 Rptr. SH
WWW.DEPOBOOK.COM

SAR105417

Exponent®

NASSCO and Southwest Marine Detailed Sediment Investigation

Volume I

Prepared for

NASSCO and Southwest Marine
San Diego, CA 92113

Prepared by

Exponent
15375 SE 30th Place, Suite 250
Bellevue, WA 98007

October 2003

Doc. no. 8601718.002 1201 0903 DN05

10.17.2
SAR105418

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1017.7

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VOLUME III

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List of Tables

Tables appear at the end of the main text.

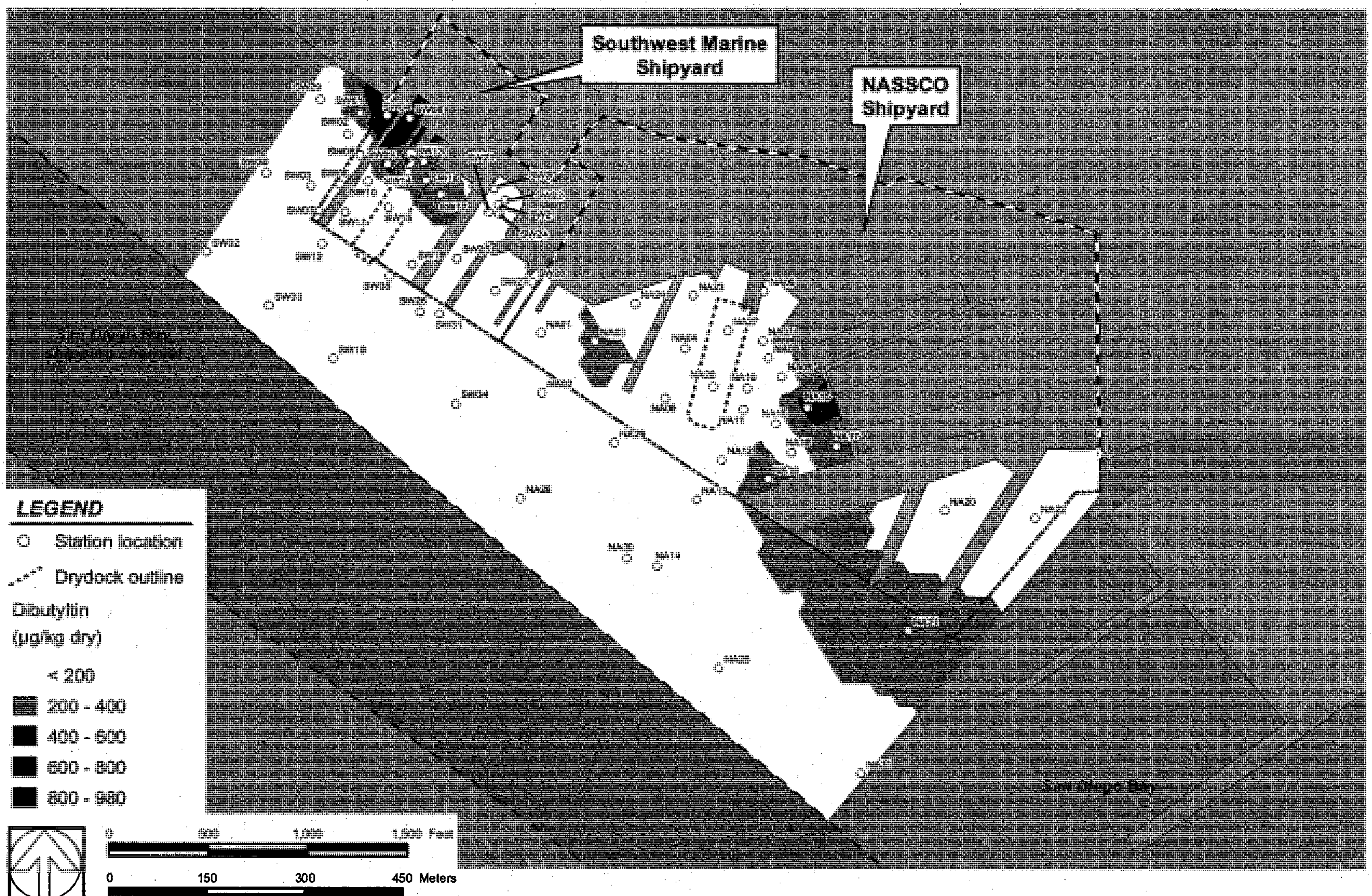

Figure 4-14. Surface sediment concentrations of dibutyltin

Exponent®

8601718/8601731.002 1201 | August 22, 2003 | G:\swm_nassco\projects\surface_data_cntrs_dibutyltin.mxd

1017.22

SAR105806

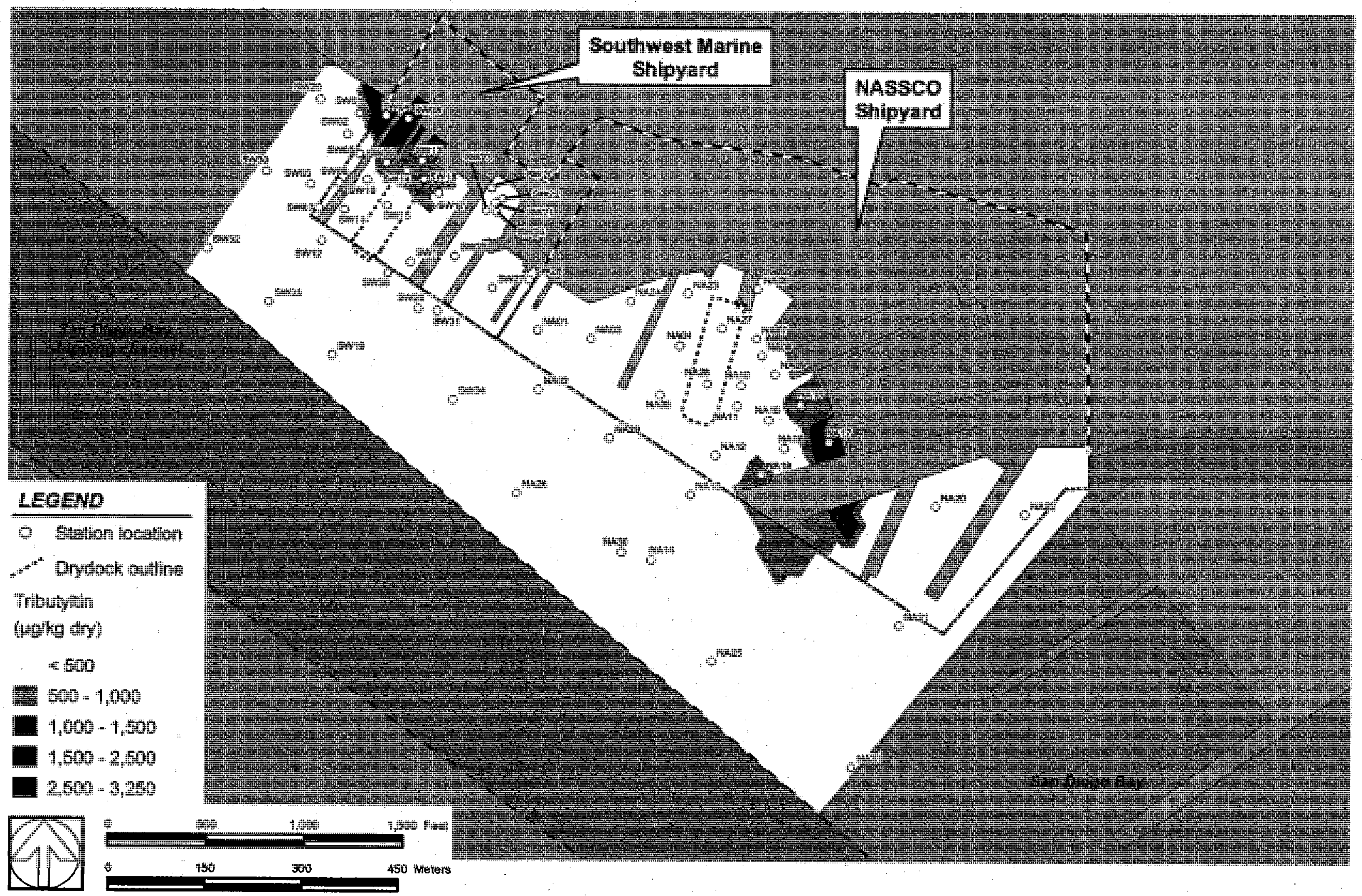

Figure 4-15. Surface sediment concentrations of tributyltin

Exponent®

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SAR105807

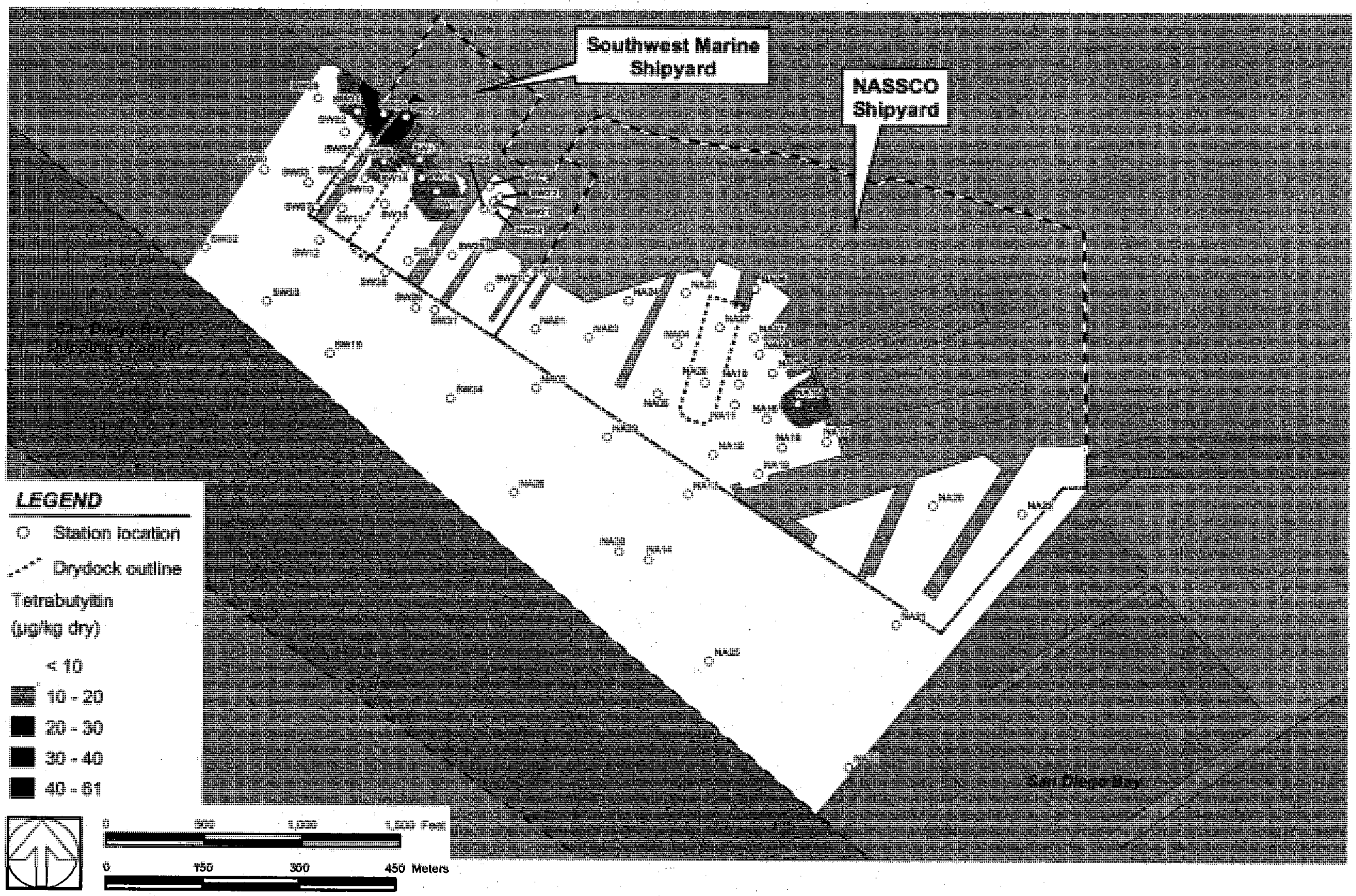

Figure 4-16. Surface sediment concentrations of tetrabutyltin

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8601718/8601731.002 1201 | August 22, 2003 | G:\swm_nassco\projects\surface_data_cntrs_tetrabutyltin.mxd

1017.24

SAR105808

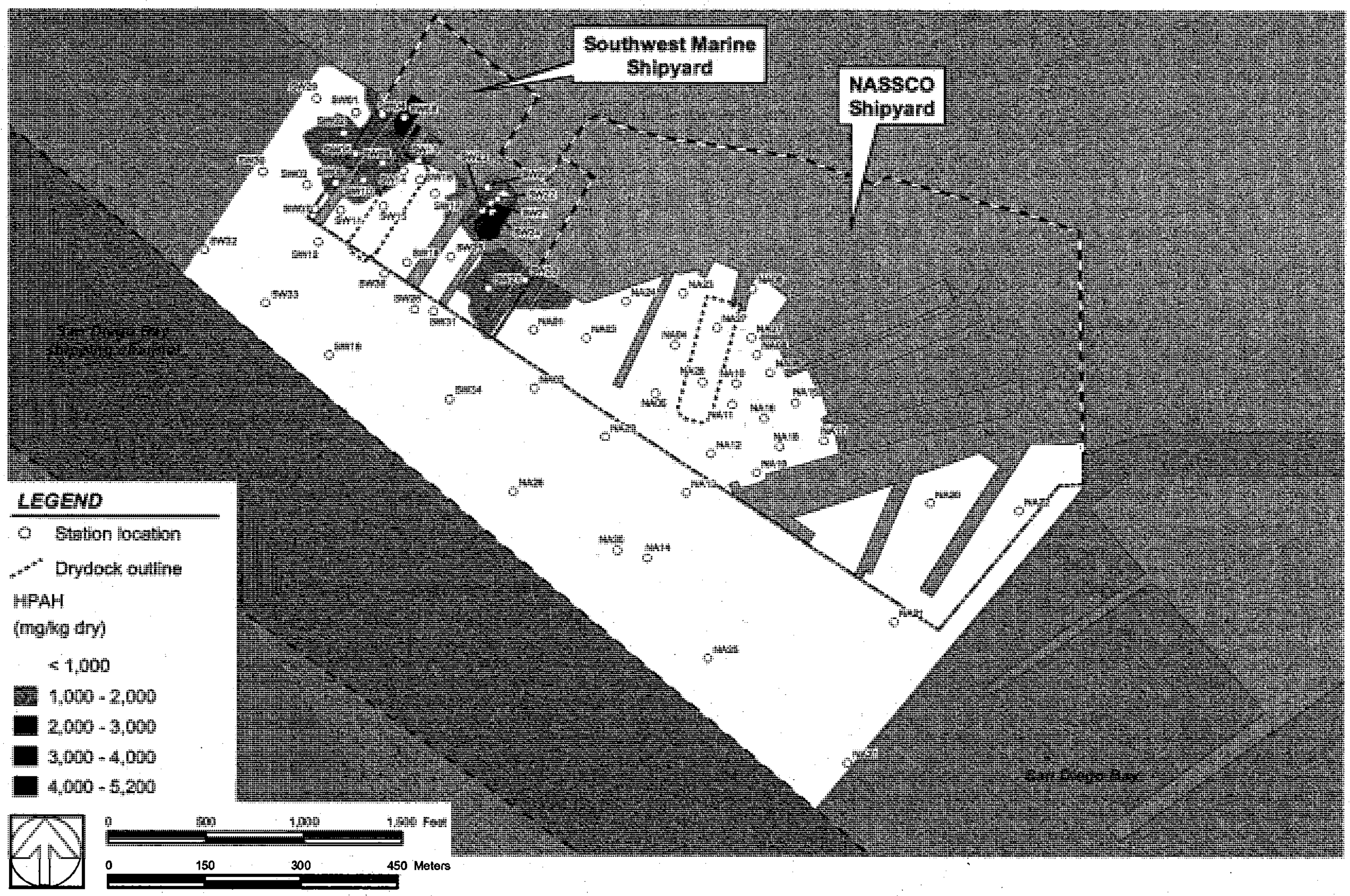

Figure 4-17. Surface sediment concentrations of high molecular weight polycyclic aromatic hydrocarbon (HPAH)

Exponent®

8601718/8601731.002 1201 | August 22, 2003 | G:\swm_nassco\projects\surface_data_cntrs_HPAH.mxd

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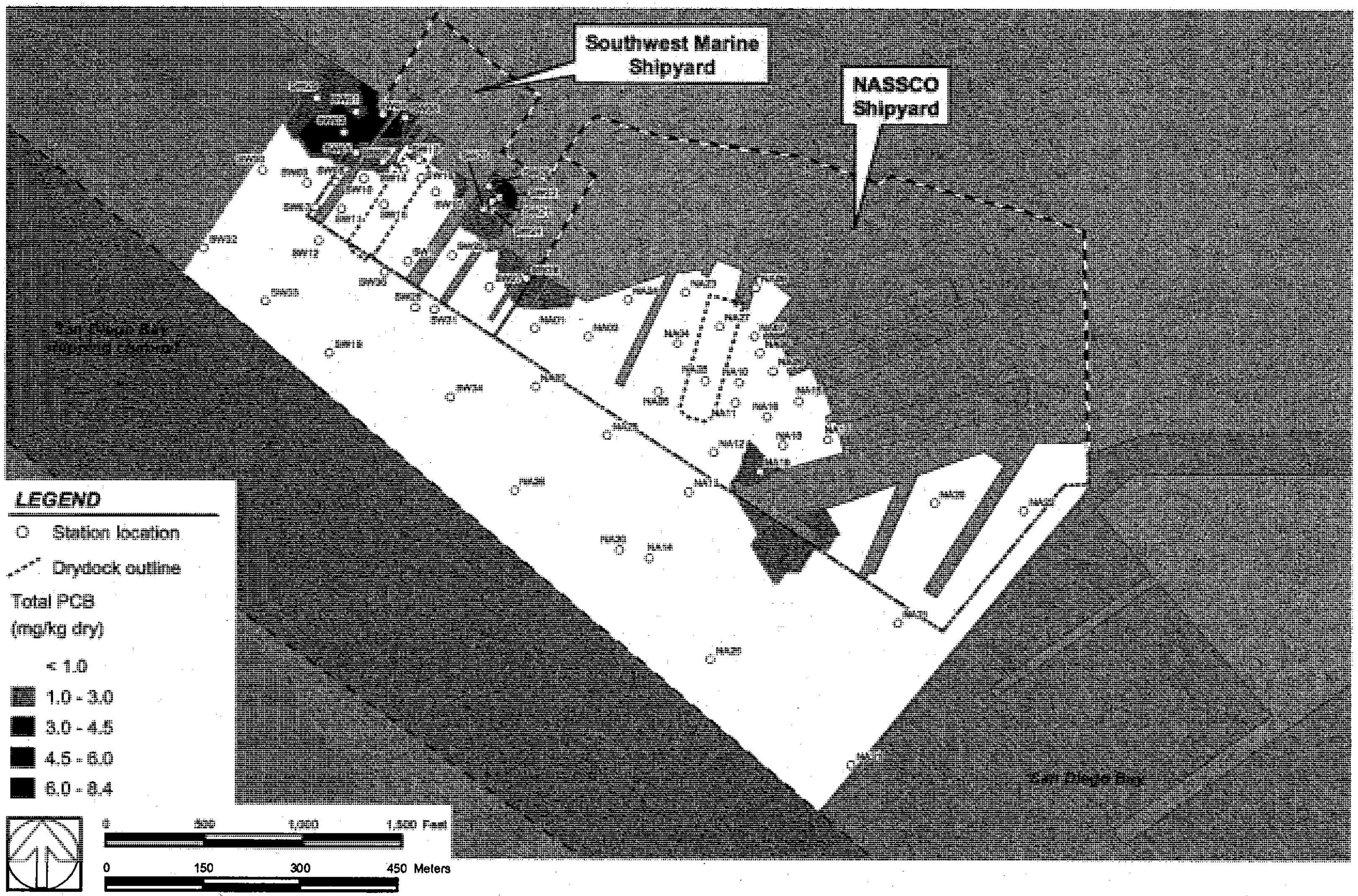

Figure 4-18. Surface sediment concentrations of total PCB homologs

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SAR105810

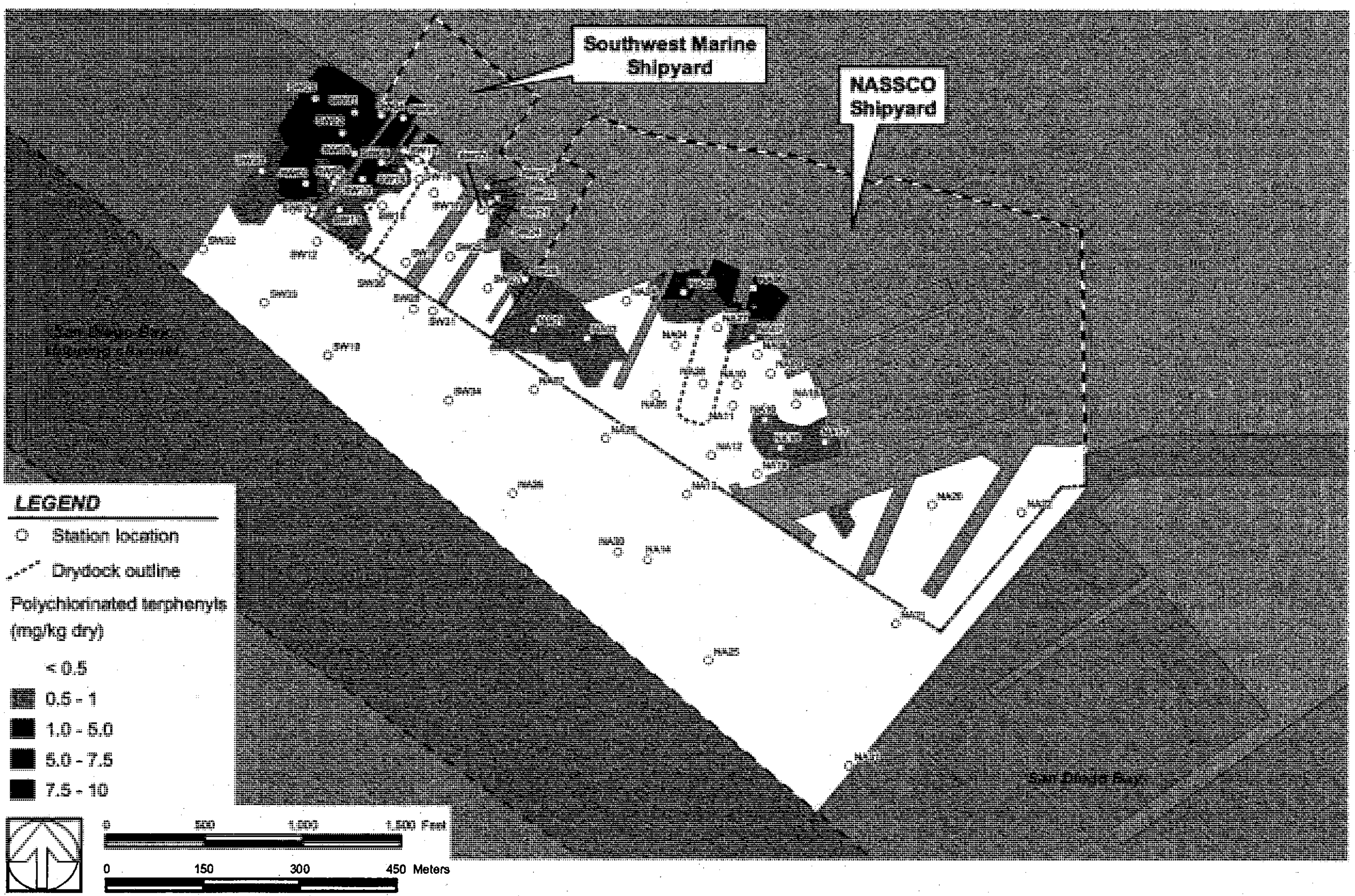

Figure 4-19. Surface sediment concentrations of polychlorinated terphenyls

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SAR105811

APPENDIX C

SAIC SEDIMENT SAMPLING REPORT - JANUARY 13, 1992

W:\9453156Z\RR01-A-R

SEDIMENT SAMPLING AT

SOUTHWEST MARINE SHIPYARD

SAN DIEGO BAY, CALIFORNIA

FINAL REPORT

Prepared For:

Southwest Marine, Incorporated
Foot of Sampson Street
San Diego, California 92170

Prepared By:

Science Applications International Corporation
10260 Campus Point Drive
San Diego, California 92121

January 13, 1992

SAIC Project No. 01-0895-05-0616

EXECUTIVE SUMMARY

Sediment sampling was performed at the Southwest Marine, Inc. shipyard in San Diego Bay, California and at the EPA reference site for the EPA-designated ocean dredged material disposal site (LA-5). The sediment samples were analyzed for grain size and for several classes of trace metal and trace organic contaminants. The purpose of the sampling and analyses was to determine the levels and spatial distribution of chemical contaminants within three proposed dredging areas at the shipyard, as well as the grain size characteristics and contaminant concentrations in the reference ocean sediments.

Considerable variability in sediment grain size properties and contaminant concentrations within individual layers across each area, and between layers at each station, was apparent. In general, the highest contaminant concentrations in the Pier 1 North and Pier 1 South areas occurred in layer 1 and to a lesser degree in layer 2. Layer 3 and refusal typically contained relatively low concentrations of most contaminants. However, in a few instances, elevated concentrations of one or more contaminants also occurred in layer 3, particularly at Pier 1 South stations where the surface layer 1 was absent. Contaminant concentrations in the refusal layer sediments from these areas typically were nondetectable and comparable to concentrations measured in the reference site sediments. The volumes of materials associated with the various layers 1, 2, 3, and refusal represent 1%, 6%, 4%, and 2%, respectively, of the total proposed dredging volumes for these two areas. The material making up the remaining dredging volume is undisturbed San Diego formation.

The POSD sump area sediments also contained elevated contaminant concentrations in layer 3 and occasionally, although to a much lesser extent, in the refusal layer. Layers 1 and 2 were absent from this area. Differences between stations and depths in the relative magnitudes of the contaminant concentrations generally were consistent for individual contaminant classes.

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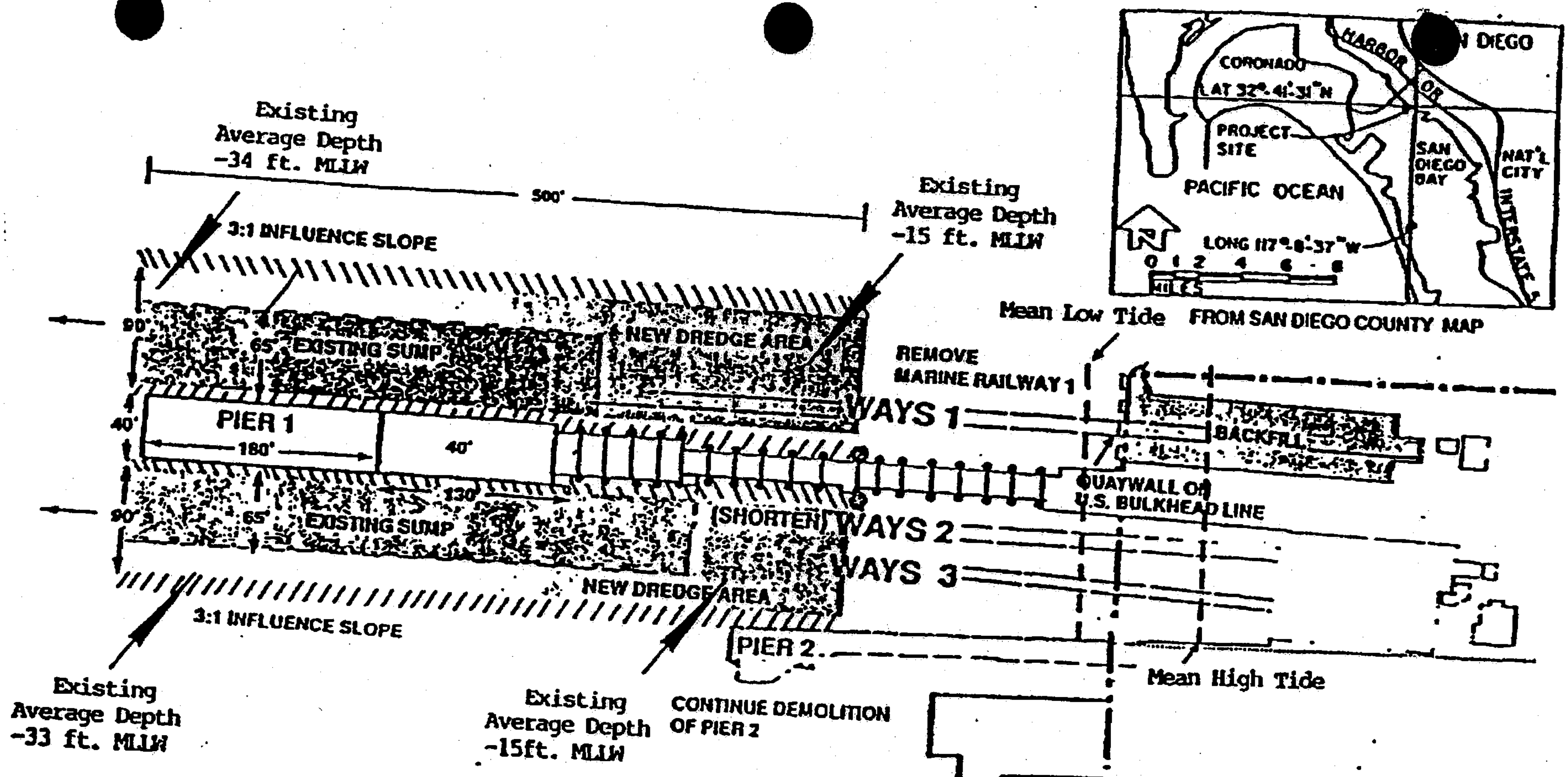


PIER 1/POSD DRYDOCK SUMP DREDGING

IN SAN DIEGO

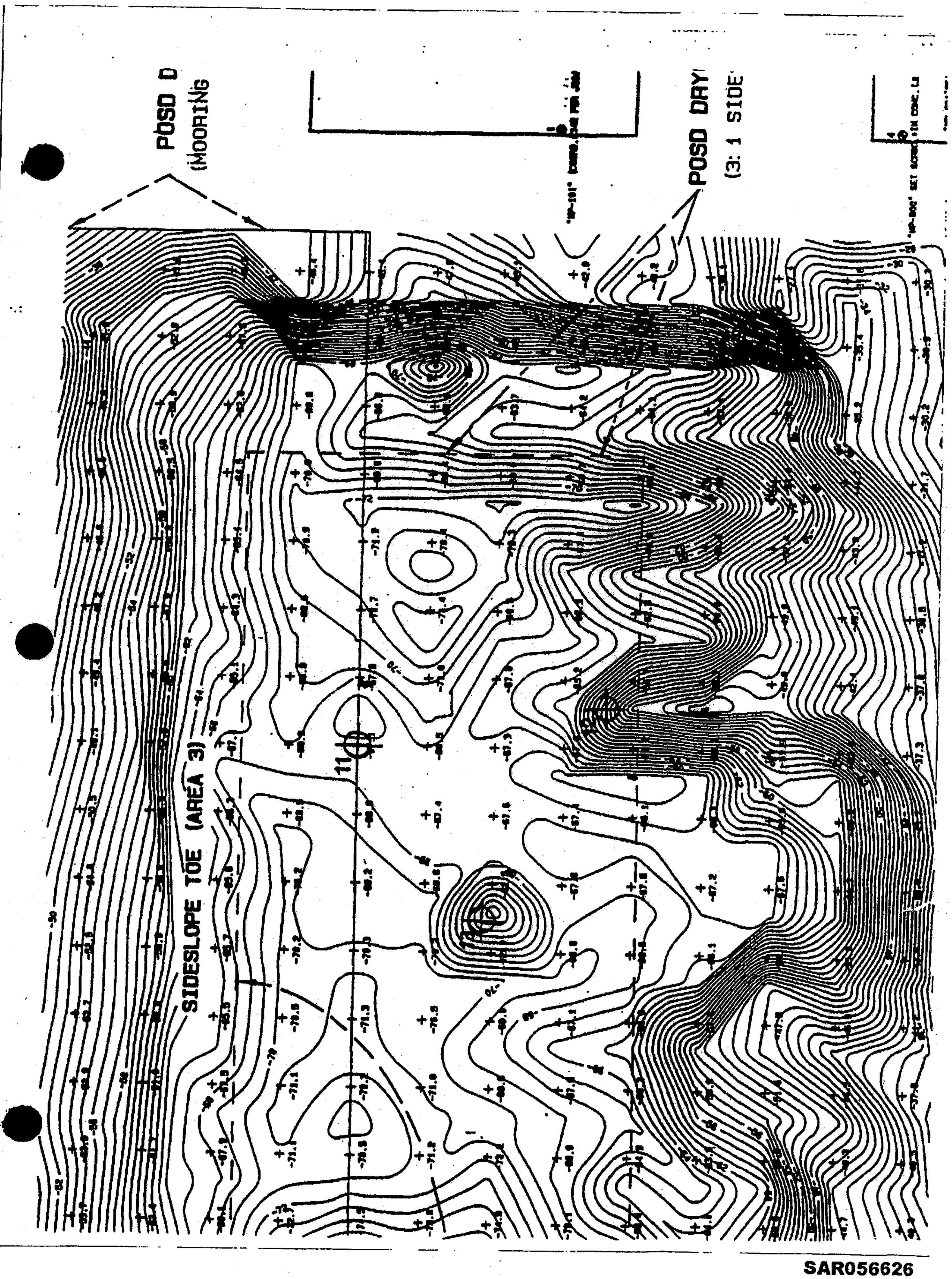
AT SAN DIEGO

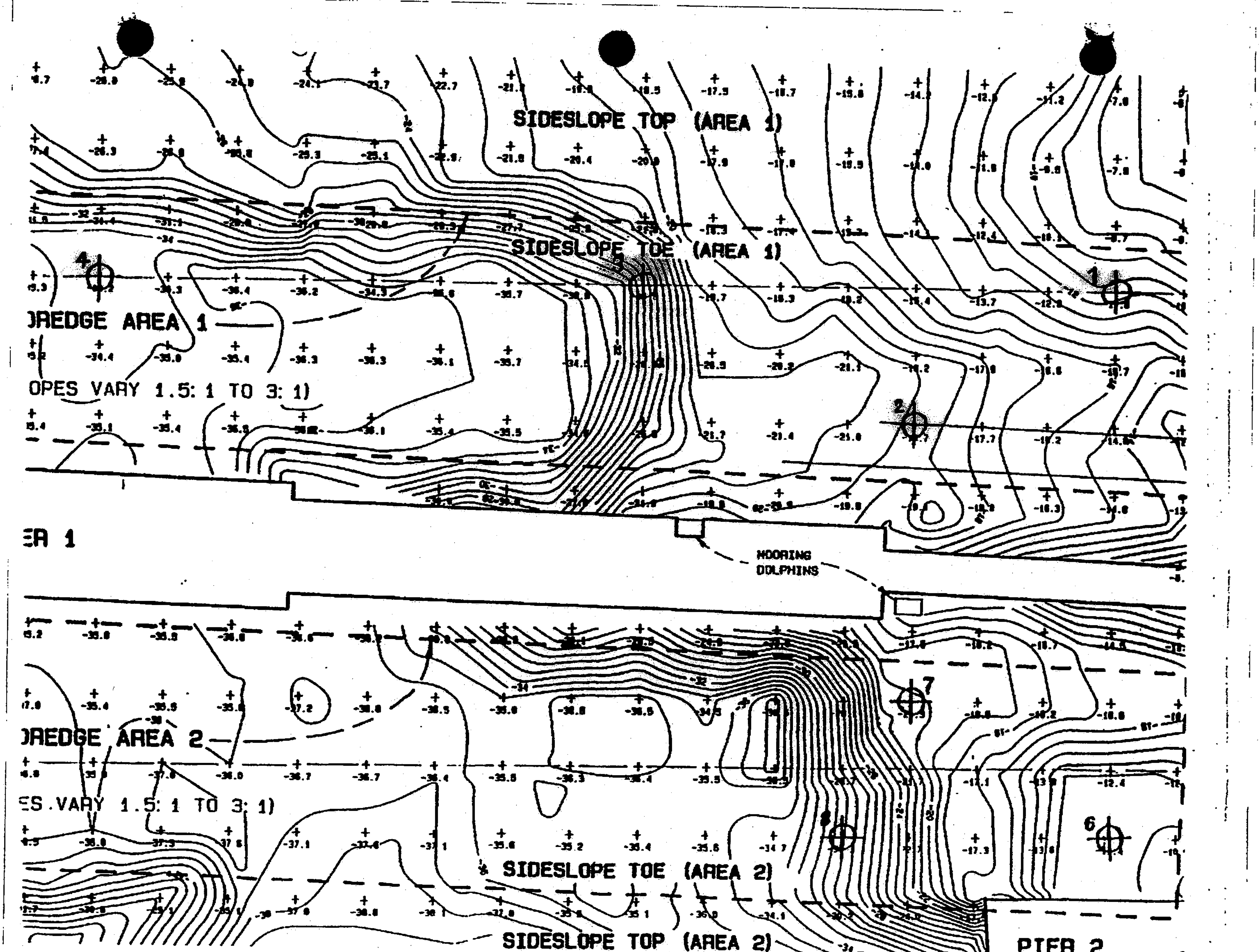
COUNTY OF SAN DIEGO STATE OF CALIFORNIA

APPLICATION BY SOUTHWEST MARINE

SHEET 2 OF 3

August, 1991


POSD D
(MOORING
POSD DRY
(3: 1 SIDE
SIDESLOPE TOE (AREA 3)
11


SIDESLOPE TOP (AREA 1)
SIDESLOPE TOE (AREA 1)
DREDGE AREA 1
OPES VARY 1.5: 1 TO 3: 1)
ER 1
MOORING
DOLPHINS
DREDGE AREA 2
ES VARY 1.5: 1 TO 3: 1)
SIDESLOPE TOE (AREA 2)
SIDESLOPE TOP (AREA 2)
PIER 2

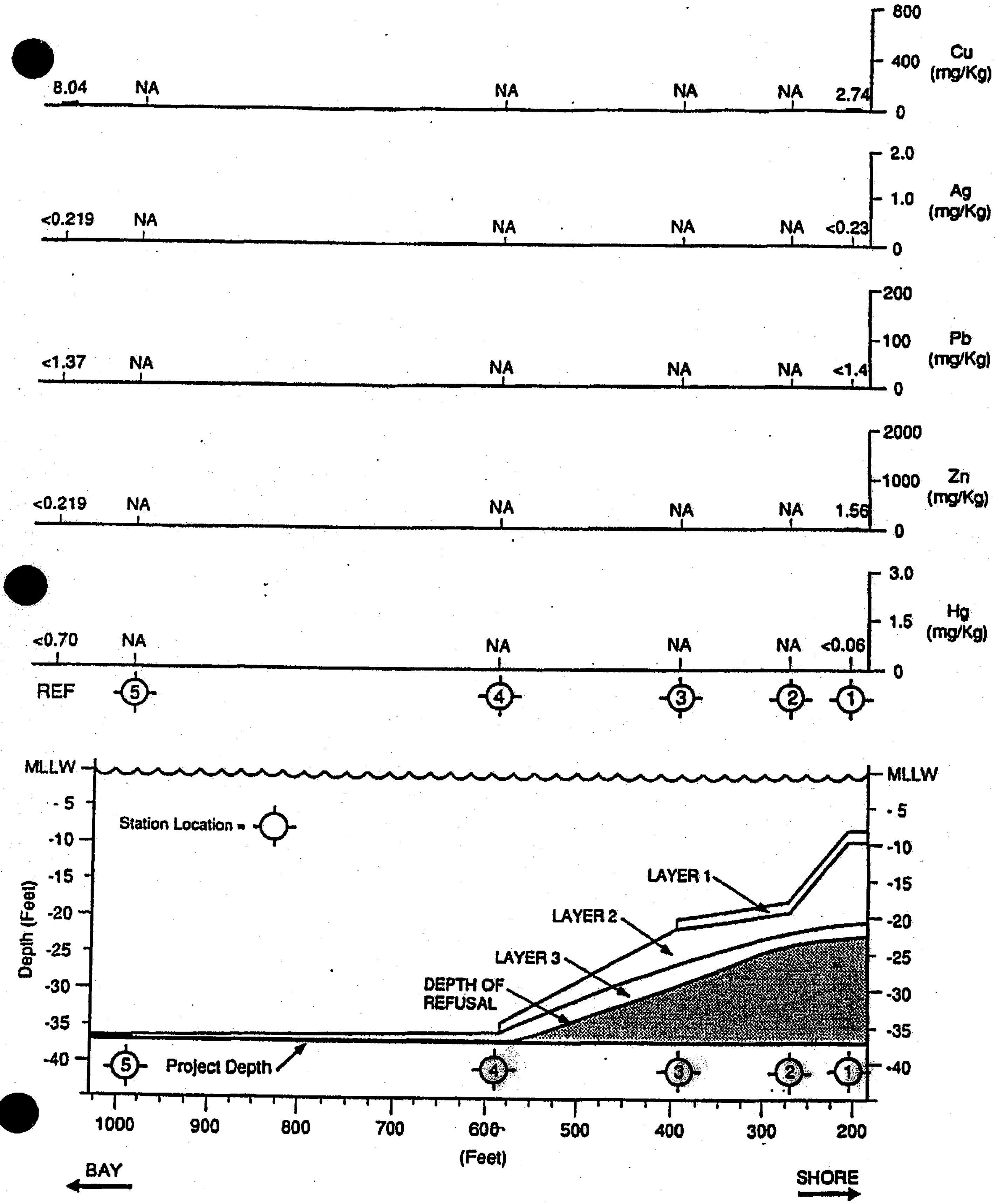


Figure 19d. Contaminant Concentrations for Pier 1 North: Refusal.

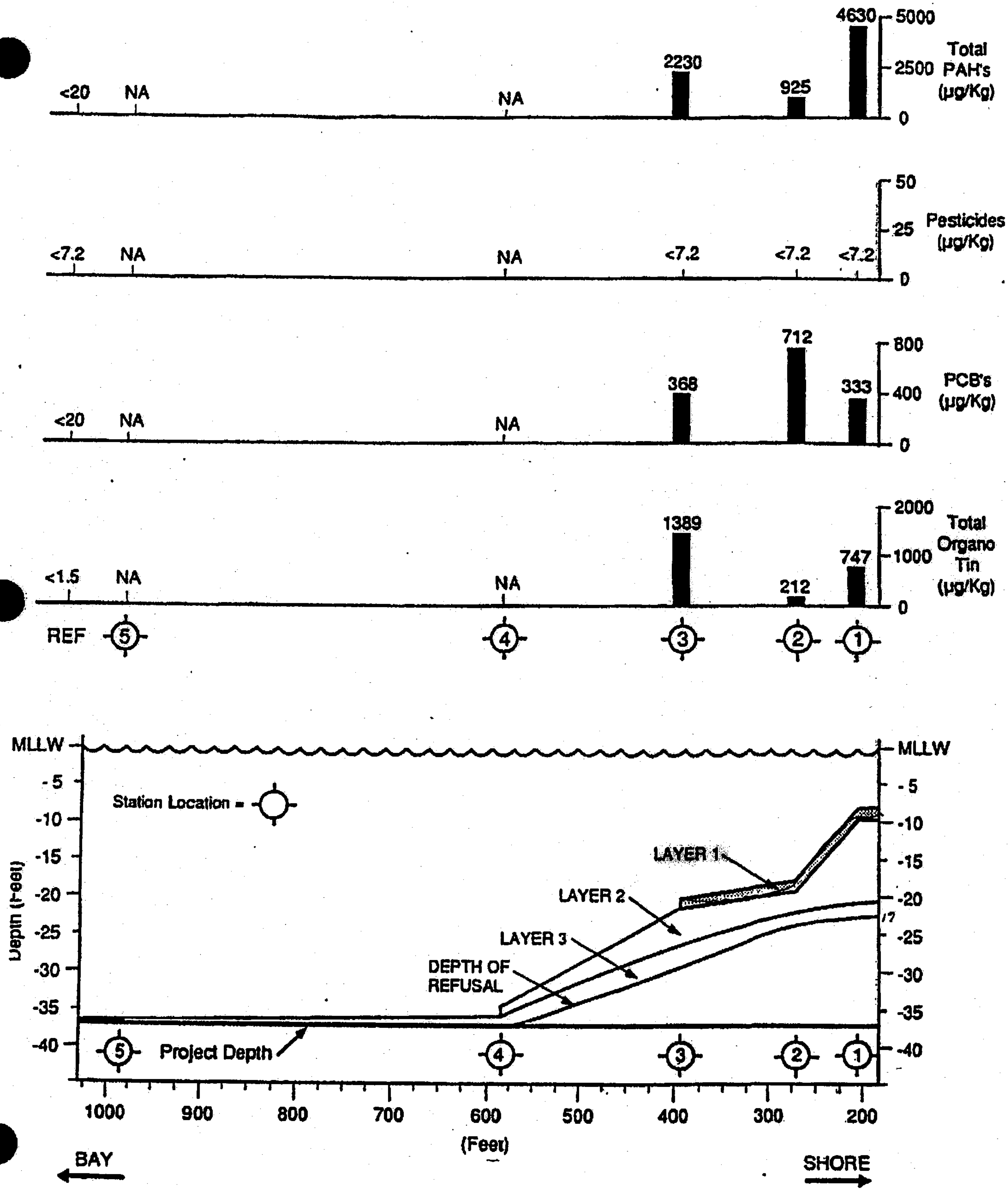


Figure 20a. **Contaminant Concentrations for Pier 1 North; Layer 1.**

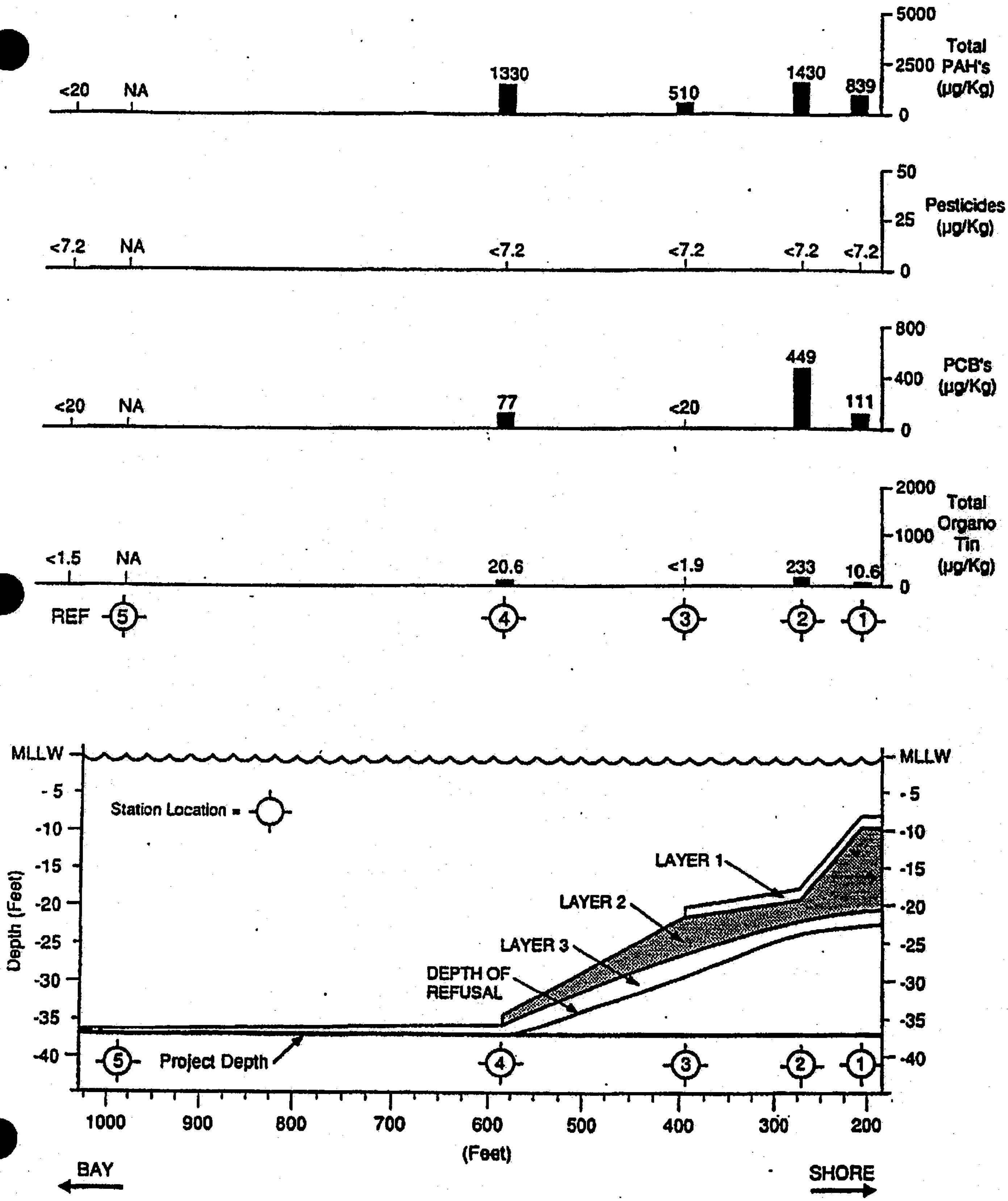


Figure 20b. Contaminant Concentrations for Pier 1 North; Layer 2.

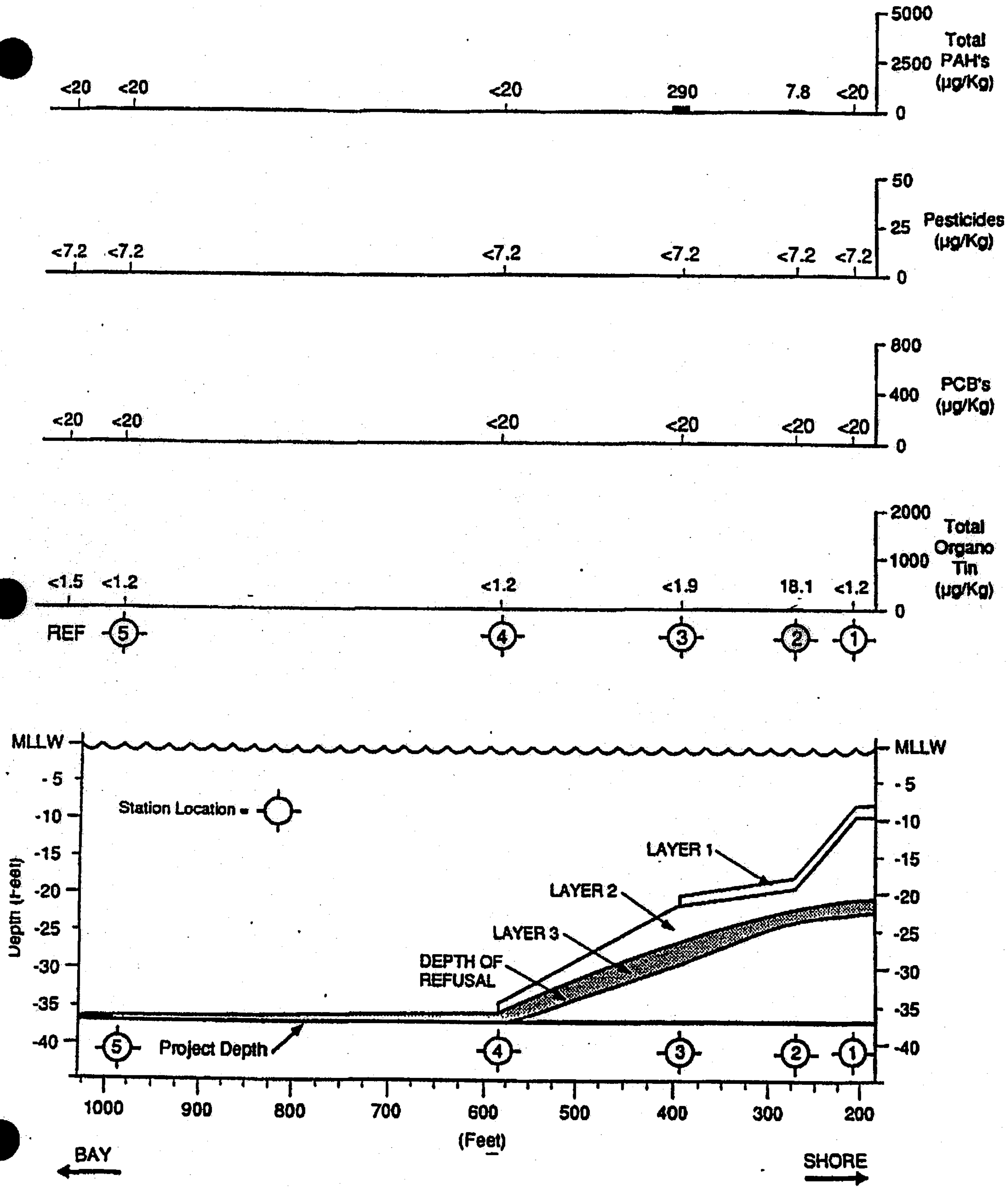


Figure 20c. **Contaminant Concentrations for Pier 1 North; Layer 3.**

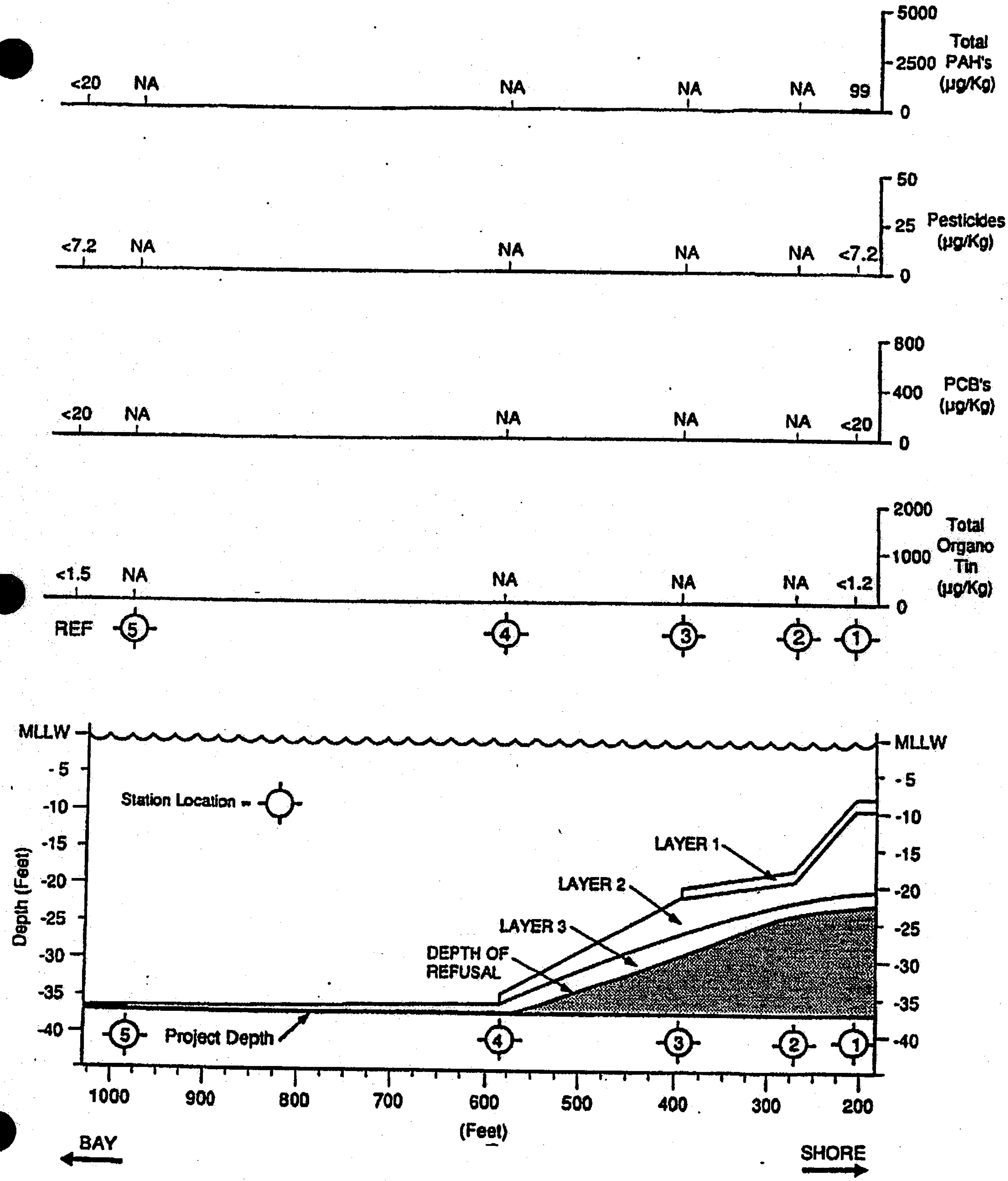


Figure 20d. **Contaminant Concentrations for Pier 1 North; Refusal.**

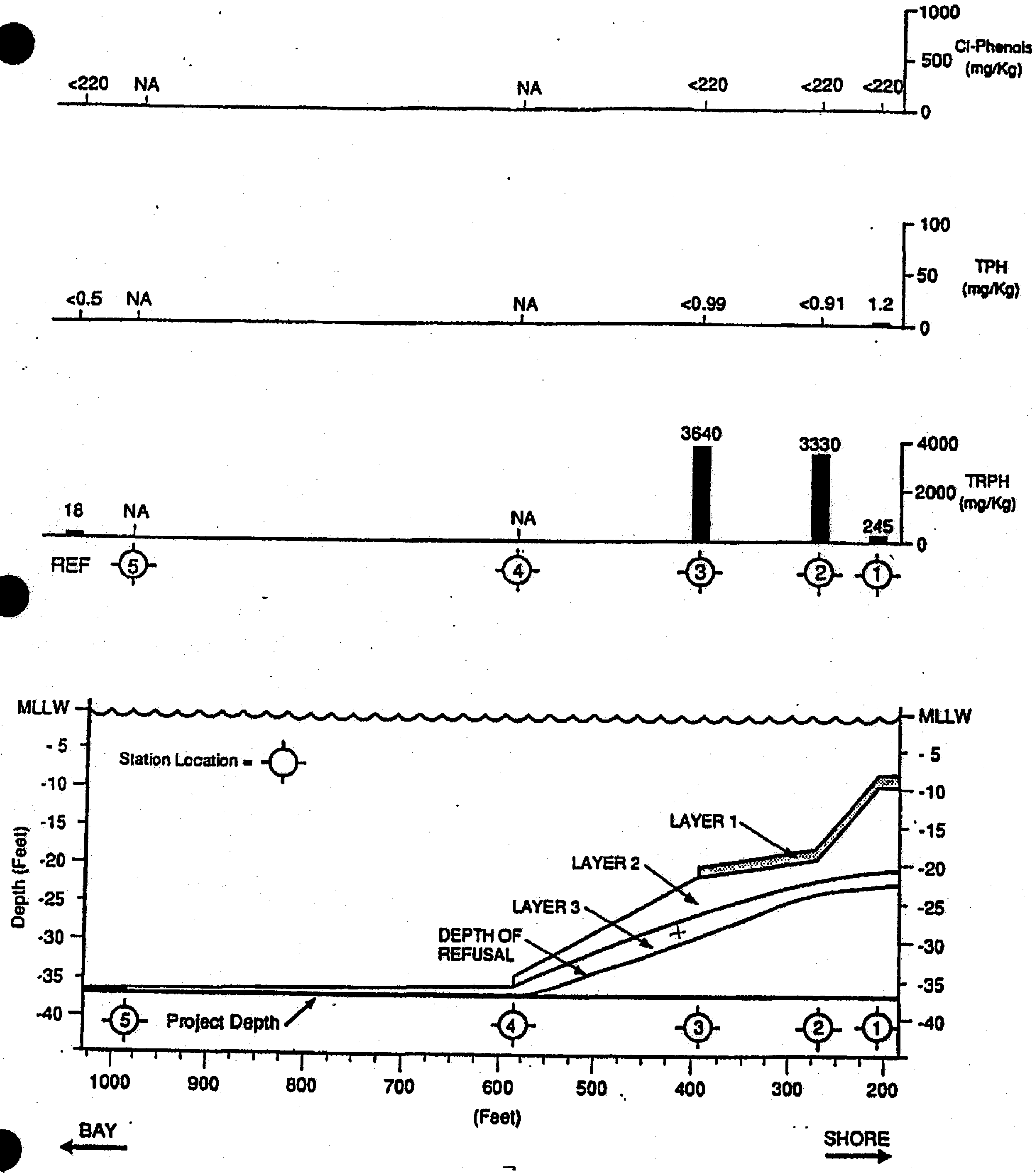


Figure 21a. ContaminantConcentrations for Pier 1 North; Layer 1.

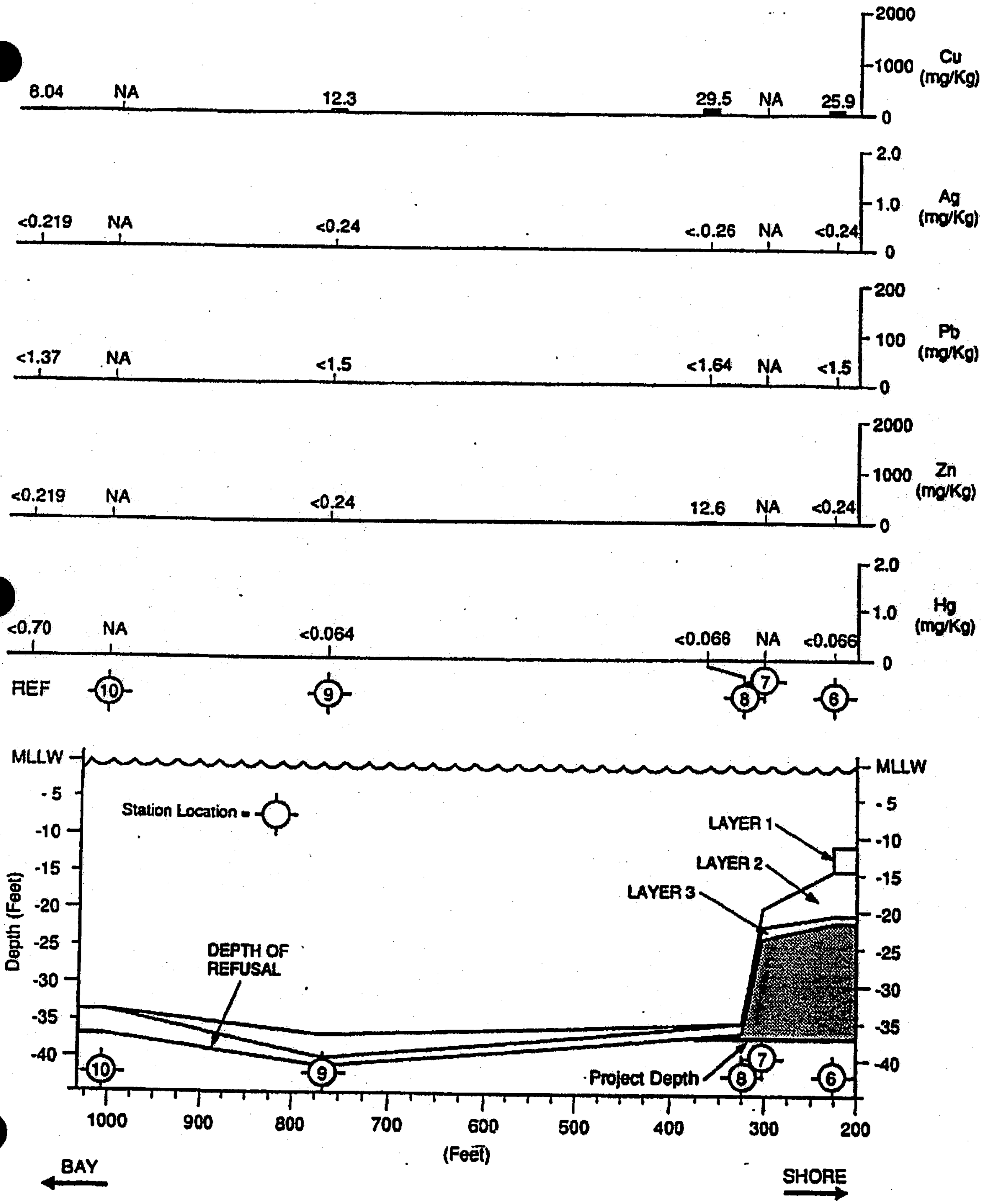


Figure 22d. **Contaminant Concentrations for Pier 1 South; Refusal.**

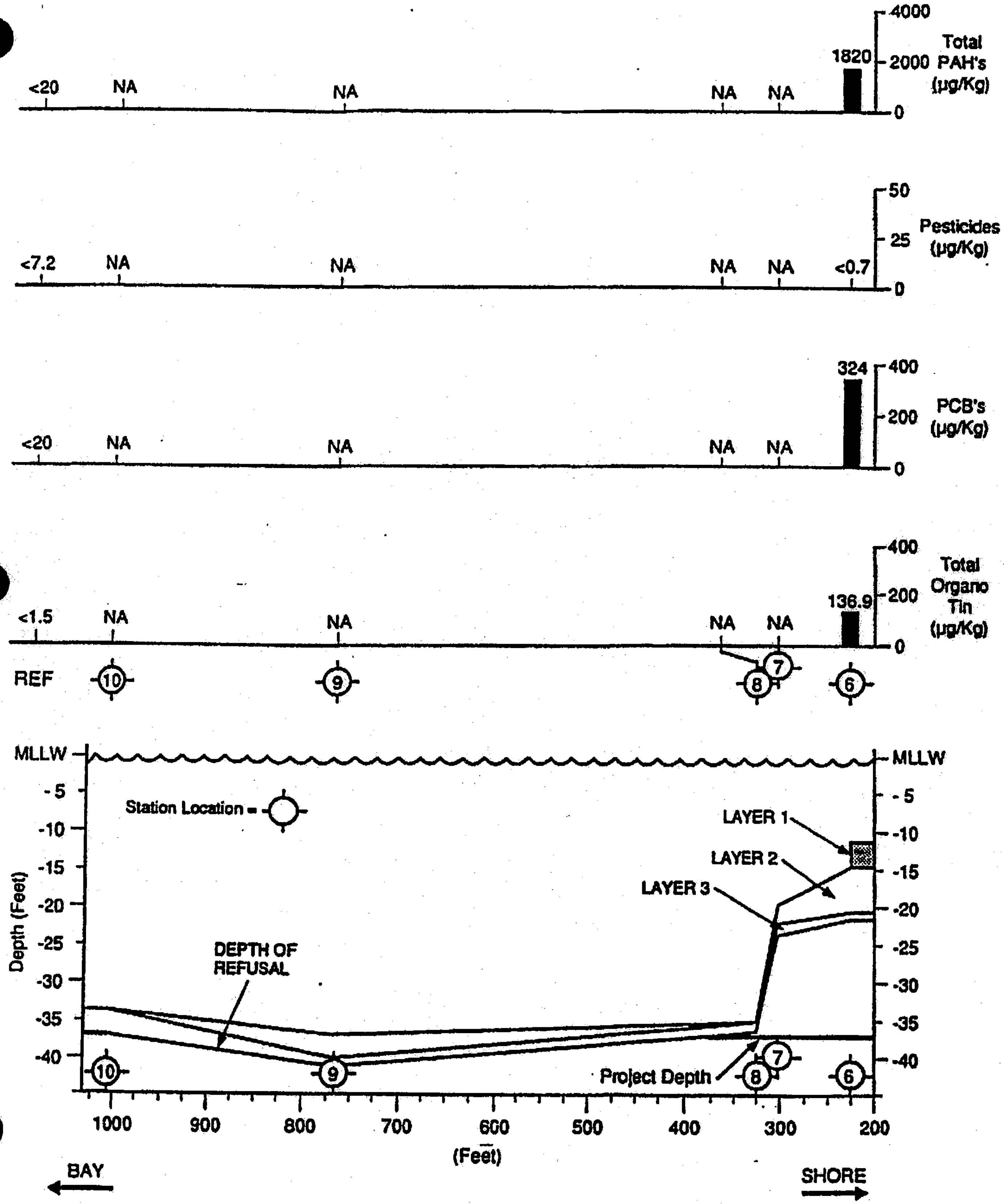


Figure 23a. Contaminant Concentrations for Pier 1 South; Layer 1.

SAR056572

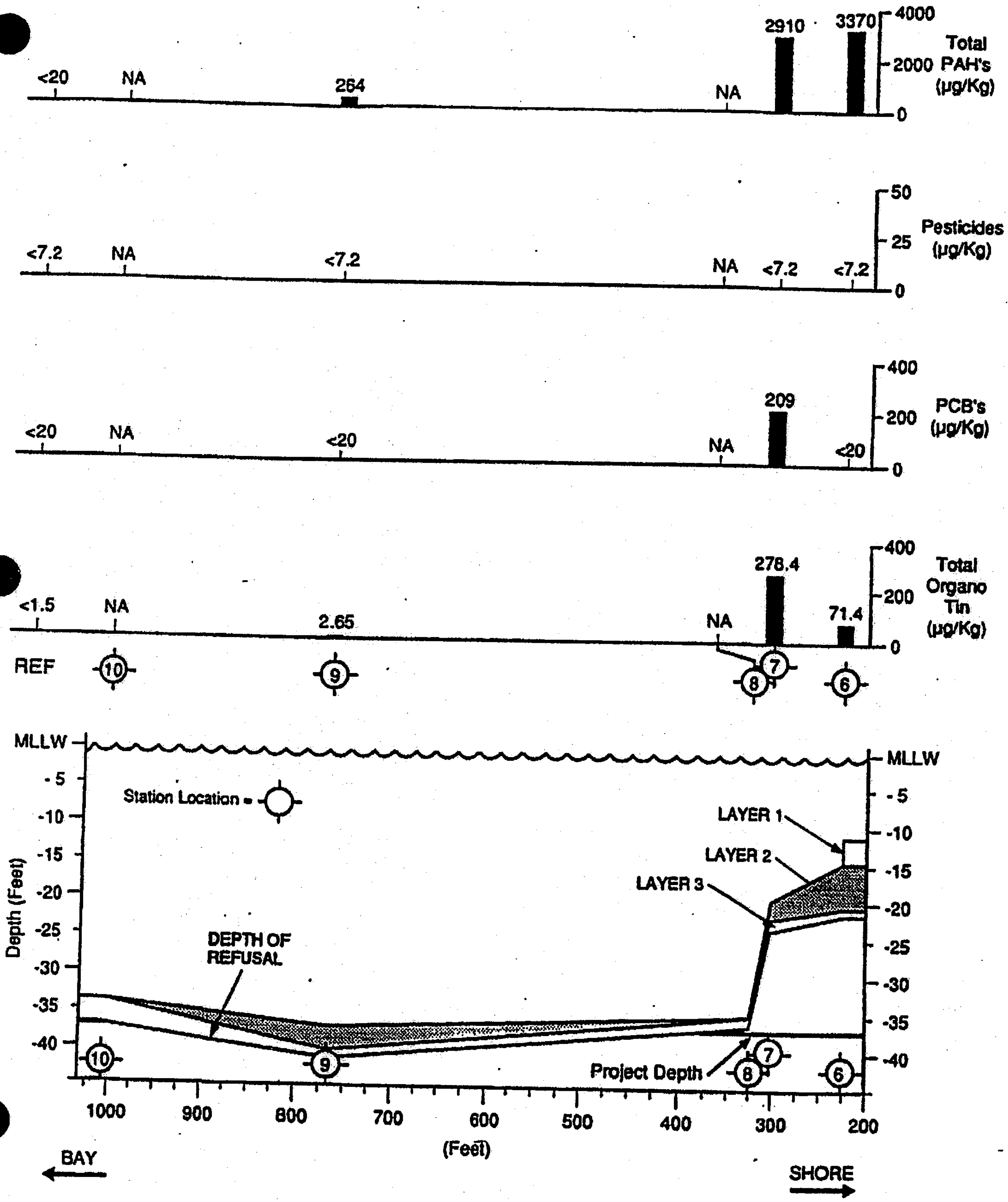


Figure 23b. **Contaminant Concentrations for Pier 1 South; Layer 2.**

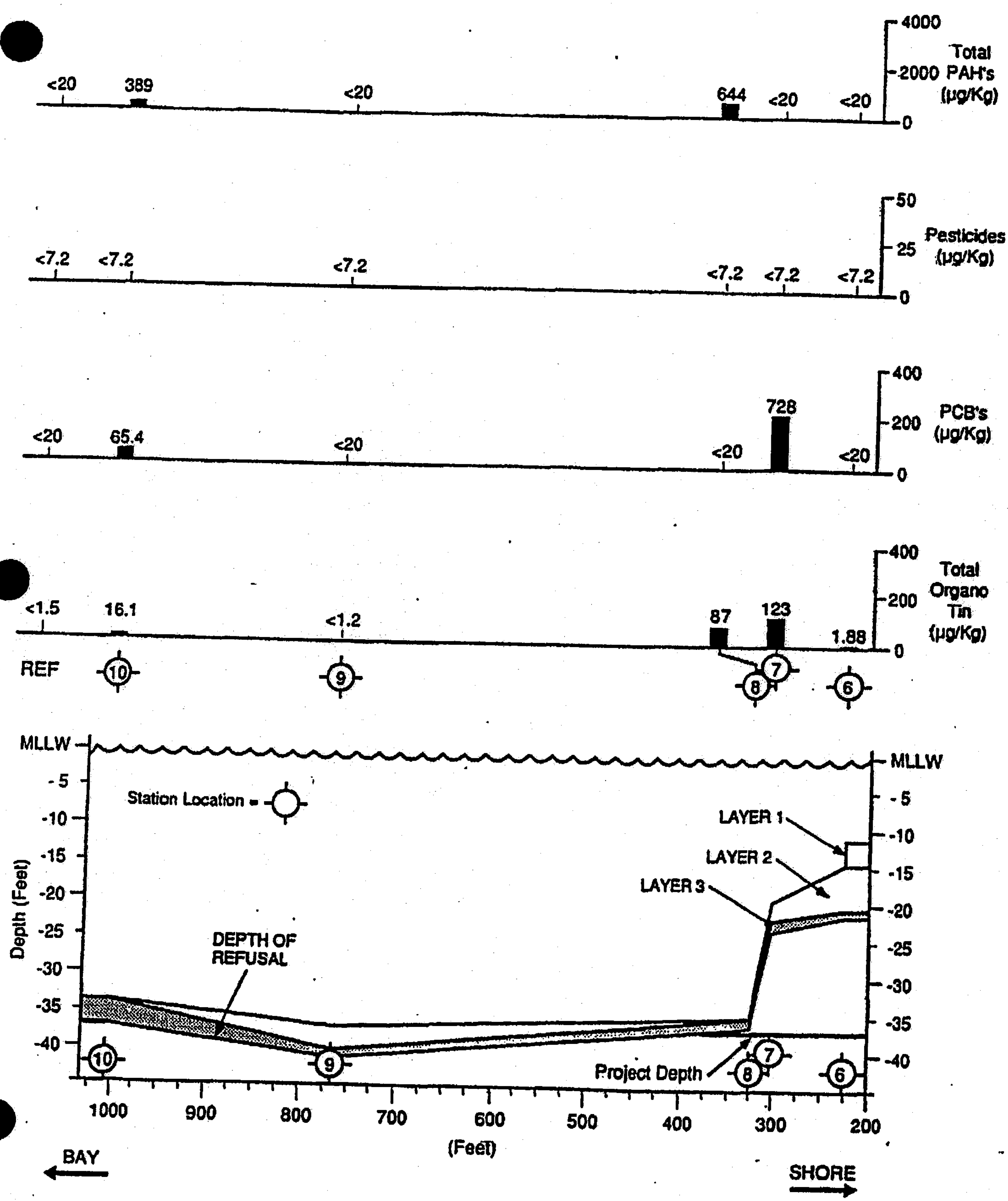


Figure 23c. **Contaminant Concentrations for Pier 1 South; Layer 3.**

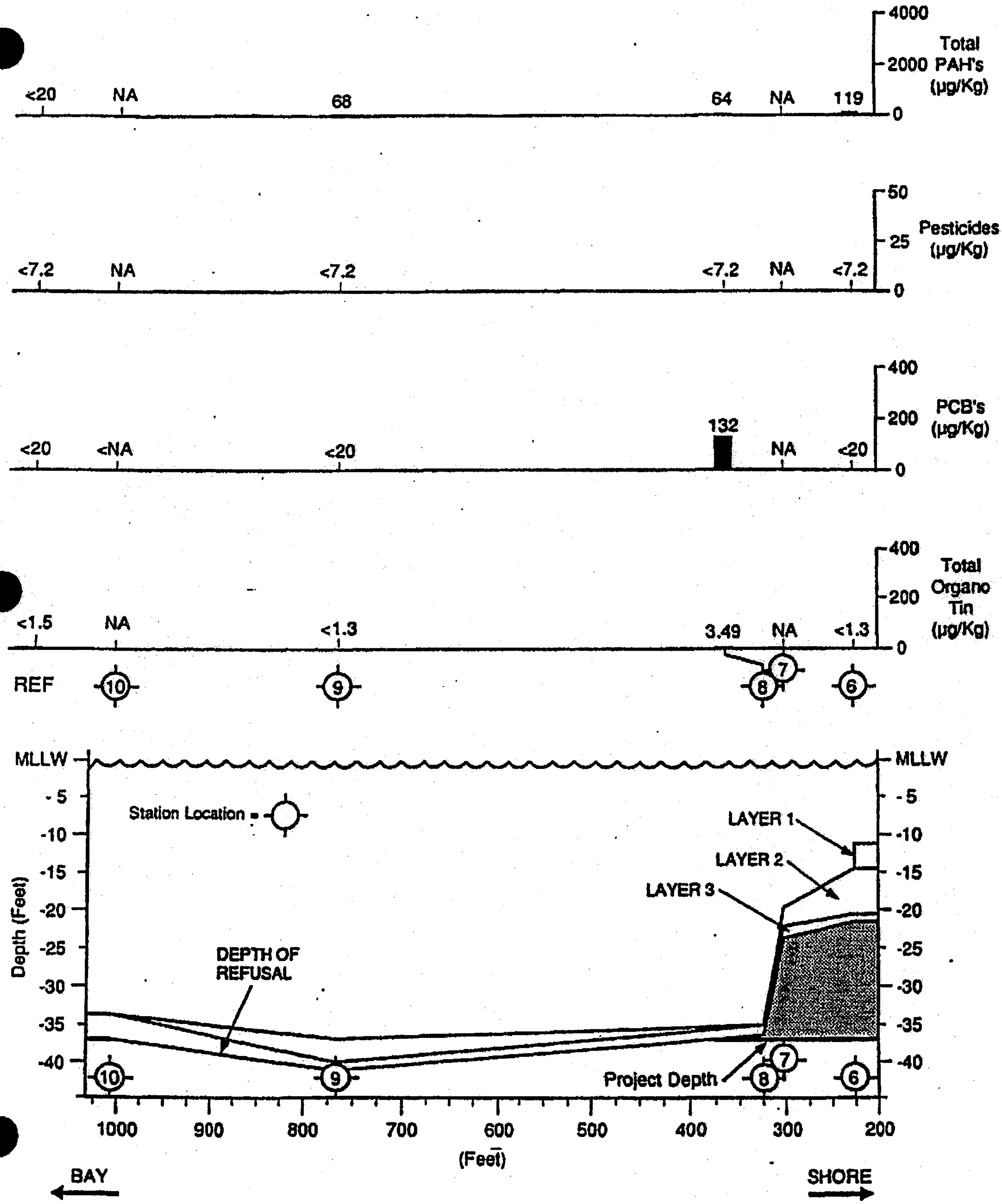


Figure 23d. **Contaminant Concentrations for Pier 1 South; Refusal.**

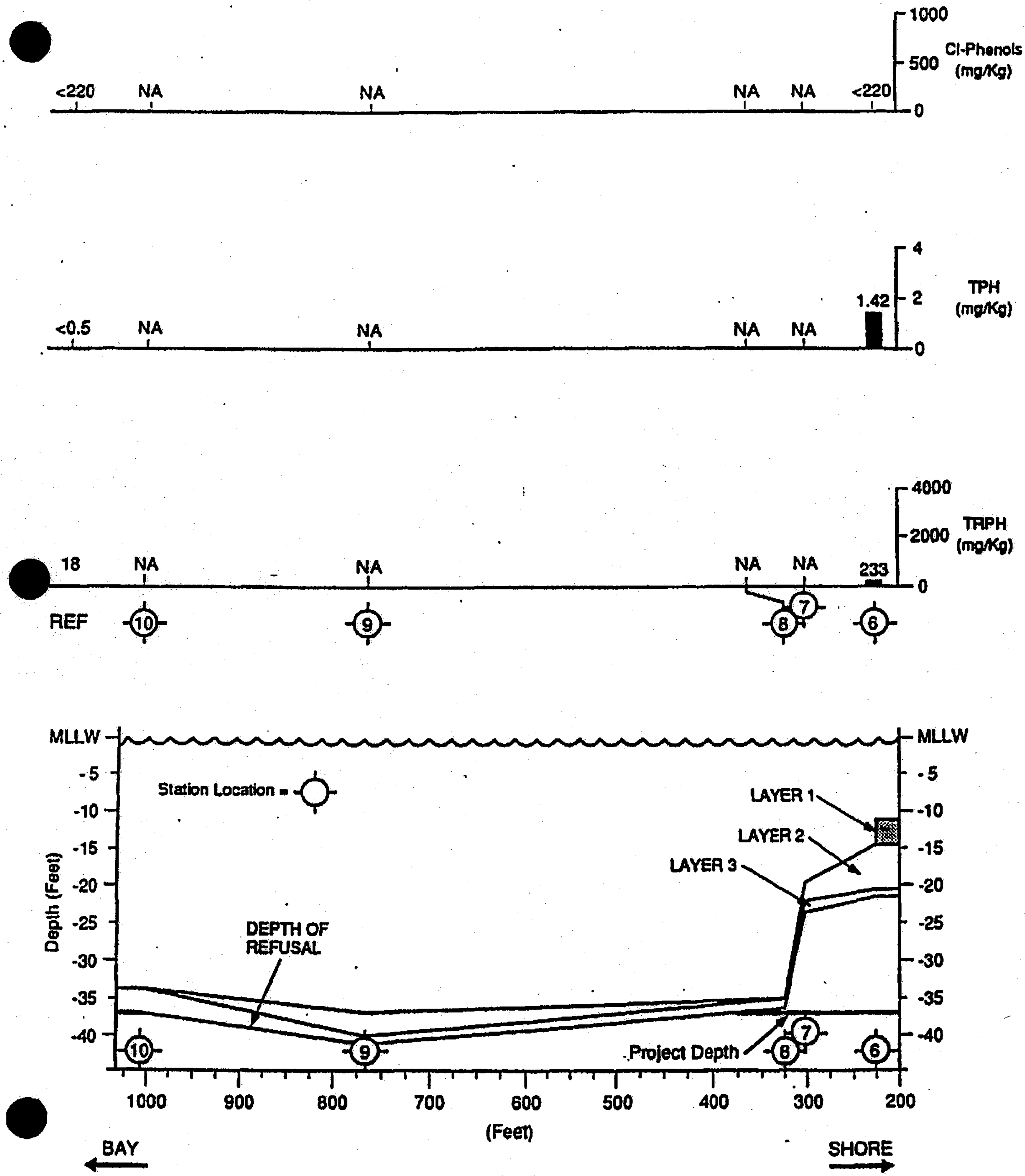


Figure 24a. Contaminant Concentrations for Pier 1 South; Layer 1.

CAB 410
5-b-3

January 28, 1977

California Regional Water
Quality Control Board
6154 Mission Gorge Road
Suite 205
San Diego, California 92120

Subject: ANNUAL NPDES WASTE DISCHARGE REPORT SILVER GATE POWER PLANT NPDES CA 0001376

Gentlemen:

In compliance with the reporting requirements of Waste Discharge Permit NPDES No. CA 0001376 for the Silver Gate Power Plant of San Diego Gas & Electric Company, we are herewith submitting the annual summary report for the 1976 operating year.

On May 10, 1976 the California Regional Water Quality Control Board, San Diego Region (CRWQCB) adopted Order No. 76-9 issuing NPDES Permit No. CA 0001376 with revised monitoring requirements. Technical Change Order No. T-1 dated, July 22, 1976, was subsequently issued and suspended monitoring reports on discharges 001B (Metal Cleaning Wastes), 001C (Boiler Blowdown), and 001D (low volume wastes) until July 1, 1977.

Monitoring reports have been submitted under the previous NPDES quarterly basis. This was carried out through June 1976 with monthly reports submitted thereafter. Copies of all reports were sent directly to the Environmental Protection Agency, Region IX.

Attached to this report are tabular and/or graphic summaries of the following monitored parameters:

Average Monthly Temperature - influent
effluent

Flow Rates

Oil and Grease Analysis (monthly) - influent
effluent

4 pgs
EXHIBIT 1019
Deponent Carlile
Date 2-10-11 Rptr.
WWW.DEPOBOOK.COM

FORM 115-5145 B

CENTRAL FILES COPY

Total Suspended Solids (monthly) - influent
effluent

pH - effluent

Total Copper - influent
effluent

Residual Chlorine - effluent

Chemicals

Cooling water influent and effluent temperatures were measured and recorded continuously. The average temperature differential of the cooling water never exceeded the limit of 15°F.

Sinceraly,

J. F. Dietz
Licensing & Environmental
Department

JFD:bmv

cc: Regional Administrator
Environmental Protection Agency
100 California Street
San Francisco, CA 94111

Attn: Permit's Branch

1019.2

SUMMARY OF
WASTE DISCHARGE MONITORING DATA
SILVER GATE POWER PLANT
1976

MONTH	TOTAL COPPER (mg/l)		FREE AVAILABLE CHLORINE (mg/l)
	INTAKE	DISCHARGE	
JANUARY	______	______	______
FEBRUARY	______	______	______
MARCH	______	______	______
APRIL	______	______	______
MAY	______	______	______
JUNE	______	______	______
JULY	0.002	0	0
AUGUST	0	0.002	0
SEPTEMBER	0.005	0.009	0
OCTOBER	0.001	0.001	0
NOVEMBER	0.010	0.008	0
DECEMBER	0.002	0.002	0

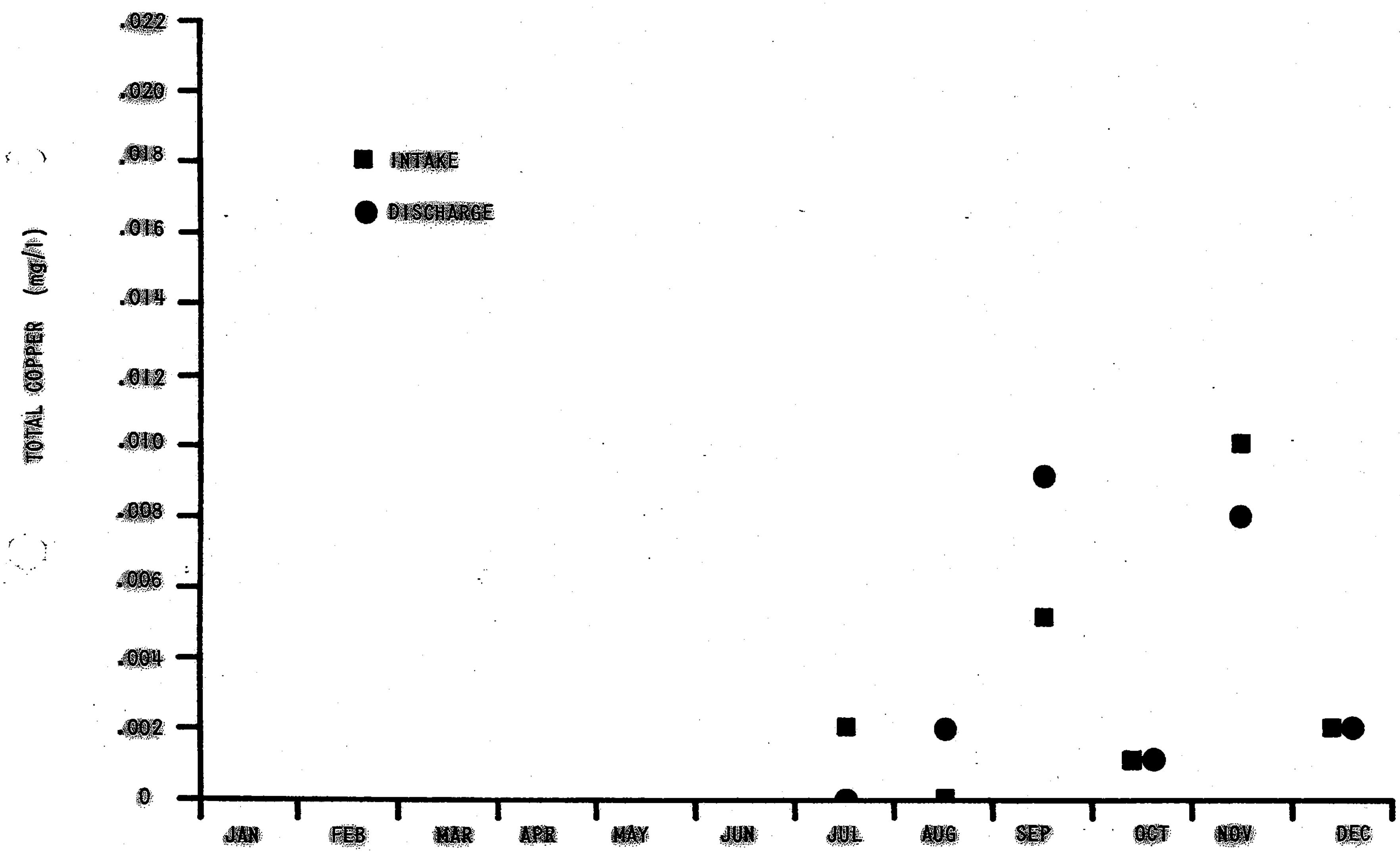
1019.5

SUMMARY OF

WASTE DISCHARGE MONITORING DATA

SILVERGATE POWER PLANT

1976



1019.4

File Number:

03-0284.051γ

TECHNICAL REPORT FOR RWQCB INVESTIGATION ORDER NO. R9-2004-0026

Silver Gate Power Plant
San Diego, California
July 14, 2004

PREPARED FOR:

SAN DIEGO GAS AND ELECTRIC COMPANY
555 West Fifth Street
Los Angeles, California 90013-1011

PREPARED BY:

ENV America Incorporated
2247 San Diego Avenue, Suite 135
San Diego, California 92110
Tel: (619) 260-0730; Fax: (619) 260-0725

ENV America Project No. SDG-04-T006

ENV AMERICA

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INVESTIGATION ORDER NO. R9-2004-0026
SILVER GATE POWER PLANT
SAN DIEGO GAS AND ELECTRIC COMPANY
San Diego, California 92113

ACKNOWLEDGMENT AND SIGNATURE PAGE

This report was prepared by ENV America Incorporated (ENV America), on behalf of the San Diego Gas and Electric Company (SDG&E).

REGISTERED GEOLOGIST No. 6580 THOMAS J. MULDER CERTIFIED ENGINEERING GEOLOGIST No. 2123 STATE OF CALIFORNIA

Thomas J. Mulder, R.G., C.E.G., C.HG.
Senior Project Manager

7-14-2004
Date

Jennifer Gruda, E.I.T.
Project Engineer

7-14-2004
Date

REGISTERED GEOLOGIST KYLE RHEUBOTTOM No. 5300 STATE OF CALIFORNIA

Kyle S. Rheubottom, R.G.
Principal

7-14-2004
Date

ENV AMERICA

DISCLAIMER

This Report was prepared for the sole use and benefit of the San Diego Gas and Electric Company (Client) and for the specific Site known as Silver Gate Power Plant Site, located at 1348 Sampson Street, San Diego, California 92113. Neither this Report, nor any of the information contained herein, shall be used or relied upon for any purpose by any person or entity other than the Client and for the Site.

ENV America makes no warranty as to the accuracy of statements made by others which are contained in this Report, nor are any other warranties or guarantees, express or implied, included or intended in this Report with respect to information supplied by outside sources or conclusions or recommendations substantially based on information supplied by outside sources. This Report has been prepared in accordance with the current generally accepted practices and standards consistent with the level of care and skill exercised under similar circumstances by other professional consultants or firms performing the same or similar services.

None of the work performed hereunder shall constitute or be represented as a legal opinion of any kind or nature, but shall be a representation of findings of fact from records examined.

1.0 INTRODUCTION

This Technical Report was prepared by ENV America for San Diego Gas and Electric Company (SDG&E) in response to San Diego Regional Water Quality Control Board (Board) Investigation Order No. R9-2004-0026 (the IO). This report summarizes historical operations associated with the former Silver Gate Power Plant (Plant), located at 1348 Sampson Street, San Diego, California (Site) (Figures 1 and 2).

1.1 Purpose of Work

San Diego Bay (Bay) sediments in the Southwest Marine and SDG&E leaseholds contain organic and metal contaminants that may have been deposited from multiple sources. The objective of this report is to document potential releases from former SDG&E activities in and around the power plant that may have contributed to sediment contamination. The scope of this report is focused on wastes that are consistent with those cited in the IO.

1.2 Scope of Services

This report summarizes SDG&E operations at the former Plant and surrounding area. The scope of work included researching historical data including internal SDG&E records, aerial photos (collections at County of San Diego Department of Planning and Land Use and San Diego Historical Society), property records, and recent investigation activities at SDG&E and neighboring properties. Public records at the Board, Port of San Diego (Port), and County of San Diego Department of Environmental Health (DEH) were reviewed and evaluated to determine if there was evidence of contaminant discharges that could have impacted Bay sediments.

1.3 Report Structure

This report addresses information required under the IO. Following this introduction are sections describing the Site conditions, SDG&E land leases, power plant history, chemical use and storage, waste handling, and discharges and monitoring. The report also includes sections that describe the potential for SDG&E and surrounding business operations to impact the Bay. Specific releases attributed to SDG&E in the IO are also discussed. The conclusions describe the distribution and likely sources of sediment contamination.

2.0 SITE DESCRIPTION

This section describes the physical attributes of the power plant and surrounding area, including surface and subsurface conditions, and historical lease boundaries.

2.1 Silver Gate Power Plant

The former Plant is approximately 750 feet from the Bay, on the northeast side of Southwest Marine (SWM) shipyard (Figure 1). The Plant consisted of three main areas, the power house (building containing the boilers, turbine generation equipment, and administrative area), the switchyard and substation (which distributed power from the plant, and today is an active substation), and the circulating water (CW) tunnels (tunnels extending from power house to Bay). The power house and switchyard are on land that SDG&E owns. The CW tunnels are on land that SDG&E leases. The Plant configuration is shown in Figure 2, and Figure 3 is a site vicinity map that shows the neighboring properties.

2.2 Geology and Hydrogeology

Belt Street is approximately coincident with the former shoreline of San Diego Bay. In the 1930s the land southwest of Belt Street was created by placement of fill dredged from the Bay. Consequently, the shallow geology northeast of Belt Street is different from the shallow geology southwest of Belt Street.

Northeast of Belt Street, there are three shallow stratigraphic units:

- Variable thickness of fill soil
- Five to 10 feet of alluvium/colluvium
- Pleistocene terrace deposits (also known as Bay Point Formation).

The alluvium and colluvium are generally described as tan to gray, dense silty sand. The Pleistocene terrace deposits are described as brown to gray brown, poorly cemented, dense to very dense silty sand.

The fill deposits south of Belt Street are reportedly material that was hydraulically dredged from the San Diego Bay. Field observations of Parcel 2 indicate that the surface soil, and presumably the underlying fill, is a poorly graded silty fine sand with shell fragments.

The property and surrounding area are located within the Chollas Hydrologic Sub Area (HSA 8.22), which is designated as a non-beneficial groundwater use area by the Board.

The depth to groundwater in around the power house is approximately 15 feet below ground surface (bgs). The gradient is assumed to be westward, toward the Bay.

2.3 Surface Water Hydrology

Because the area around the Plant is primarily paved, rainfall generally results in run-off to municipal or Port storm drains, which discharge into the Bay. Some individual properties, such as NASSCO, SWM and SDG&E substations, currently have storm water capture capabilities; but historically storm water runoff was directed to the bay. According to the City of San Diego storm water conveyance system drawings, surface water run-off from the power plant and surrounding businesses is conveyed through a 30-inch pipe that runs along Sampson Street and discharges into the Bay. Exhibit A contains drawings prepared by the City and Port that show the storm water conveyances for the surrounding area.

A notice of intent (NOI) for the Plant was submitted on March 27, 1992, to the Board under the Statewide General Industrial Activities Storm Water Discharge Permit per NPDES No. CAS000001, Order 91-13-DWQ. In response to this NOI, the Board issued the Plant Waste Discharge ID (WDID) 9 37S05565. Under this permit, the Plant operated in accordance with a site specific Storm Water Pollution Control Plan (SWPCP). A facility drainage plan depicting the location of roof drains and drain inlets from this plan is included in Exhibit A. On October 2, 1995, SDG&E submitted a notice of termination (NOT) application to the Board as a result of the inactive status of the Plant. This NOT was approved by the Board on July 23, 1997.

SDG&E maintained facility spill prevention and control plans. These plans described equipment processes and associated containment incorporated into the plant design to prevent non-permitted releases from the facility. A Spill Prevention Control and Countermeasure (SPCC) plan dated in 1981 was located and reviewed. This SPCC plan described site grading, storage, and secondary containment incorporated into the Site design to control material releases if any were to occur from daily operations. This plan described the general direction of surface water drainage across the Site to be to the east towards Sampson Street and then south towards the Bay. Descriptions of secondary containment for all oil storage units were provided and consisted of:

- Transformers contained within concrete sumps;
- Eastward grading above the underground storage tanks (UST) away from the Bay;
- Six-inch high curb across the UST area that contained potential transformer spills or potential minor fuel oil tank overflows;
- A ten-inch high ramp across the driveway into the UST/transformer switchyard area that bounded the tank area between the ramp, the power plant building and a two foot high retaining wall;
- A sealed drain valve within the ramp capable of holding up to 25,000 gallons in the contained enclosure;
- Four-inch high curbs along the power house building to contain four small transformers that served generating Unit 2;
- A 12-inch high concrete wall and a 4-inch high doorway around the transformers that serve generating Unit 1;
- Drainage of turbines directed into a sump pump that discharged to wastewater Void 2 via level-actuated automatic pumps;
- High level alarms on wastewater Voids 1 and 2 to prevent overflow; and
- Manual release of water required for the secondary containment areas to ensure only clean water was released.

The SPCC plan stated that there were no reportable spills in the prior eight years, indicating that no spills occurred over the period 1973 to 1981.

The NPDES storm water permit for Southwest Marine (NPDES Permit No. CA0109151) as well as figures provided in the Sediment Characterization study (Exponent, 2003) indicated that Southwest Marine storm water was historically discharged to the Bay through eight outfalls located within the Southwest Marine leasehold. Since 1998, only one of the eight Southwest Marine outfalls has been in use.

The storm water conveyance system drawings obtained from the City of San Diego are dated 1994. Storm drain drawings prepared by the Port for the Jurisdictional Urban Runoff Management Plan in 2003 depict a 60-inch diameter pipe that discharges to the Bay from the Southwest Marine leasehold. This plan also depicts an abandoned 42-

inch storm pipe that historically collected surface water from Sampson Street and the surrounding area and discharged to the Bay. This outfall was located within the Southwest Marine leasehold near Pier 3.

Chollas Creek also discharges to the Bay (Figure 1). The terminal area of the creek has deposits of contaminants that have been flushed from upstream domestic and industrial operations, which contain various organic compounds, including polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), and metals.

2.4 Land Leases

The Plant and associated switchyard and substations are located on property owned by SDG&E. The circulating water (CW) tunnels are located on land within the Burlington Northern Santa Fe (BNSF) Railroad (formerly the Atchison, Topeka and Santa Fe [AT&SF] Railroad) right of way and on State land managed by the Port, formerly managed by the City of San Diego from 1941 to 1960 at which time the Port was formed to manage all tidelands adjacent to the Bay. Historically, there have been several subleases of SDG&E leased land.

Figure 4 illustrates the various lease boundaries for the three parcels that SDG&E has leased from the Port. The leased land has been referred to as Parcels 1, 2 and 3.

In the next few years, SDG&E plans to disassemble and remove the Plant. SDG&E also plans to cancel the associated leases of adjacent properties. As part of canceling these leases, SDG&E will restore the leased properties to a condition mutually agreeable to SDG&E and the property owners. This restoration may involve abandonment of the CW tunnels and associated structures.

- <u>Port tidelands</u>

  Land leased from the Port, 2.14 acres. This landside area contains an approximately 525 foot length of tunnels beneath land occupied by Belt Street, Southwest Marine and ISP Alginates. This is publicly owned land that is managed by the Port. The visible surface features of the SDG&E CW tunnels are (a) manhole entryways within the yard of Southwest Marine, and (b) inlet and outlet structures located on the waterfront. The Port lease documents recognize this landside area as two parcels.

"Parcel 1" is a 0.15 acre parcel that is occupied by Belt Street. On this parcel, the tunnels are overlain by a heavily traveled road and multiple buried utilities that run beneath Belt Street, including natural gas, storm sewer, sanitary sewer, and electric service.

"Parcel 2" is a 1.99 acre parcel that is subleased to Southwest Marine and ISP Alginates. ISP Alginates uses their space for maintenance activities and parking. Southwest Marine uses their space for shipyard operations and parking.

Based on aerial photographs (see Section 3.1), SDG&E's Parcel 2 has been subleased to Southwest Marine and ISP Alginates and their predecessor companies since the mid-1960s.

3.0 SITE OPERATIONAL HISTORY

This section describes the Plant property and operational history.

3.1 History of Property and Vicinity

The following is a tabular summary of the history of operations on the Plant Site and the adjoining leased land of Port Parcel 2, with a focus on information relevant to environmental concerns. The best information of historical land uses was obtained from reviewing historical photographs, copies of which are included in Exhibit B. The history was developed by reviewing a number of records, including:

- Photograph collections at the San Diego Historical Society (SDHS);
- Aerial photograph collections at the County of San Diego Department of Planning and Land Use (DPLU) Cartography Department; and
- SDG&E internal files.

land by bay w/ intake tunnels

Historical Summary

Plant Land Area	Port Parcel 2
March 1930: land area used for lumber storage March 1937: land area was vacant	March 1930: parcel was beach and submerged tidelands (SDHS Photo 89-17537-46) March 1937: parcel was vacant, undeveloped, recently-filled tidelands (SDHS Photo 79-741-226)
1941: construction of generating Unit 1 began January 1943: generating Unit 1 began operating	March 1941: south side of parcel had piles of construction debris (SDHS Photo 79-741-672) 1949 - 1952: parcel used for outdoor storage and parking, apparently SDG&E storage (DPLU Photo 1949AXN_1F_154, SDHS Photo 82-13673-721)
1952: generating Unit 4 construction completed	1952: parcel contained a pond, here named "Pond A," with above-grade berms (SDHS Photo 82-13673-718) 1953 - 1959: parcel was primarily vacant (DPLU Photo 1953AXN-3m-197, SDG&E photo from 5/59) June 1955: six SDG&E photographs illustrate location of an oil/water separator, here named "Structure C," and a minor overflow/spill to surface soil May 1959: one SDG&E photograph illustrates that Structure C was not extant, and another oil/water separator was present, here named "Structure D"

Historical Summary	
Plant Land Area	Port Parcel 2
	1966-1973: parcel contained a pond, here named "Pond B" (DPLU Photo 1966-GSVB01-1-112, DPLU Photo 1973-SDPD-26-5) 1966 – present: parcel used for parking, and used for industrial operations of SWM and ISP Alginates and their predecessor companies
1978: wastewater treatment plant brought online	1974: use of Pond B discontinued
mid-1980s: electric generating activities ceased mid-1980s – present: powerhouse and CW deck unused, substation continuing in use	

3.2 Power Plant Operational History

The power house contains six boilers which supplied steam to four steam turbine generating units, known as Units 1 through 4. The construction of the power plant began in the early 1940s, with Unit 1. Construction of Units 2, 3 and 4 proceeded sequentially until Unit 4 was finished in the early 1950s. The only major addition after 1952 was the addition of a waste water treatment plant, which was constructed on the CW Deck in 1978.

The plant operated almost continuously from 1943 to 1974. The power plant was used intermittently after 1974 to meet peak demands, but generally ran at reduced capacity. Units 1 and 2 were taken off-line in 1983. Units 3 and 4 were taken off-line in 1984. The boilers burned natural gas or fuel oil (dual fuel boilers).

After the mid-1980s, the power plant equipment was mothballed and maintained for a period. The mothball maintenance activities likely included dehumidified air storage of the turbines and boilers, degassing and dry storage of the generators, and rinsing and dry storage of the condensers. The mothball maintenance was discontinued a number of years ago.

In recent years, maintenance was performed to maintain necessary items such as the basement sump pumps, wastewater voids, wastewater void ventilation, plant lighting, elevator certifications and security. Various parties have occasionally salvaged parts and tools from the plant, but the majority of the power plant equipment is still onsite.

SDG&E plans to begin disassembly and removal of the boilers and turbine generating units in late 2004.

Fuel oil used to fire the boilers was stored in three 220,000-gallon underground storage tanks (USTs) that were located below the switchyard and substation. These tanks consisted of 12 inch thick concrete lined with a ½-inch thick steel plate. These tanks were "temporarily closed in place," and are not accessible until a future time when the substation equipment is removed. Construction of the USTs was likely concurrent with power plant construction, and there was no documentation found that described changes to the tank configuration.

San Diego Bay was used for non-contact, once-through cooling water in the power plant. The cooling water was transmitted via four tunnels (two intake tunnels and two discharge tunnels), each of which had cross-sectional dimensions of approximately 8 feet wide by 8 feet tall. The non-contact cooling water was passed through tube-type condensers to cool the steam. The tunnels apparently were constructed concurrent with construction of Unit 1 and remain in place today.

3.3 Chemicals Stored and Used Onsite

Table 1 shows a summary of the major chemicals that were used in Plant systems. The table indicates the time period of usage and the storage location. Nearly all chemicals were stored within the plant interior, with the exception of sodium hydroxide and sulfuric acid, which were stored in tanks on the CW deck; and chlorine, which was stored adjacent to the control house. Included in Exhibit C are copies of the chemical usage/purchase records provided by SDG&E to the Board per NPDES Permit No. CA0001376.

A lube oil system distributed oil to the turbines. Other chemicals were used in small quantities, such as cleaners and lubricating oils for ongoing plant repairs.

3.4 Wastes Generated and Stored or Discharged From the Site

The Plant generated several waste streams, including water from cooling and wash/cleaning processes, solids from plant repairs and modifications, air stack emissions, and equipment lubricants. This report focuses on the waste streams that may have resulted in discharges to the bay, which are primarily limited to waste water streams. The following sub-sections describe the sources of waste water, which are summarized on Table 2. Additionally, selected relevant process descriptions obtained during this investigation are included in Exhibit C. We have also included a brief description of non-water liquid wastes that would have been generated at the plant.

Waste streams underwent various methods of treatment and discharge over the life of the plant. In September 1978 a waste water treatment plant was completed on the CW deck and subsequently certain aqueous waste streams underwent onsite treatment. Waste water characteristics and operational information was obtained from SDG&E internal documents, NPDES permits, and Army Corp of Engineers (ACE) permits. The primary waste streams that were contained in discharges included the following:

- Non-contact cooling seawater;
- Domestic wastewater, which was discharged to the sanitary sewer system;
- Air-preheater wash water;
- Boiler wash water;
- Chemical boiler tube cleaning water;
- Boiler and evaporator blowdown water;
- Bilge water collected from the basement floor trench system; and
- Service system cooling water; this waste was a small contributor as it was circulated in a contained closed loop system that was used to cool generation equipment such as bearings, jackets and compressors.

3.4.1 Non-Contact Cooling Water

The non-contact cooling water was used to cool and condense steam in the condensers. Sea water was circulated from the Bay through the tunnels at flow rates that typically ranged from 120 to 180 million gallons per day (MGD), with maximum flows of about 220 MGD during peak generation periods when all boilers were in use. Figure 5 shows the basic flow-path of the circulating water through the plant. The only chemical added to the circulating water was chlorine, which was used to reduce bio-fouling. The circulating water discharges to the Bay were regulated under various permits as described in Section 4.0.

3.4.2 Air Pre-Heater and Boiler Fireside Wash Water

Air pre-heaters were typically washed once a year when fired by gas and twice a year when using fuel oil. Similarly, the outside (fireside) of the boiler tubes were washed to remove soot and accumulated combustion by-products (scale) from metal surfaces in order to maintain efficient heat transfer of the tubing. High pressure water was used to clean the surfaces. Boilers washing averaged two per year. Individual pre-heater washes generated about 90,000 gallons of water (SDG&E, date unknown). The annual waste stream from the boiler washings was approximately 140,000 gallons per year (SDG&E, 1972). The wash water was captured in the wastewater voids, where suspended solids were settled. The water was then pumped into the sanitary sewer and the solids were disposed of offsite (SDG&E, 1972). Upon completion of the waste water treatment plant, the wash water was treated onsite and then discharged to the Bay under NPDES Permit No. CA0001376.

3.4.3 Chemical Boiler Tube Cleaning Water

The inside of the water/steam tubing in each of the six boilers was cleaned at least every four years to remove scale. A chemical solution was used to clean the equipment, which was followed by various rinses, including alkaline solutions. The cleaning water was captured in the waste voids, where it was neutralized and then disposed of into the sanitary sewer. Boiler cleaning chemicals were discharged into a void and subsequently hauled to a disposal site approved by the Board. Neutralized chemicals were discharged to the City sewer (SDG&E, 1972). Upon completion of the waste water treatment plant in 1978 (on the circulating water deck), the cleaning water was treated onsite and then discharged to the Bay under NPDES Permit No. CA0001376. Water that was untreated, if any, was held in one of the wastewater voids on the CW deck until it was disposed of offsite.

3.4.4 Boiler Blowdown Water

Boiler blowdown refers to the release of relatively clean water from the steam system. Water was purged from a low point in the system to release settled and precipitated solids. Boiler blowdown was conducted on a daily basis and generated approximately 5.9 million gallons of water per year (SDG&E, 1972). It appears that prior to 1978 the boiler blowdown was routed directly to the CW discharge tunnels (SDG&E, 1972). After the water treatment plant was constructed, blowdown water went to the wastewater voids, where it was tested for iron and copper and then either treated and discharged or directly discharged to the Bay, if no treatment was needed. Boiler blowdown reportedly averaged approximately 75,000 gallons per month (SDG&E, date unknown). Once operations ceased at the plant, boiler blowdown discharges also ceased.

3.4.5 Basement Bilge Water

Basement bilge water consisted of liquids that accumulated in trenches in the plant basement. The WWTP manual (SDG&E, 1978) lists the following waste sources: "turbine drains, boiler drains, condenser drain pump drains, cooling water supply drains, water box drains, service air compressor drains, fire pump drains, relief valve drains, condensate storage and overflow and condensate makeup pump drains." The basement bilge system was divided into two areas, the turbine side and the boiler side. Diagrams from 1965 show that bilge water from the turbine side was piped into the discharge cooling water tunnels, andthe bilge water from the boiler side was pumped, via an 8 inch diameter pipeline, to an "oil-water separating pond" located on Parcel 2, referred to as "Nobles Lake", which was used for evaporation and settling. However, it is noted that an ACE application (SDG&E, 1972) stated that only blowdown and cooling water were discharged to the CW tunnels, whereas other wastes were disposed of by evaporation, discharge to sewer or offsite disposal. Some water from the pond was discharged to the Bay. A more detailed description of the settling pond is contained in the *Site Assessment Report, Tideland Lease Area, Silver Gate Power Plant,* (ENV America, 2004).

In late 1974, SDG&E ceased using the pond due to changing environmental practices and regulations. From 1974 to 1977, all bilge wastewater was accumulated in three wastewater voids in the CW deck area of the power plant (total capacity of the voids was 270,000 gallons), from which it was either treated onsite or discharged in batches to the City sanitary sewer. In 1978, SDG&E completed construction of a wastewater treatment plant, after which bilge water was treated onsite prior to discharge into the Bay.

Today, discharge of the facility's minimal wastewater is conducted on a batch basis. All facility wastewater is collected in the equipment sumps and the plant bilge trench system. The wastewater is accumulated in Void No. 2, tested and discharged under permit to the City sanitary sewer system. The wastewater consists of mostly rainwater and possibly in-seepage of groundwater. Recent batch discharges include 105,500 gallons in 1998; 29,500 gallons in October 1999; and 49,500 in April 2001.

3.4.6 Service System Cooling Water

The service system cooling water was in a fully contained network of pipes and heat exchangers which should not have resulted in discharges. The water was treated with sodium dichromate as a corrosion inhibitor. Although no documentation was found describing draining and replacement of coolant, chemical usage logs described annual purchases of additional sodium chromate. One instance of a leak into the cooling water was documents in the compliance records.

3.4.7 Non-Water Liquid Wastes

Wastes that were generated separate from water streams included a lube oil system, which circulated oil from reservoirs through the generating turbines. The lube oil system included eight oil storage tanks, the largest of which was 3,000 gallons. The tanks drained to a 20,000-gallon sump. From at least 1980 onward the sump was equipped with level-actuated pumps that discharged to Void No. 2, where oil would be contained and appropriately disposed or treated (SDG&E, 1981).

4.0 FACILITY DISCHARGE MONITORING RECORDS

This section summarizes waste discharge records for the waste water streams described in Section 3.

Discharges from the former Plant began when Unit 1 started generating in approximately 1943. Little information is available to document facility discharges prior to 1969. Starting in 1969, discharges were regulated by the Board, ACE, and the United State Environmental Protection Agency (USEPA). Discharge permit applications, compliance records, and facility-agency correspondence documents were reviewed for the period 1969 through 1995. In April 1995, the Plant NPDES permit was rescinded.

4.1 DISCHARGE PERMIT HISTORY

The first RWQCB Order, Resolution 69-R32, was issued by the Board in 1969. This resolution governed discharges during the period 1969 to 1974. In 1974, a NPDES permit (CA0001376) was adopted (Order 74-90) succeeding Resolution 69-R32, which was applicable until 1976. The plant's NPDES permit was subsequently renewed in 1976 (Order 76-9) and in 1985 (Order 85-07). A description of each of these permits is provided below, and Table 3 summarizes the permit conditions and discharge limitations.

4.2 RESOLUTION 69-R32

In July 1969, at the Board's request, SDG&E submitted a Report of Waste Discharge (ROWD) for the plant (Exhibit C). This ROWD described the plant's management of waste streams and cooling water discharge. It also specifically stated that all boiler chemical cleaning wastes were hauled offsite. Resolution 69-R32 was adopted by the Board in November 1969 (Board, 1969). This resolution regulated facility chemical usage to those chemicals already in use. These chemicals were identified to be sodium phosphate, sodium chromate, and ferrous sulfate. SDG&E was required to submit chemical usage data on a monthly basis pursuant to this resolution. Discharge practices pursuant to this resolution were described as follows:

- All industrial wastes, other than cooling water and boiler blowdown, were to be excluded from the discharge to the San Diego Bay;

- Chemical cleaning of the boilers was conducted every other year. All wastes from this process were hauled offsite;
- All domestic waste was discharged to the San Diego Metropolitan Sewage System; and
- The amounts of boiler cleaning waste generated and the point of disposal for each boiling event was to be documented.

In June 1971, a permit application under the Refuse Act per 33 U.S.C. 407 was submitted to the ACE. It indicated that facility discharges consisted of "relatively" pure water from boiler blowdown. The ACE permit application also stated that "Other wastes are excluded from this discharge and are disposed of by evaporation and/or city sewer (where approved). In some cases, disposal is made by hauling to an approved land disposal facility" (USEPA, 1972).

Additional waste stream treatment details were required by the ACE in response to SDG&E application under the Refuse Act to discharge non-contact cooling water into the Bay. In this response, dated June 1972, SDG&E indicated that boiler blowdown was conducted daily and generated approximately 5.9 million gallons per year of wastewater. Boiler wash (boiler tube fireside wash) was conducted on two boilers per year and generated a volume of 140,000 gallons per year. The SDG&E response stated that wash water from this process "...is drained into a holding cistern and the suspended solids allowed to settle. The liquid portion is neutralized to a pH of 6-7 and pumped to the City sanitary sewer. The remaining solids are hauled to a disposal site approved by the California Regional Water Quality Control Board" (SDG&E, 1972). A boiler cleaning (boiler chemical cleaning) was performed on two boilers per year. "The boiler cleaning chemicals are discharged into a holding tank and hauled to a disposal site approved by the California Regional Water Quality Control Board" (SDG&E, 1972).

Constituents monitored pursuant to the requirements of this resolution included flow rate, temperature, total suspended solids (TSS), total phosphorous, dissolved oxygen (DO), oil and grease, and pH. Discharge limits were based on a comparison between parameter concentrations in the cooling water intake versus the cooling water outlet. Quarterly reports were submitted to the Board. These reports presented monitoring results for each month in the quarter. The effluent limits for temperature, TSS, and oil and grease were established based on a comparison with the intake cooling water levels. As a result, the maximum temperature increase could not exceed 22 degrees Fahrenheit or an average temperature increase of 15 degrees Fahrenheit, no measurable increase in TSS was allowed and no more than 0.01 mg/L of oil and grease could be added to the Bay. Monitoring records are described in Section 4.7.

4.3 ORDER 74-90

Order 74-90 was adopted in December 1974 and covered the period December 1974 to June 1976. It described one facility discharge referred to as "discharge 001, cooling water." It stated that this discharge averaged 165.6 MGD and contained an average daily TSS concentration of 5.7 mg/L and a total iron daily average concentration of 0.20 mg/L. This order did not allow the discharge of oil, as defined by 40 CFR 110, at any time. It further stated that screenings, sludges, and other solid waste must be disposed of in such a manner as they do not enter any navigable waterway or tributary and that storm water runoff shall be routed so that it does not come in contact with raw materials, chemicals, and contaminants.

Constituents monitored pursuant to the requirements of this order consisted of flow rate, temperature, TSS, DO, oil and grease, total residual chlorine, settleable solids, and pH. Similar to Resolution 69-R32, no measurable increase in TSS was allowed and the maximum temperature increase could not exceed 22 degrees Fahrenheit or an average temperature increase of 15 degrees Fahrenheit. In addition, the order stated the Bay water must not be reduced to less than 4.5 mg/L of dissolved oxygen. Oil and grease, total residual chlorine, and settleable solids had set concentration and daily loading requirements.

Quarterly reports were submitted to the Board. These reports presented monitoring results for each month in the quarter, which are described in greater detail in Section 4.7.

4.4 ORDER 76-9

This order was adopted in May 1976 and covered the period May 1976 through June 1985. This permit marks the first period when metals analyses for copper and iron in wastewater were required. In addition, during this period of operation and monitoring, SDG&E was required to meet the new EPA steam electric generating categorical effluent limits for low volume wastes, boiler blowdown and metal cleaning wastes. To accomplish this, SDG&E constructed a wastewater treatment plant for wastewater processing. This plant was brought on-line in September 1978 and was used to treat the metal cleaning waste and low volume waste prior to discharge from the facility.

Waste streams under this permit were divided into combined waste discharge (discharge 001), metal cleaning waste (discharge 001B), boiler blowdown (discharge 001C), and low volume waste (discharge 001D). The combined waste discharge consisted of non-contact cooling water used to cool the condensers and pumps and other waste discharges that entered the Bay. Metal cleaning wastes were associated with boiler wash and air pre-heater wash water (if chemicals were used) and all chemical cleaning wastes from boiler cleanings. Low volume wastes consisted of bilge water, drainage of the service water system spent circulation water, and any equipment drip water that entered into the power house basement bilge trenches.

Monitoring of the metal cleaning waste stream, the boiler blowdown waste stream, and the low volume waste stream was suspended under this order via Technical Order 77-29 and subsequent amendments thereto, issued by the Board from July 1976 through April 1978. This was done to allow SDG&E time to reconfigure equipment and piping and to construct the new wastewater treatment plant. As a result, copper and iron monitoring did not begin until June 1978.

Monitoring under Order 76-9 included monitoring of the cooling water intake for TSS, oil and grease, and total copper. Discharge 001 was monitored for temperature, TSS, oil and grease, free available chlorine, pH, and total copper. However, monitoring limits were only set for temperature and free available chlorine. There was no limit set for total copper in this discharge. The compliance records suggest that TSS, oil and grease, and total copper were compared with an influent sample collected from the cooling water intake at the same time as the effluent sample to ensure the discharge was not adversely impacting the Bay. Discharge 001B and discharge 001C were monitored for TSS, total copper, total iron, and oil and grease. Concentration limits consisting of an allowable 30-day average and daily maximum concentration limit were established. Additionally, a 30-day average mass loading requirement and a daily maximum mass loading were established for each of these parameters. Discharge 001D was limited to TSS and oil and grease with concentration and mass loading limits.

Monitoring reports were submitted on a monthly basis to the Board. In addition, a year-end annual report was submitted which presented the average monthly concentration measured for each waste stream in tabular form and on trend plots. Compliance records are described in Section 4.7.

4.5 ORDER 85-07

This order was adopted in January 1985 and covered the period January 1985 through April 1995 when SDG&E rescinded their NPDES permit. Similar to Order 76-9, this order permitted the discharge of combined waste, metal cleaning waste, and low volume waste. Order 85-07 permitted the discharge of once-through cooling water, circulating pump lubrication water, and evaporator boiler blowdown water to the Bay without treatment. Pursuant to Order 85-07, the combined discharge consisted of once-through non-contact cooling water, and treated waste streams including cooling water pump lubrication wastes, low volume wastes and metals cleaning wastes.

Metal cleaning wastes included waste water from periodic boiler tube chemical cleanings, air pre-heater wash water and boiler fireside wash water. Treatment per permit requirements consisted of neutralization, chemical precipitation and flocculation. At times, boiler chemical cleaning waste was collected and shipped offsite to an approved disposal facility. This was a common practice in later years when little metal cleaning wastewater was generated due to intermittent operation of the plant.

Low volume wastes included condenser cleaning wash water, bilge water, evaporator blowdown, boiler blowdown and water collected from floor and sample drains throughout the facility. This waste stream, except for boiler blowdown and evaporator blowdown, was collected prior to discharge, isolated, sampled, treated if necessary and subsequently released from the facility.

Monitoring results were submitted monthly, semi-annually, and annually to the Board. Monthly reports included temperature data for both the influent and effluent. The combined discharge waste stream was monitored for temperature, TSS, oil and grease, pH, and total residual chlorine. Limits existed for the instant and daily maximum concentration and daily mass loading were required for total residual chlorine. The metal cleaning waste stream was monitored for TSS, oil and grease, total iron and total copper. Limits existed for instant maximum allowable concentrations, daily maximum allowable concentrations, monthly average allowable concentrations, instant maximum allowable loadings, daily maximum allowable loading, and monthly average allowable loading for each parameter. The low volume waste stream was monitored for oil and grease and TSS with concentration and mass loading limits.

In the semi-annual monitoring reports required pursuant to Order 85-07, SDG&E was required to monitor the combined discharge for toxicity, metals consisting of arsenic, cadmium, chromium, copper, lead mercury, nickel, silver and zinc, cyanide, ammonia, phenols, pesticides, and organics. Limits were set for the instant maximum concentration and the instant maximum loading for each of these parameters. A six month median toxicity maximum limit was set for the low volume waste in the semi-annual monitoring reports. However, there was no additional monitoring required for the metal cleaning waste.

The semi-annual report for Order 85-07 required monitoring of the in-plant waste stream. The in-plant waste stream represented a pre-discharge wastewater sample of all in-plant waste streams combined including the metal cleaning waste and low volume wastes such as boiler and evaporator blowdown. Limits for the in-plant waste were established by the Board for metals consisting of arsenic, cadmium, chromium, copper, lead mercury, nickel, silver and zinc, cyanide, ammonia, phenols, pesticides, and organics. Monitoring limits for these parameters were set for instant maximum concentration, instant maximum loading, daily maximum loading, and 6-month median maximum loading.

The monitoring limits for the combined discharge and in-plant waste were set by the Board using the California State Water Resources Control Board (SWRCB) Ocean Plan Water Quality Standards. This method was used to set effluent limits for mass loading requirements due to the absence of standards for bays and estuaries. These limits were set based on full-scale operation of the plant (all units running). However, since SDG&E did not operate at full capacity during the majority of the period covered under this permit, the Board required SDG&E to compute actual loading limits based on the actual flow rate on the day of sampling. Thus, the limits outlined in Table 3 were not the actual limits for the plant, unless the discharge flow rates were at full permitted flows. Instead, SDG&E was required to meet much lower, more stringent limits than those shown in the table due to actual discharge flows. Compliance records are described in greater detail in Section 4.7.

4.6 WASTE STREAM SAMPLING METHODS

There was little documentation available describing actual waste stream sampling locations. Information with regard to sampling locations for NPDES monitoring under Order 85-07 was available and is presented below for each waste stream. It has been assumed that similar sampling locations were utilized in previous years as facility operations remained constant, other then the construction of the wastewater treatment plant in 1978. The combined discharge was sampled from the CW deck within a void space or as the waste exited the facility at the CW outlet tunnel located on the south side of the CW deck adjacent to the inlet tunnels.

Combined Discharge

The combined discharge sampling was conducted at the location where the two 8 foot diameter tunnels exited the facility en route to the Bay.

Metal Cleaning Waste

The metal cleaning waste stream was sampled from various locations following treatment in the wastewater treatment plant. Composite samples collected for TSS, copper, and iron were collected from the multi-stage filter outlet of the wastewater treatment plant. Samples collected for oil and grease analysis were collected from Void 2 on the CW deck.

Low Volume Waste

The low volume waste streams were sampled prior to discharge to the combined discharge. Low volume waste streams such as bilge water were always directed to a void for settling and separation. Samples for TSS were collected as a composite sample from the multi-stage filter outlet on the wastewater treatment plant. Oil and grease grab samples were collected directly from the void. If a batch of low volume waste was not sent through the multi-stage filter on the wastewater treatment plant, it would be isolated in the void, sampled and then released to the Bay. Boiler blowdown and evaporator blowdown were sampled prior to the combined discharge from sample points located within the plant.

In-Plant Waste

The in-plant waste was also sampled pursuant to semi-annual monitoring requirements set by the Board. This waste stream was sampled prior to discharge into the non-contact cooling water in the CW tunnels. Typically, the in-plant waste sample was collected from the voids prior to being combined with the non-contact cooling water. In the event an exceedance occurred in the combined discharge sample, the in-plant data could be used to determine if the source was from the plant wastewater.

4.7 MONITORING RECORDS

Pursuant to Resolution 69-R32 and NPDES CA0001376 (Order 74-90, Odder 76-9 and Order 85-07), monitoring data were submitted to the Board. The compliance records were reviewed to identify and evaluate instances when permit limits were exceeded. Table 4 summarizes available monitoring records and lists permit exceedances.

The following sections discuss the monitoring results for each compliance period where specific exceedances of chemicals of concern (COCs) relative to the current IO occurred. The COCs included in the IO and presented herein are cadmium, chromium, mercury, nickel and PCTs. Total suspended solids are also included in this discussion since they may have contained COCs.

4.7.1 Resolution 69-R32

The compliance records located for review at the Board and in SDG&E internal files were limited to the year 1974, although it is noted that this resolution covered the period December 1969 to December 1974. Under this resolution, quarterly reports were submitted to the Board.

During the year 1974, the compliance records reviewed indicated that TSS compliance limits were exceeded. TSS compliance limits were set based on the difference between influent and effluent concentrations of the circulating water from the Bay. The criteria set by the Board did not allow any increase in TSS concentrations. The compliance limits for TSS were exceeded seven times during 1974. However, the magnitude of the exceedances is not known as SDG&E reported only that the TSS concentration between the intake and discharge water exceeded 0 milligrams per liter (mg/L). TSS exceedances were described in an SDG&E June 1974 internal memorandum to have resulted from sample variation between the influent and discharge water. This is understandable given the very large volume of Bay cooling water being sampled, and the difficulty of ensuring that influent samples were collected from the same water as the effluent samples. This memorandum indicated that new sampling methods were being researched to ensure sampling data were representative of actual conditions.

4.7.2 Order 74-9

Compliance records for this order were reviewed for the period December 1974 through June 1976. TSS limits which were the same under this Order as for Resolution 69-R32, were exceeded on seven occasions during this period. TSS concentration exceedances ranged between 0.1 mg/L to 1.6 mg/L. These seven occasions indicate that exceedances of the compliance limit occurred only 1.4% of the time during this period. Similar explanations for the TSS exceedances were given during this period as were provided during the 1969 to 1974 period; namely sampling methods and laboratory analytical precision. Again, compliance reports submitted to the Board indicated that a different method of sampling was being researched to ensure representative data were obtained.

4.7.3 Order 76-9

Compliance records for this order were reviewed for the period June 1976 through January 1985. Limits for TSS in the low volume waste stream were exceeded in one sample in May 1981. This sample exceeded the 30-day average concentration of 30 mg/L (measured TSS concentration of 66.9 mg/L); the daily maximum concentration of 100 mg/L (measured TSS concentration of 126 mg/L); and the 30-day average mass emission limit of 23.8 lb/day (computed TSS 30-day average mass emission limit of 34.2 lbs/day). There was no explanation provided as to the cause of these exceedances in the documents available for review.

4.7.4 Order 85-07

Compliance records for this order were reviewed for the period January 1985 through plant shutdown in April 1995. There were no exceedances of the monthly compliance limits during this period. However, semi-annual compliance limits were exceeded over three time periods for chemicals identified in the IO.

The first exceedance occurred for chromium during the first half of 1985 in the in-plant waste stream. The chromium six month median in-plant mass emission limit of 0.0011 lbs/day was exceeded. The plant computed a concentration of 0.0794 lbs/day chromium in June 1985 during a small plant discharge from void 1. An explanation for this exceedance was not provided. The plant was operating in stand-by mode and made infrequent discharges during the first half of 1985. According to the semi-annual compliance report, it appears that a combined waste discharge was made on June 3, 1985 and not on June 25, 1985, when the small waste volume (approximately 0.017 MGD) was discharged from void 1.

During the first half of 1988, chromium exceeded the compliance limits on two sampling events. On April 6, 1988, the in-plant waste stream chromium six month median mass emission limit of 0.1477 lbs/day was exceeded (computed six month median mass emission limit of 0.2983 lbs/day based on an in-plant flow rate of 0.07 MGD). On June 15, 1988 the chromium combined discharge instant maximum concentration limit of 78 micrograms per liter (ug/L) was exceeded (measured chromium concentration of 240 ug/l); the combined discharge chromium mass emission limit of 3.798 lbs/day was exceeded (computed chromium mass emission limit of 11.69 lbs/day based on a flow rate of 5.84 MGD); and the chromium six month median in-plant waste mass emission limit of 0.3798 lbs/day was exceeded (computed chromium six month median mass emission limit of 0.908 lbs/day based on a flow rate of 0.038 MGD. It is important to note that the chromium concentration in the cooling water inlet was approximately 170 ug/L.

Due to the initial chromium exceedance that occurred in April 1988, SDG&E conducted an investigation of their facility and re-sampled in June 1988 during their next facility discharge. It was determined at this time that the chromium present in the in-plant waste stream and subsequently in the combined waste discharge leaving the facility resulted from a leak in the plant's service water system. This waste stream was immediately isolated to prevent further discharge. Remaining wastewater onsite was hauled offsite for final disposal.

The final chromium exceedance occurred during the second half of 1989. The chromium combined discharge instant maximum concentration of 78 ug/L was exceeded (measured concentration of 1,022 ug/L) during this period. The in-plant waste stream was sampled at the same time as the combined discharge, and it contained essentially no total chromium (concentration less than 4 ug/L). In response to the elevated concentration of chromium in the combined discharge, SDG&E performed a facility inspection to ensure no leaks or spills had occurred. It was concluded that all piping and valves were in good condition. Facility data were further evaluated to identify the cause and/or source of chromium. The flow rate for the cooling water was approximately 19,300 gallons per minute (gpm) and the in-plant waste stream had a flow rate of approximately 128 gpm. Thus, the combined discharge flow rate was approximately 19,428 gpm at the time the exceedance occurred. Using these flow rates and assuming a concentration of 0 ug/L chromium in the Bay, it was estimated that the in-plant waste total chromium concentration would have needed to be approximately 155,200 ug/L to result in the measured concentration of 1,022 ug/L present in the combined discharge. Since the in-plant waste stream was sampled and did not contain chromium, it was assumed that the Bay water was the source.

5.0 POTENTIAL FACILITY RELEASES OF METAL AND ORGANIC COMPOUNDS

The IO identified several metals and polychlorinated terphenyls that were detected at elevated concentrations in sediments at the north end of Southwest Marine's leasehold. This section describes potential COC releases to the bay through Plant facility operations. It also addresses three specific SDG&E historical releases described in the IO that were associated with the plant and nearby facilities.

5.1 POTENTIAL RELEASES FROM FACILITY OPERATIONS

The Plant generated several waste streams as described in the previous sections. Historical documentation shows that operational practices typically prevented facility generated contaminants from entering the Bay. In 1978 the WWTP became operational, and served to further reduce potential releases to the Bay. Prior to 1978 the containment voids located on the CW deck were used to capture various waste streams and allow off-site disposal.

5.1.1 Bilge and Blowdown Water

Two waste streams may have discharged metals and organics to the Bay during the early operation of the plant (prior to 1974). Accumulation of liquids in the turbine side bilge trenches appears to have been discharged to the circulating tunnels that went directly to the bay (based on a 1965 plant diagram). Bilge water contained various liquids as described in Section 3.4.5. Bilge water from the boiler side was pumped to an oil/water separator and/or a settling pond in lease Parcel 2, where oily material and solids were separated before discharge to the Bay.

Potential releases in the bilge water may have included oil and grease from equipment lubrication, total suspended solids from water system drains, and possible service system water leaks or spills that contained chromium VI.

The second direct Bay discharge was from boiler and evaporator blowdown water, which may have contained solids and low level metals. After the WWTP was constructed, blow-down water was captured in voids, tested, and treated if necessary prior to Bay discharge (SDG&E, date unknown). Although permits allowed direct discharge of blowdown water, waste streams were sometimes combined such that they required testing and potential treatment prior to discharge.

Water discharge sampling and analyses from 1974 onward showed occasional permit exceedances of total suspended solids, oil and grease, iron, copper and chromium (Table 4).

5.1.2 Chromium Usage

The IO listed several specific chemicals of concern for the Plant, one of which was chromium. Chromium VI was used at the plant in the form of sodium dichromate as a corrosion inhibitor in the service water cooling system. Annual NPDES reports from 1976 through 1994 listed the amount of sodium dichromate used annually at the plant, which ranged from 0 to a maximum of about 1200 pounds (Exhibit C). This was the only source of chromium found in plant documentation.

The service water was a closed loop system that did not have direct discharges to the Bay. Operational data indicate only extraordinary events such as leaks and spills could have released chromium to the environment. Leaks in the system may have impacted CW tunnel discharges (as described in chrome exceedance in 1988, Table 4). Leaks or spills may have also drained to the bilge system, which would have been pumped to Parcel 2 settling ponds prior to 1974. No documents describing spills or unauthorized releases of sodium chromate were found.

5.1.3 Storm Water Runoff

Site surface waster hydrology is described in Section 2.3. On the north (substation) side of the plant the site surface slopes eastward to Sampson Street, where storm water runoff is channeled to storm drains that discharge to the Bay. Water on the substation side of the plant is contained by berms that have been in place since at least 1981 (SDG&E, 1981). In addition to secondary containment structures inside the substation, the ground surface of the substation is covered with gravel, which filters potentially eroded sediments. The CW deck, which is on the south side of the plant, is about 10 feet lower than the surrounding surface grade. Water from the roof and CW deck drains into the open CW tunnels. Parking areas on the south side of the plant drain directly to Sampson Street.

No documentation was found that described spills or leaks outside the plant that would have impacted storm water runoff. Chemicals were reportedly kept inside the plant, or had secondary containments, which would have prevented releases to water runoff. Potential releases due to storm water runoff do not appear to be a concern.

5.2 SDG&E RELEASES NOTED IN INVESTIGATION ORDER

The IO identified three specific releases that may have impacted the Bay sediment. Each of these releases was researched to determine potential impacts to the bay.

5.2.1 Transformer Oil Spill, 2295 East Harbor Drive and Sampson Street

This release was documented in the Board files in the Historical Occupancy Search Report prepared by Woodward Clyde (1995) on behalf of Southwest Marine in May, 1995. The release was discovered through a federal database search completed by VISTA on behalf of Woodward Clyde. The release was reported in the Emergency Response and Notification System (ERNS) federal database maintained by the USEPA. Similar documentation of the release was recovered by BBL during a federal database search in October 2000 on behalf of ENV America. Information available in this USEPA database, which can be viewed on the internet, indicates that in April 1988 approximately 40 gallons of transformer oil containing 1,400 ppm PCBs was spilled onto asphalt and a small area of soil as a result of a leaking transformer. The database indicates that the spill was cleaned up and the area was re-sampled. No records exist at this address under the name SDG&E at either the Board or the DEH. Further, all records for this address maintained by the DEH show ARCO as the property owner. SDG&E reported that they had no information on this event.

5.2.2 Underground Storage Tank Releases, 2141 Main Street

Underground storage tank (UST) files for two tanks, #801 and #802, were reviewed at the DEH and the Board offices. These files indicated that a release corresponding to moist, stained soil was first documented in 1986 from tank #802. It was also noted that the tank was emptied and taken out of service in 1982. Tank #802 was first installed in 1970, had a capacity of 500 gallons, and was used to store diesel or gasoline fuel between 1970 and 1982. Corrosion holes were observed in the tank's steel frame in 1986 following discovery of the stained soil. In-situ bioremediation was implemented as the site remedial action for groundwater. Groundwater modeling was completed to determine if the release had the potential to impact the Bay at concentrations that would exceed the Bay standard of 21 ug/L. The modeling results showed that the benzene in groundwater (maximum concentration of 3.1 mg/L) would not reach the Bay, which was 1,800 feet away. A no further action decision was issued for the Site in 1994 by SD DEH in conjunction/agreement with the Board.

5.2.3 *Wastewater Ponds, SDG&E Leased Land (Parcel 2)*

San Diego Board files document the disposal of waste via evaporation ponds in an Army Corp of Engineer discharge permit dated 1971. These "ponds" were reportedly used to settle solids and separate oil and grease from bilge water as described in Section 3.4.5.

The history of the structures is described in detail in a separate report by ENV America (2004), which summarizes site investigation activities conducted in 2003. Aerial photos showed a total of four structures on Parcel 2 over the course of about 20 years. These structures consisted of what are interpreted to have been two oil/water separators and two settling/evaporation ponds. Only one release was documented in available records. One of the oil/water separators became plugged in 1955, spilling waste to the land surface.

A few of the soil samples collected from borings drilled as part of the 2003 site investigation contained hydrocarbons, polychlorinated biphenyls, and metals in soil (analytical results are in Exhibit D). The investigation results indicated there was localized residual waste in former "Pond B". Boring B2 penetrated a stained horizon at approximately 2 feet below grade, beneath which was clean soil. Groundwater samples from the borings indicated there was no appreciable impact to the underlying groundwater. Neighboring shipyard operations may have also contributed wastes to the structures, as aerial photos indicate that Pond B was within a fenced area of Southwest Marine's shipyard from 1966 onward.

Use of the ponds was terminated by 1974 with the adoption of the first NPDES permit (Order No. 74-90) issued by the SD Board to the Plant. Upon completion of the WWTP in 1978, treatment of waste streams was confined to the CW deck.

6.0 DISTRIBUTION AND SOURCES OF CHEMICALS IN SEDIMENT

Finding Number 10 of the IO inferred that elevated concentrations of cadmium, chromium, mercury, nickel and polychlorinated terphenyls (PCTs), documented by Exponent (2003) in sediments at the north end of SWM's leasehold, were due in whole or in part to discharges from SDG&E's operations. However, the inference is not supported by Exponent's (2003) data and the site history.

ENV America prepared new isoconcentration maps for the Exponent (2003) data, because the Exponent report presented isoconcentration contour maps of chemical results without including relevant data such as concentrations at individual sample stations, bathymetry or boundaries of prior dredging. Additionally, Exponent's isoconcentration contour maps did not account for the potential effects of the Silver Gate circulating water system upon local Bay circulation and sediment deposition in the vicinity of the circulating water intake and discharge. The following text describes our analysis of the distribution and sources of chemicals in sediment.

6.1 SOURCES OF CONTAMINANTS AND INFLUENCES ON CONTAMINANT DISTRIBUTION

The potential local sources of releases to the Bay include:

- Releases from the SWM shipyard, including:
    - Surface water runoff from the shipyard and piers;
    - Direct discharges to the Bay;
- Discharges from City and Port storm sewers;
- Potential release from the chemical plants located on the north side of SDG&E's leasehold; and
- SDG&E's discharges of circulating water.

The preceding sections of this report described SDG&E's known and potential releases to the Bay.

The shipyard had documented releases to the Bay. For instance, Woodward Clyde (1995) stated that the SWM shipyard property "dust suppression system for blasting house consisted of blowers directed at the bay with a water spray to cause dust to settle into the water" and "all waste generated on the dry dock including blast grit, paint, etc. were discharged into the bay."

Figure 6 illustrates the probable current flows that would have occurred during periods when the circulating water system was active at Silver Gate. The Silver Gate circulating water system had a maximum pumping capacity of 222 million gallons per day, or 154,000 gallons per minute (at peak operation). The circulating water intake and discharge streams at the shoreline were separated by sheet pile jetties. Several historical photos of the water front (e.g. Exhibit B, 1952 photograph, SDHS, 82-13673-718) illustrate that the discharge flowed into the Bay from the discharge outlet in a direction perpendicular to the shoreline. Such a flow directed into the Bay likely would have caused corresponding currents in the vicinity of Pier 3 as illustrated in Figure 6. We theorize that discharges of shipyard waste in the vicinity of the marine railways, which flanked Pier 1, would generally result in relatively rapid deposition of coarser particles near the release, and transport of suspended finer particles to eventual deposition sites at downstream locations. The sheet pile jetties were constructed of steel sheets that extended into the underlying sediment. The sheet pile jetties were solid barriers, which would have prevented migration of contaminants parallel to the shoreline across the jetties. In preparing the isoconcentration contour maps in Figures 7 to 13, the sheet pile jetties were treated as barriers that would have controlled the contaminant distribution.

The data for cadmium, chromium, mercury, nickel, PCTs and tributyltin were re-mapped and are presented in Figures 7 to 13. Tributyltin is also included here because tributyltin is a contaminant that is associated with shipyards and is generally not associated with fossil fuel power plants. Tributyltin is useful for comparison to other metals suspected to be from non-shipyard sources. Isoconcentration contours were drawn using the maximum value from the surface and the uppermost (0-2 foot) core samples.

Our records review indicates that the majority of chemical releases from the shipyard and other local industries to the Bay were prior to the introduction of stricter waste management practices in the 1970s and 1980s. In addition, the majority of releases may pre-date the latest maintenance dredging of berths on either side of SWM's Pier 1, which is estimated to have occurred within the last 20 years. SAIC (1992) includes drawings that indicate dredging was planned for the pier and sumps in the early 1990s. ENV America attempted to obtain dredge records, but was unable to obtain the records in the short period allotted to prepare this report. The dredge records may provide information that would allow further understanding of the distribution of contaminants in sediment.

6.2 TRIBUTYLTIN

Tributyltin is an organotin compound used primarily as a biocide in antifouling paints and its presence in Bay sediment is most likely due to releases from shipyard and maritime operations. Figure 12 illustrates the distribution of tributyltin in sediments of SDG&E's leasehold and the northern portion of SWM's leasehold. In the Bay area covered by Figure 12, tributyltin was detected at the highest concentration at Exponent (2003) sampling station SW08, directly in front of the marine railways located between Piers 1 and 2. Figure 12 also illustrates that tributyltin was detected at relatively elevated concentrations throughout SDG&E's wharf lease and on ISP Alginate's leasehold. The presence of tributyltin, which is not related to power plant discharges, is a strong indicator that other detected contaminants on SDG&E's wharf leasehold come from the shipyard.

6.3 POLYCHLORINATED TERPHENYLS (PCTS)

PCTs are chlorinated aromatic hydrocarbons that were used in similar ways as PCBs. According to Kimbrough (1980), "in the U.S., PCTs were mainly used as plasticizers." According to Hale et al (1990), "suggested major uses of PCTs were as fire-retardants, as vapor suppressants to extend the kill-life of insecticides, as coatings to render fabric flame- and rot-proof and water-repellant, and in the manufacture of brake linings, abrasives for grinding wheels, lacquers, varnishes, and paints. In the electrical field, [PCT] Aroclors have been suggested for use in wire and cable coatings, as impregnants for braided cotton and asbestos insulation, and as dielectric sealants." And according to Jensen and Jorgensen (1983), an important use of PCTs was in waxes for investment casting. PCTs detected in sediment may have originated from a variety of industrial and domestic sources, including shipyards and municipal storm water runoff.

The available information does not strongly indicate that PCTs were discharged from SDG&E's operations. Figure 11 illustrates that the highest concentration of PCTs was detected in the surface and shallow sediment in the northern area of SWM's leasehold directly in front of the marine railways located between Piers 1 and 2 (sediment station SW08 core sample from 0 to 2 feet). Figure 11 also illustrates that PCTs were detected at elevated concentrations on SDG&E's wharf lease at sediment sampling stations SW01 and SW02. Exponent's (2003) Figure 4-19 illustrated that PCTs were detected at relatively elevated concentrations at numerous locations along the length of the NASSCO and the SWM bulkhead. All of the detectable PCTs illustrated in Figure 11 were Aroclor 5460 (Aroclors 5432 and 5442 were not detected in any sample). Given the distribution pattern of PCTs, we conclude that the primary source of PCTs was the shipyard.

SDG&E's environmental staff reported to ENV America that SDG&E is not aware of using PCTs in SDG&E operations, nor has SDG&E detected PCTs on SDG&E facilities in the course of their routine in-house analytical work. SDG&E staff reportedly have no historical knowledge of purchasing or using PCTs at SDG&E facilities. SDG&E's Environmental Analysis Laboratory conducts PCB analyses to support SDG&E's environmental characterization and waste management operations. SDG&E's laboratory Team Leader stated that in his experience PCTs have not been detected in their routine PCB analyses (PCTs would be detected in routine PCB analyses if they were present).

6.4 METALS

The four metals, cadmium, chromium, nickel and mercury, had similar distribution patterns (Figures 7 to 10). The isoconcentration contours of the four metals do not conclusively indicate an SDG&E source for the four metals. The highest metal concentrations were detected at sediment sampling stations SW01, SW02, SW04 and SW08, which are directly in front of the marine railways (SW04 and SW08) and the CW discharge (SW01 SW02). The metal distribution patterns have strong similarities with the distribution patterns for tributyltin and PCTs, contaminants which appear to be present due only to shipyard operations.

Exponent (2003) presented a limited mineralogy study of copper and chromium speciation at four sediment stations, including stations SW02 and SW04. Exponent (2003) determined that at station SW04 the most frequently occurring form of mineral was slag, chromium occurred primarily as iron-chrome oxide and copper occurred primarily as chalcopyrite. Metal slag is a common blast grit, and it is likely that the slag at station SW04 is sand blasting waste. Exponent (2003) found that the analytical results from SW02 had analytical error rates that made the results for SW02 unreliable (the results indicated that chromium occurred primarily as an iron sulfate, and copper occurred primarily as native copper and chalcopyrite.).

We conclude that the four metals, cadmium, chromium, mercury and nickel, are present in sediments due to releases from the SWM leasehold, but the data are inconclusive in determining whether SDG&E's discharges contributed to the metals detected in sediment.

7.0 SUMMARY AND RECOMENDATIONS

The Silver Gate power plant operated from 1943 to the mid-1980s. During this period the Plant used circulating (CW) tunnels to transmit non-contact, once-through cooling water (up to 222 MGD), which was discharged to the Bay at a location which was immediately adjacent to the SWM shipyard. The shipyard operations have occurred over a long period, beginning in the 1930s, long before construction of the Silver Gate power plant (1943-1952). The Shipyard operations have continued to date, almost 20 years since the shutdown of the Silver Gate power plant.

The Plant CW discharge has a documented record from 1969 through plant shutdown in the mid-1980s and onward until the final NPDES permit was terminated in 1995. The primary waste stream that was known to have been discharged to the Bay was boiler blowdown. There is limited information indicating that bilge trench water or service water may have been discharged to the Bay at times; however, most information indicates that bilge trench water and service water were treated and disposed of by means that did not involve discharge to the Bay. Two additional sites mentioned in the IO, 2295 East Harbor Drive and 2141 Main Street, were reviewed and determined to have had minimal potential for releases to the Bay.

Finding Number 10 of the IO inferred that measurements of elevated concentrations of cadmium, chromium, mercury, nickel and polychlorinated terphenyls (PCTs), documented by Exponent (2003) in sediments at the north end of SWM's leasehold, were due in whole or in part to discharges from SDG&E's operations. Section 6 of this report presented an analysis of the distribution and sources of chemicals in sediment of the SDG&E wharf leasehold and the north portion of SWM's wharf leasehold. Section 6 presented revised isoconcentration maps, with additional details not shown in the maps prepared by Exponent (2003). Those additional details include relevant data such as concentrations at individual sample stations, bathymetry and locations of SDG&E's sheet pile jetties. The revised contour maps were prepared to account for the potential effects of the Silver Gate circulating water system upon local Bay circulation and sediment deposition in the vicinity of the circulating water intake and discharge.

Tributyltin was evaluated here because tributyltin is a contaminant that is associated with shipyards and is generally not associated with fossil fuel power plants. Tributyltin is an organotin compound used primarily as a biocide in antifouling paints and its presence in Bay sediment is most likely due to releases from shipyard and maritime operations. The distribution of tributyltin impacts (illustrated in Figure 12), extends across the SDG&E wharf lease. Based on the distribution of tributyltin, it is apparent that shipyard contaminants may occur throughout the SDG&E wharf lease.

We analyzed the distribution pattern of PCTs and PCT usage and concluded that the primary source of PCTs was not SDG&E, and there was little data supporting a conclusion that SDG&E's discharges contributed to PCTs detected in sediment.

The analysis in Section 6 also demonstrated the four metals of concern identified in the IO, cadmium, chromium, nickel and mercury, are present in sediments due to releases from the SWM leasehold, but the data are inconclusive in determining whether SDG&E's discharges contributed to the metals detected in sediment.

The Exponent (2003) sediment sampling stations in the SDG&E wharf leasehold and the north portion of SWM's wharf leasehold were spaced over 100 feet apart, and there were only three sediment sampling stations in SDG&E's leasehold. The data indicate that SDG&E discharges were not a cause of sediment contamination. Additional data are recommended to conclude with certainty that SDG&E discharges were not a cause of sediment contamination.

Recommendation. We recommend that additional sediment data be collected to establish whether SDG&E was a contributor to the shipyard sediment contamination detected in the SDG&E wharf leasehold and the north portion of SWM's wharf leasehold. The additional sediment data should be collected to (1) increase the sample density to determine accurate concentrations trends across the leaseholds, and (2) collect forensic chemistry and mineralogy data that may be used to determine the source of sediment contaminants. Additionally, dredging and historical sediment sampling data, such as that presented in SAIC (1992), should be compiled and evaluated to better understand contaminant distribution in sediments

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SDG&E, 1981. *Spill Prevention Control and Countermeasure Plan*, Silver Gate Power Plant. October 1981. (Included in Exhibit A).

SDG&E, 1988. NPDES Form 2C Application for Permit to Discharge Waste Water. June 23, 1989. (Included in Exhibit C).

SDG&E, 1992. *Silver Gate Power Plant Storm Water Pollution Prevention Program Facility Storm Water Drainage Map*. March 27, 1992. (Included in Exhibit A).

SDG&E, various dates. Tabulated lists of chemical usage (1976, 1977) and chemical purchases (1978 to 1984, 1987, 1989 to 1993) compiled from NPDES compliance reports. (Included in Exhibit C).

SDG&E, date unknown. *Silver Gate Power Plant Waste Water Treatment Facility Training Manual*. Date not documented, assumed to be 1978 or 1979. (Included in Exhibit C).

San Diego Unified Port District, 2003. *Jurisdictional Urban Runoff Management Program (JURMP) Dry Weather MS$ Maps*. January 2003. (Included in Exhibit A).

San Diego Unified Port District. *SDG&E Real Estate Files*. 1941 – Present.

USEPA, 1972, San Diego G&E - Silver Gate 075-0YQ-000182, Correspondence from the USEPA to the State Water Resources Control Board, May 12.

WoodWard Clyde, 1995. *Historical Occupancy Search Southwest Marine Foot of Sampson Street San Diego, California*. Prepared or Southwest Marine, May 5.

Table 2
Processes and Associated Discharge Practices
Silver Gate Power Plant
Page 1 of 3

Process Name	Corresponding NPDES Permit Process Discharge Description [1]	Process Description	Waste Constituents	Quantity[1]	Discharge Practice	Reference
Non-Contact Cooling Water for Heat Exchange	Non-Contact Cooling Water (Discharge 001)	Once-through non-contact cooling water for condenser cooling and service cooling of bearings, oil, etc.	Chlorine (added to prevent fouling of heat exchangers)	• Average rate of 165.6 millions gallons per day (MGD) • Max rate of 223 MGD	• 1940s to Plant Shutdown: to CW tunnels to Bay	• RWQCB, 1969 • USEPA, 1972 • SDG&E, 1972 • SDG&E, 1978 • SDG&E, date unknown • SDG&E, 1980a • SDG&E, 1980b • SDG&E 1988
Air Pre-heater Wash	Low Volume Waste (Discharge 001D) (Note: classified as Metal Cleaning Waste (Discharge 001B) if the addition of chemicals was required)	Water wash solution flush through air pipes to remove scale	Dissolved and suspended solids; metals	• Six washings per year (1 to 2 times per year per boiler) (Betz, 1978) • One wash per year per air heater when burn gas • Two washes per year per air heater when burn oil • 90,000 gallons per wash per air heater (Betz, 1978) • 90,000-120,000 gallons per wash per year per air heater (SDG&E, source unknown) • 179,500 gallons per month (SDG&E, March 1975) • 6,000 gallons per day (SDG&E, December 1975) • 158,000 gallons per day (SDG&E 1980a, 1980b, 1988 and RWQCB, 1985)	• 1940s to 1977: to CW voids then to sanitary sewer • 1978 to Plant Shutdown: to WWTP (clean effluent to Bay via CW tunnels)	• RWQCB, 1969 • SDG&E, 1972 • SDG&E, 1975 • SDG&E, 1978 • Betz, 1978 • SDG&E, date unknown • SDG&E, 1980a • SDG&E, 1985 • SDG&E, 1988 • RWQCB, 1985
Boiler Fireside Wash	Metal Cleaning Waste (Discharge 001B)	Washing/cleaning of external side of water tubes to remove soot and combustion by-products with high pressure water	Dissolved and suspended solids; metals	• Infrequent - typically occurred during unit shut-down • 1978 WWTP manual (Betz, 1978) indicated, "...fireside washes not conducted currently." • 120,000 gallons per month (SDG&E, March 1975) • 140,000 gallons per year per boiler at 2 boiler washings per year (SDG&E, 1972) • 4,000 gallons per day (SDG&E, 1975)	• 1940s to 1977: to CW voids where water was neutralized and pumped into City Sewer. Solids were settled, removed and shipped to offsite facility • 1978 to Plant Shutdown: to WWTP, clean effluent to Bay • 1978: Boiler Fireside Washes not conducted (Betz, 1978) • All scale to offsite disposal facility	• RWQCB, 1969 • SDG&E, 1972 • SDG&E, 1975 • SDG&E, date unknown • SDG&E, 1978 • Betz, 1978 • SDG&E, 1980a • RWQCB, 1985 • SDG&E, 1988

Notes:
[1] The listed volume discrepancies may be attributed to:
- Varying documentation describing a range of operations that were conducted over the years.
- Documented volume representing one versus all equipment pieces (i.e. one boiler versus six).
- Varying operating periods and equipment usage (all units on-line versus half versus none when the plant operated in stand-by mode in the later years).

Process Name	Corresponding NPDES Permit Process Discharge Description [1]	Process Description	Waste Constituents	Quantity[1]	Discharge Practice	Reference
Boiler Tubing Wash	Metal Cleaning Wastes (Discharge 001B)	Chemical solution wash of interior of water tubes	Solids/scale and metals	• Performed every two to four years (RWQCB, 1969) • At times, two boilers per year at 7,000 gallons per boiler per year (SDG&E, 1972) • 114,000 gallons per boiler cleaning (Betz, 1978) • 112,190 gallons per month for chemical cleaning (SDG&E, March 1975) • 4,000 gallons per day (SDG&E, December 1975)	• 1940s to 1978: Neutralization chemicals from wash to City sewer; Boiler cleaning chemicals collected and hauled to offsite facility approved by the RWQCB • 1978 to Plant Shutdown: to WWTP to Bay	• SDG&E, 1969a • RWQCB, 1969 • SDG&E, 1972 • SDG&E, 1975 • SDG&E, date unknown • SDG&E, 1978 • SDG&E, 1980a • RWQCB, 1985
Boiler Blowdown	Boiler Blowdown (Discharge 001C)	Potable water and steam rinse of boiler; also used evaporator makeup water. Blowdown of steam from boilers or evaporators when solids concentration became too high	Suspended solids Relatively uncontaminated stream	• Once every 24 hour period • 137,000 gallons per day (SDG&E, 1980b, SDG&E, 1988, and RWQCB, 1985) • 75,000 gallons per month (SDG&E, date unknown) • 170,000 gallons per month for all boilers (Betz, 1978) • 5.95 million gallons per year (SDG&E, 1972)	• 1940s to 1978: CW Tunnels to Bay • 1978 to Plant Shutdown: to CW voids to WWTP (if treatment needed) and to Bay	• RWQCB,1969 • USEPA, 1972 • SDG&E, 1972 • SDG&E, 1975 • SDG&E, 1978 • SDG&E, date unknown • BETZ, 1978 • SDG&E, 1980a • SDG&E, 1980b • SDG&E, 1988
Evaporator Blowdown	Low Volume Waste (Discharge 001D)	Supply makeup water to steam generation units. Blowdown of steam from boilers or evaporators when solids concentration became too high	Suspended solids	• 6,000 gallons per day (SDG&E, 1980, 1988 and RWQCB, 1985) • 46,000 gallons per day (SDG&E, December 1975) • 120,000 gallons per month (Betz, 1978) • 400,000 gallons per month (upper end when combined with bilge water) (SDG&E, date unknown) • 1.32 million gallons per month (SDG&E, March 1975)	• 1940s to 1978: CW Tunnels to Bay • 1978 to Plant Shutdown: to CW voids to WWTP (if treatment needed) to Bay	• SDG&E, 1975 • SDG&E, date unknown • Betz, 1978 • SDG&E, 1980a • SDG&E, 1980b • SDG&E, 1988

Notes:

[1] The listed volume discrepancies may be attributed to:

- Varying documentation describing a range of operations that were conducted over the years.
- Documented volume representing one versus all equipment pieces (i.e. one boiler versus six).
- Varying operating periods and equipment usage (all units on-line versus half versus none when the plant operated in stand-by mode in the later years).

Table 2
Processes and Associated Discharge Practices
Silver Gate Power Plant

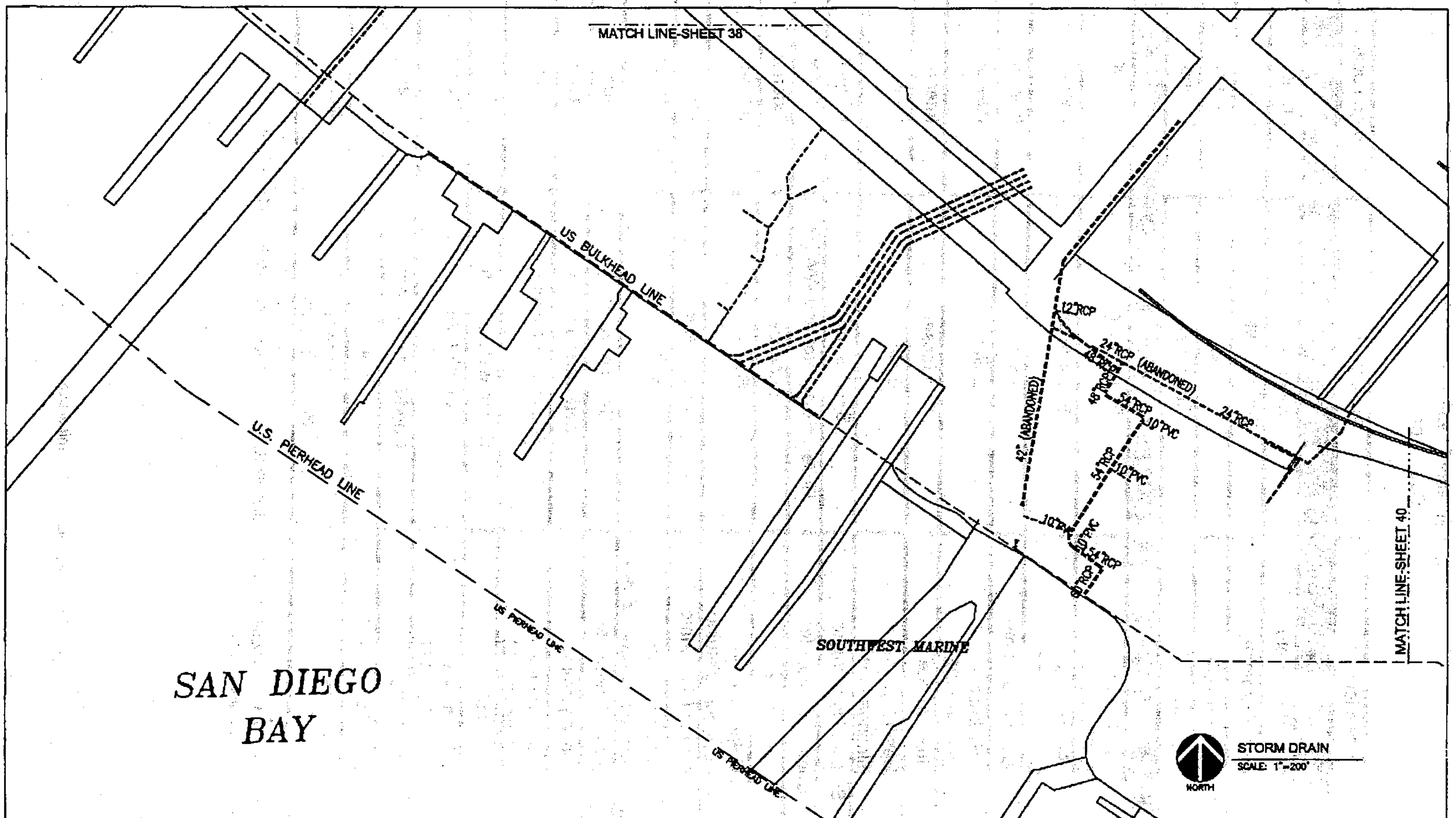
Process Name	Corresponding NPDES Permit Process Discharge Description [1]	Process Description	Waste Constituents	Quantity [1]	Discharge Practice	Reference
Bilge Trenches	Low Volume Waste (Discharge 001D)	Basement bilge water from floor drainage system (includes water from turbine drains, boiler drains, condenser drain pump drains, cooling water supply drains, water box drains, service air compressor drains, relief valve drains, condensate storage overflow, and condensate makeup pump drains)	Oil, grease, suspended solids, and metals	• 11,000 gallons per day (SDG&E, 1980b and SDG&E, 1988) • 15,000 gallons per day from pump lubrication water (SDG&E, 1980a and SDG&E, 1988) • 49,000 gallons per day (SDG&E, December 1975) • 134,000 gallons per month from floor and sample drains (Betz, 1978) • 400,000 gallons per month when combined with evaporator blowdown	• 1940s to 1974: to oil-water settling pond; solids removed and disposed offsite; water periodically pumped to Bay • 1974 to 1978: to CW voids for settling, then to CW tunnels to Bay; solids removed from CW voids and disposed offsite • 1978 to Shutdown: to CW voids to WWTP to Bay	• SDG&E, 1972 • SDG&E, 1975 • SDG&E, date unknown • SDG&E, 1976 • Betz, 1978 • SDG&E, 1980a • SDG&E, 1980b • SDG&E, 1988
Service Water	No discharge	Closed-loop circulation of city water with the addition of sodium dichromate to prevent corrosion	Sodium Bichromate/ Sodium Dichromate	• Chemical purchases ranged between 0 lbs to 1,200 lbs	• Closed Loop system that recycled water throughout units – no discharge	• RWQCB, 1969 • RWQCB, 1974 • RWQCB, 1976 • RWQCB, 1985

Notes:
[1] The listed volume discrepancies may be attributed to:
- Varying documentation describing a range of operations that were conducted over the years.
- Documented volume representing one versus all equipment pieces (i.e. one boiler versus six).
- Varying operating periods and equipment usage (all units on-line versus half versus none when the plant operated in stand-by mode in the later years).

Table 1
Chemical Usage Reported in NPDES Reports
Silver Gate Power Plant

Chemical	Plant System	Storage Location
Pre-1976		
Sodium Phosphate	Evaporator	Interior
Sodium Chromate	Service water	Interior
Ferrous Phosphate	Boiler	Interior
Chlorine	Condenser	Exterior
Post-1976		
Antifoam (Calgon C-1)	Evaporator	Interior
Antiscalant (Calgon CL-14)	Evaporator	Interior
Disodium Phosphate	Boiler	Interior
Hydrazine (Calgon K-35)	Boiler	Interior
Iron Sulfate	Condenser	Interior
Betz Octafilm (filmingamine)	Boiler	Interior
Sodium Dichromate	Service water	Interior
Sodium Hydroxide	Boiler, evaporator and WWTP	Exterior
Chlorine	Condenser	Exterior
Calgon NL-90 (50% cyclohexylamine)	Boiler	Interior
Tri-Sodium Phosphate	Evaporator	Interior
Sodium Sulfite (Calgon K-91 and Calgon L5-32)	Boiler	Interior
Sodium Bichromate	Service water	Interior
Filming Amine	Feed water system	Interior
Cyclohexylamine (Calgon NL-90)	Feed water system	Interior
Octafilm	Condensate system	Interior
Penetrant (Calgon CL-361)	Condenser	Interior
ML 90	Condensate system	Interior
K 91	Boiler	Interior
Xylene	Laboratory (fuel oil testing)	Interior

Notes:
1. Source: RWQCB File 13.0089.01 for Resolution 69-R32, Order 74-90, Order 76-9, and Order 85-07
2. WWTP = wastewater treatment



STORM DRAIN UTILITY INFORMATION WERE TAKEN FROM THE UTILITY REFERENCE DRAWING 3E-C

REVISIONS	DATE	APPROVED

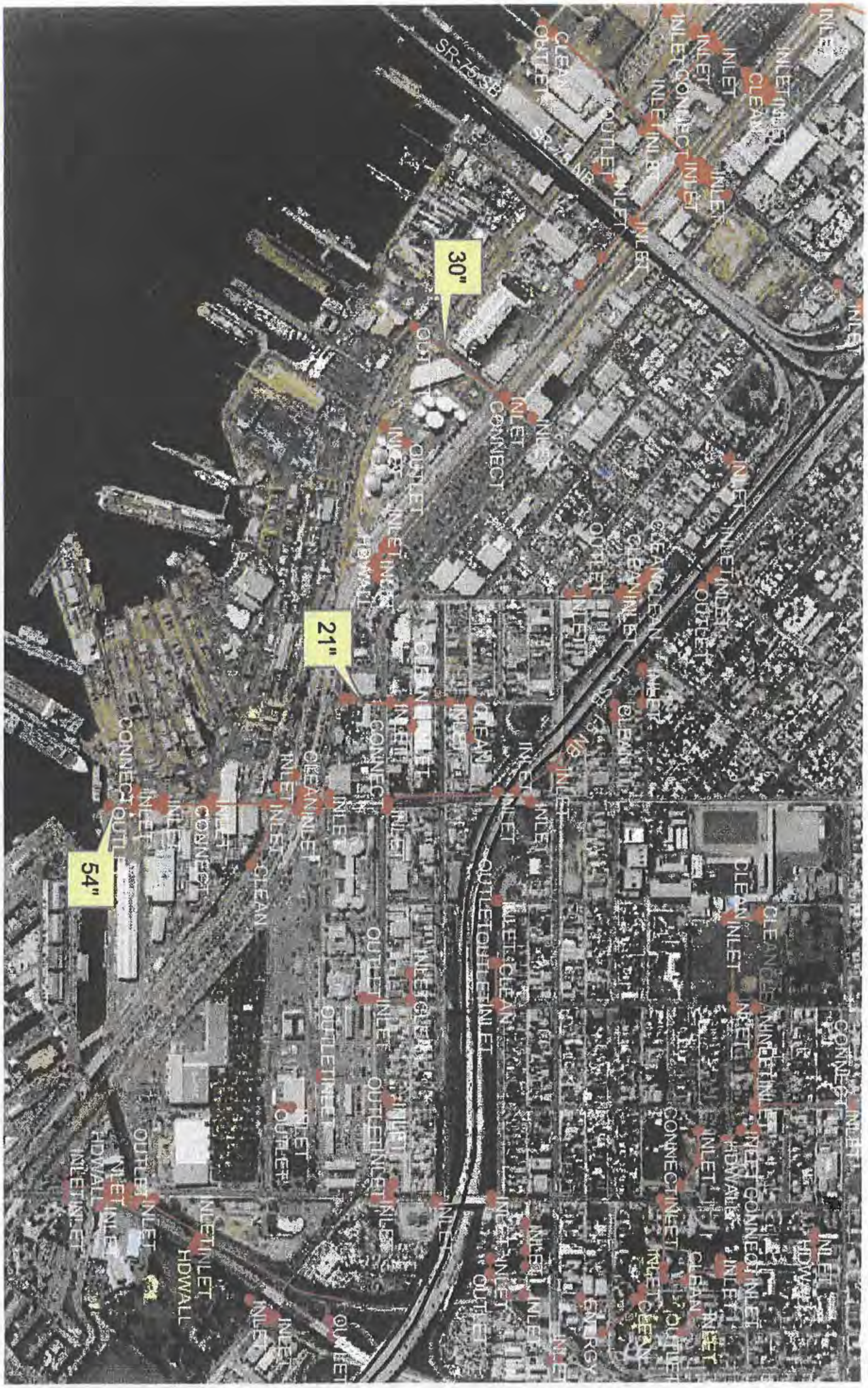
San Diego Unified Port District
San Diego • California

TIDELANDS

STORM DRAIN REFERENCE DRAWING

SHEET 39 OF 51

SAR193319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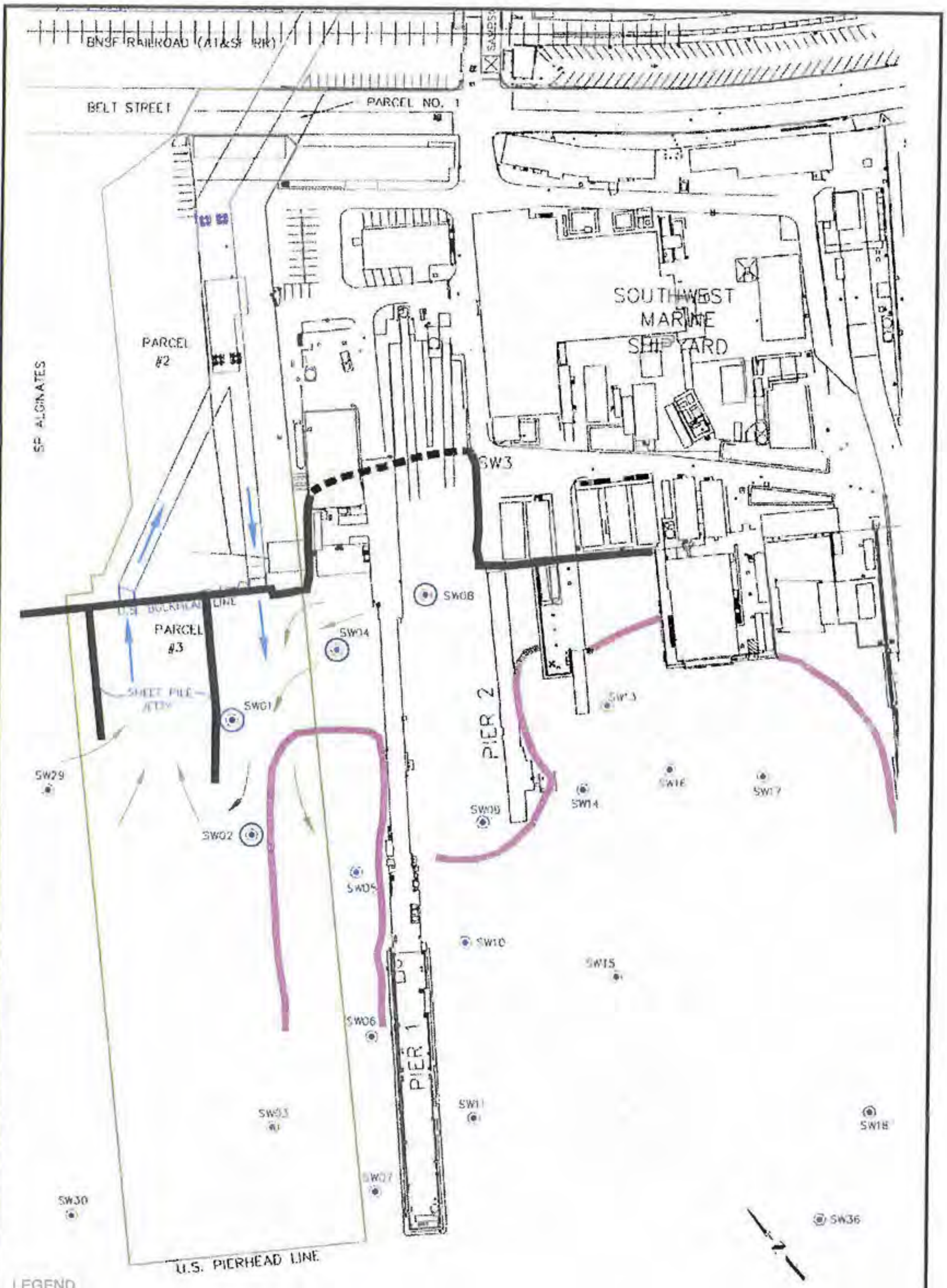
21"
54"
SR-75 SB
SR-75 NB


48"
63"
30"
30"
Unknown
36"
36"



LEGEND

- PROPERTY LEASE BOUNDARIES
- CW TUNNELS
- LOCATION OF SHORELINE AND SHEET PILE JETTIES
- EXPONENT'S (2003) SEDIMENT SAMPLING STATIONS WITH RELATIVELY LOWER CONCENTRATIONS OF COCs
- EXPONENT'S (2003) SEDIMENT SAMPLING STATIONS WITH RELATIVELY HIGHER CONCENTRATIONS OF COCs
- CIRCULATING WATER INTAKE AND DISCHARGE, WITH MAXIMUM FLOW OF 222 MILLION GALLONS PER DAY (154,000 GALLONS PER MINUTE)
- ESTIMATED CURRENT FLOW DIRECTIONS DURING PERIODS WHEN CIRCULATING WATER SYSTEM ON (1943 UNTIL PLANT SHUTDOWN IN 1980s)
- DREDGED BERTHS

NOTE:
BATHYMETRY DATA FROM SOUTHLAND SEPTEMBER – DECEMBER 1999 SURVEY

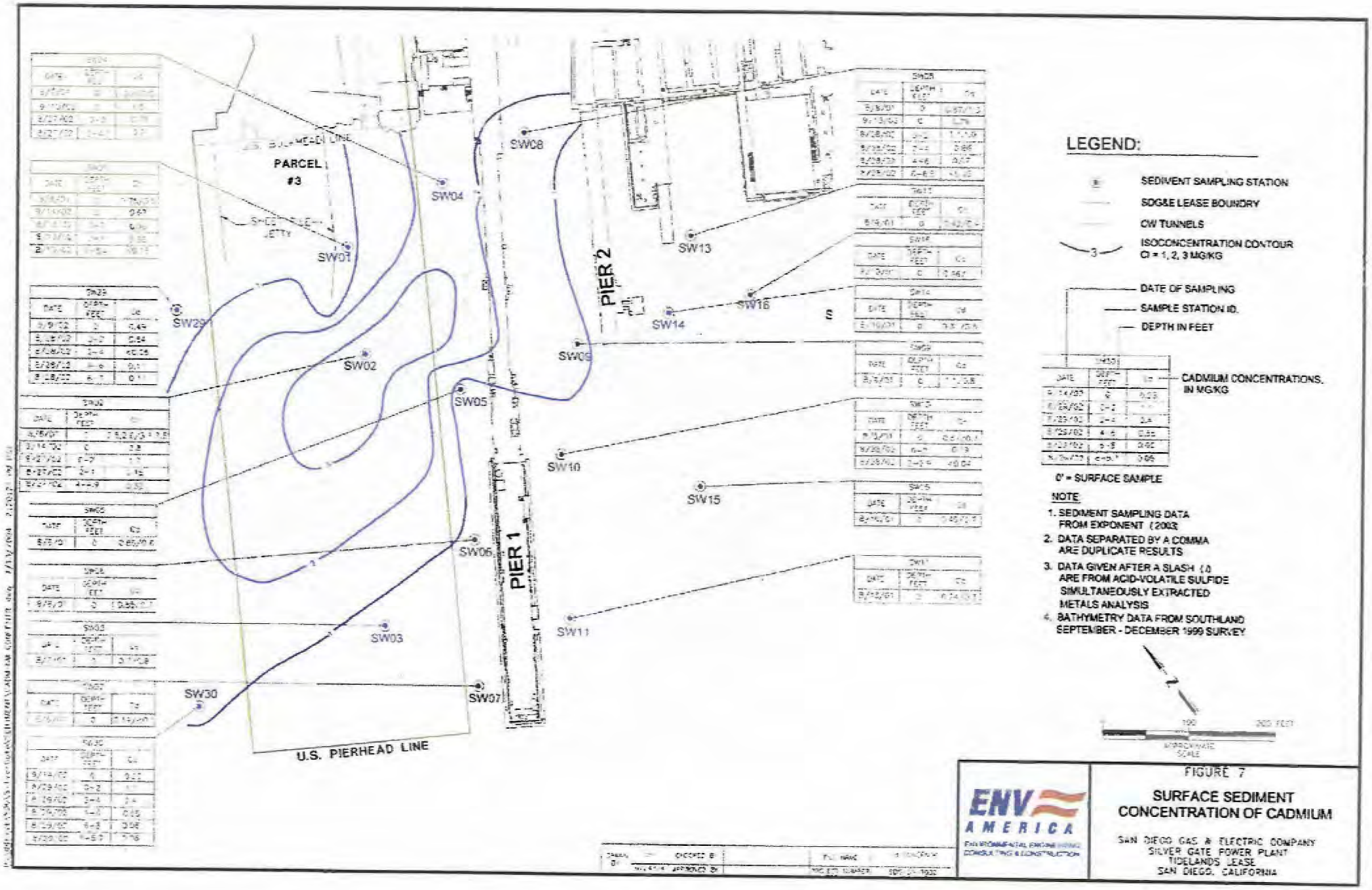
DRAWN BY	DP	CHECKED BY		FILE NAME	TBT CONCENTR
DATE	6/14/04	APPROVED BY		PROJECT NUMBER	SDG-01-T002

ENV AMERICA
ENVIRONMENTAL ENGINEERING CONSULTING & CONSTRUCTION

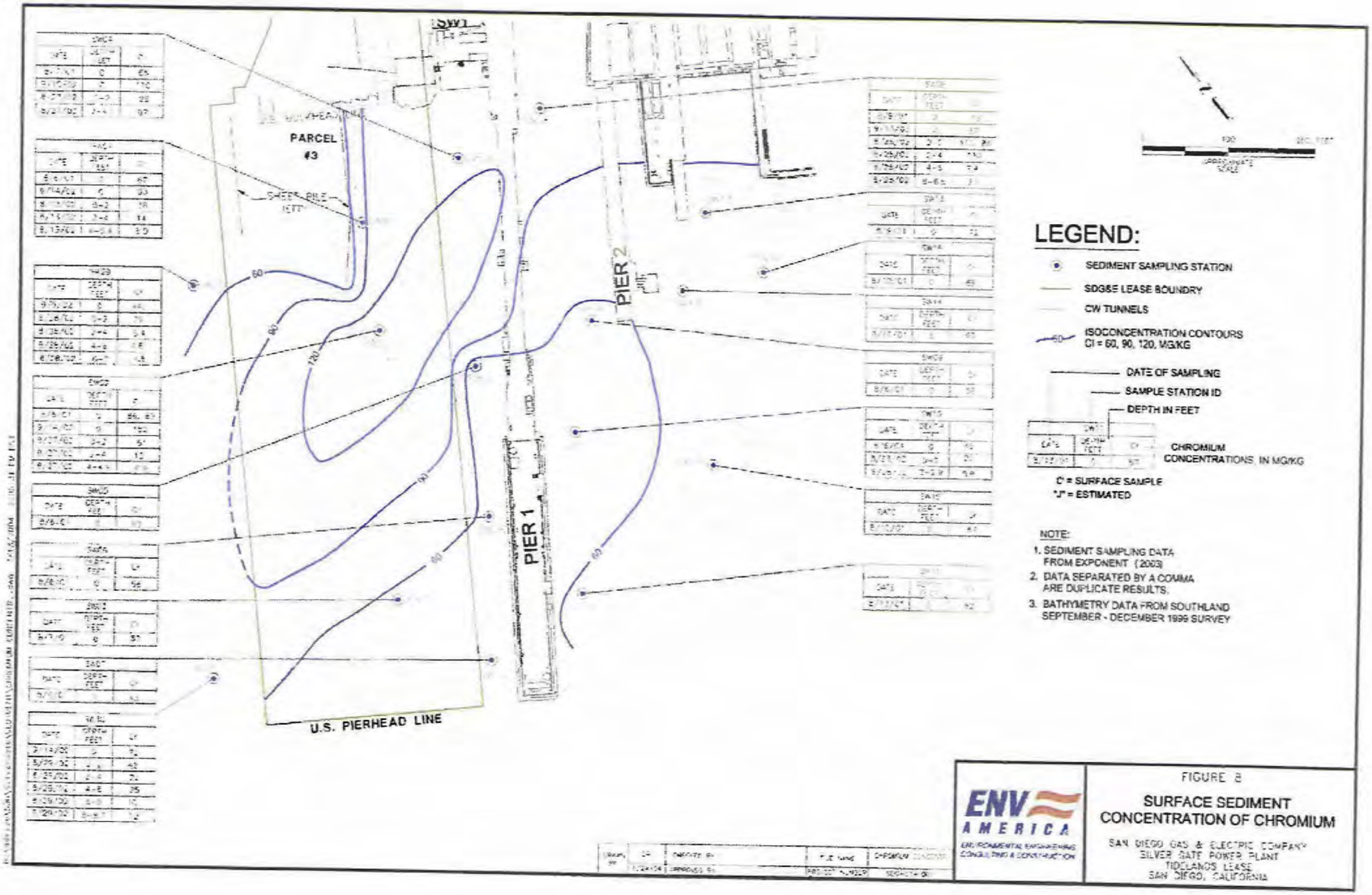
FIGURE 6

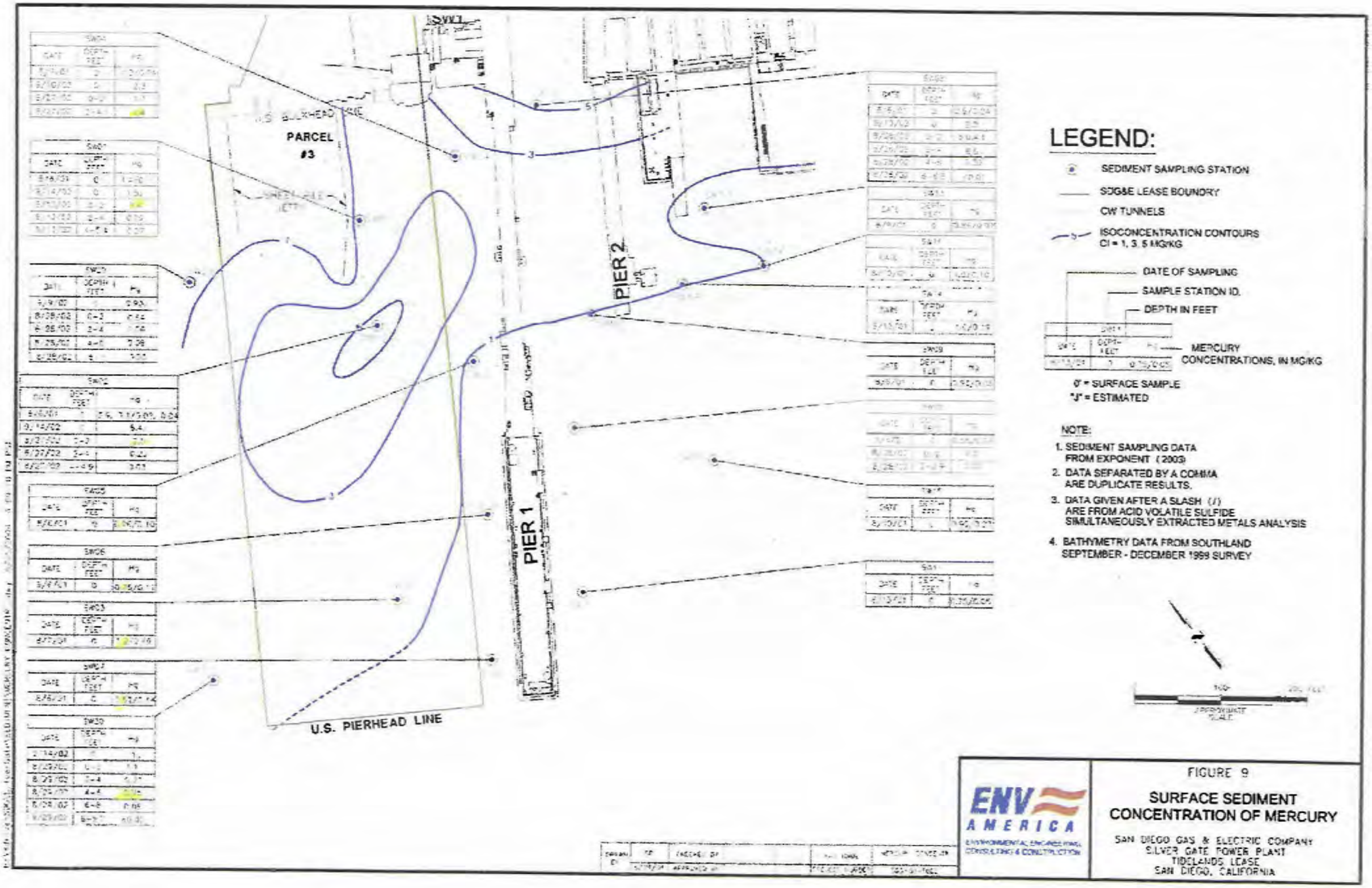
CONCEPTUAL MODEL OF CURRENT FLOW DURING CW OPERATION

SAN DIEGO GAS & ELECTRIC COMPANY
SILVER GATE POWER PLANT
TIDELANDS LEASE
SAN DIEGO, CALIFORNIA

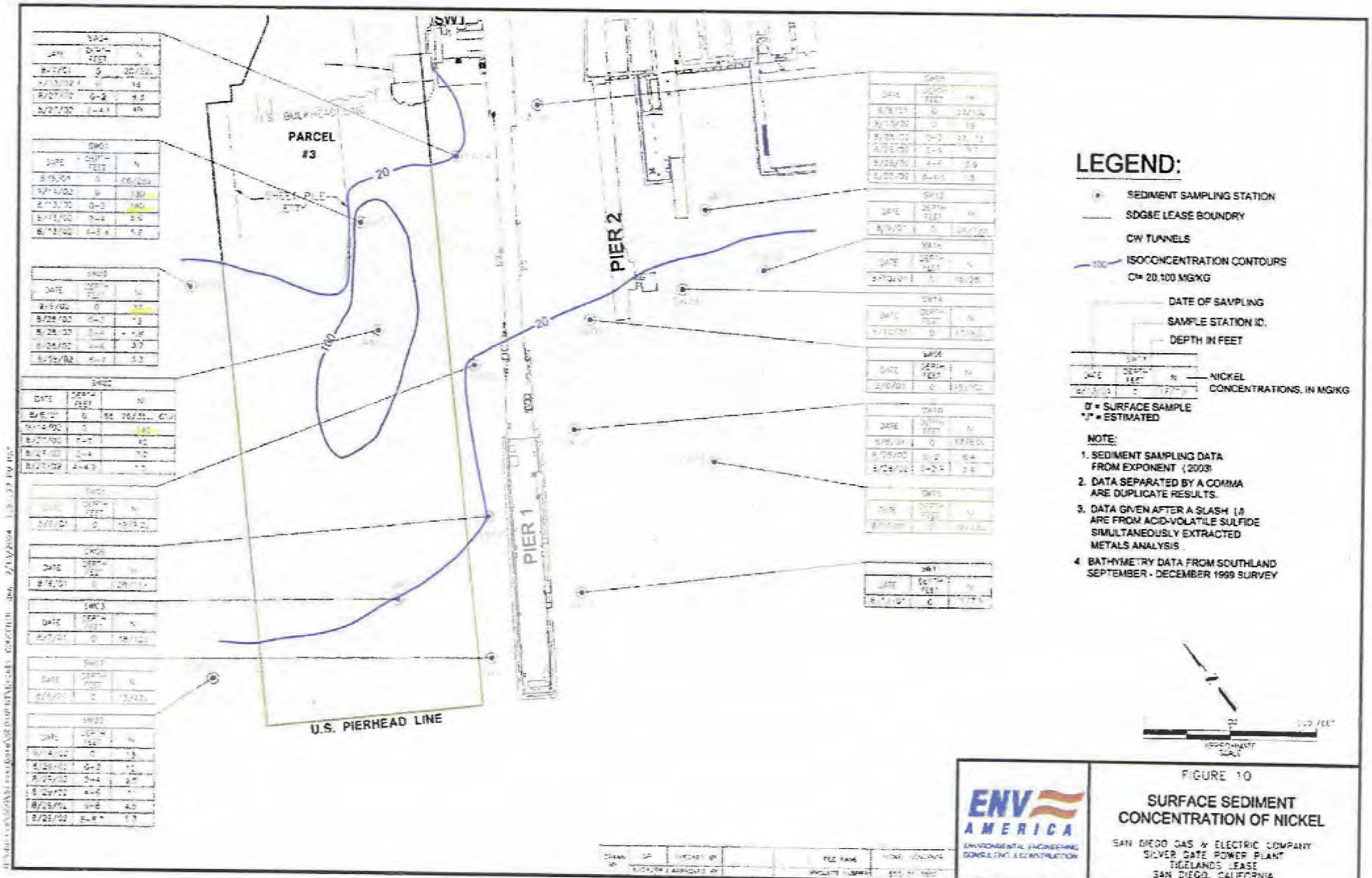


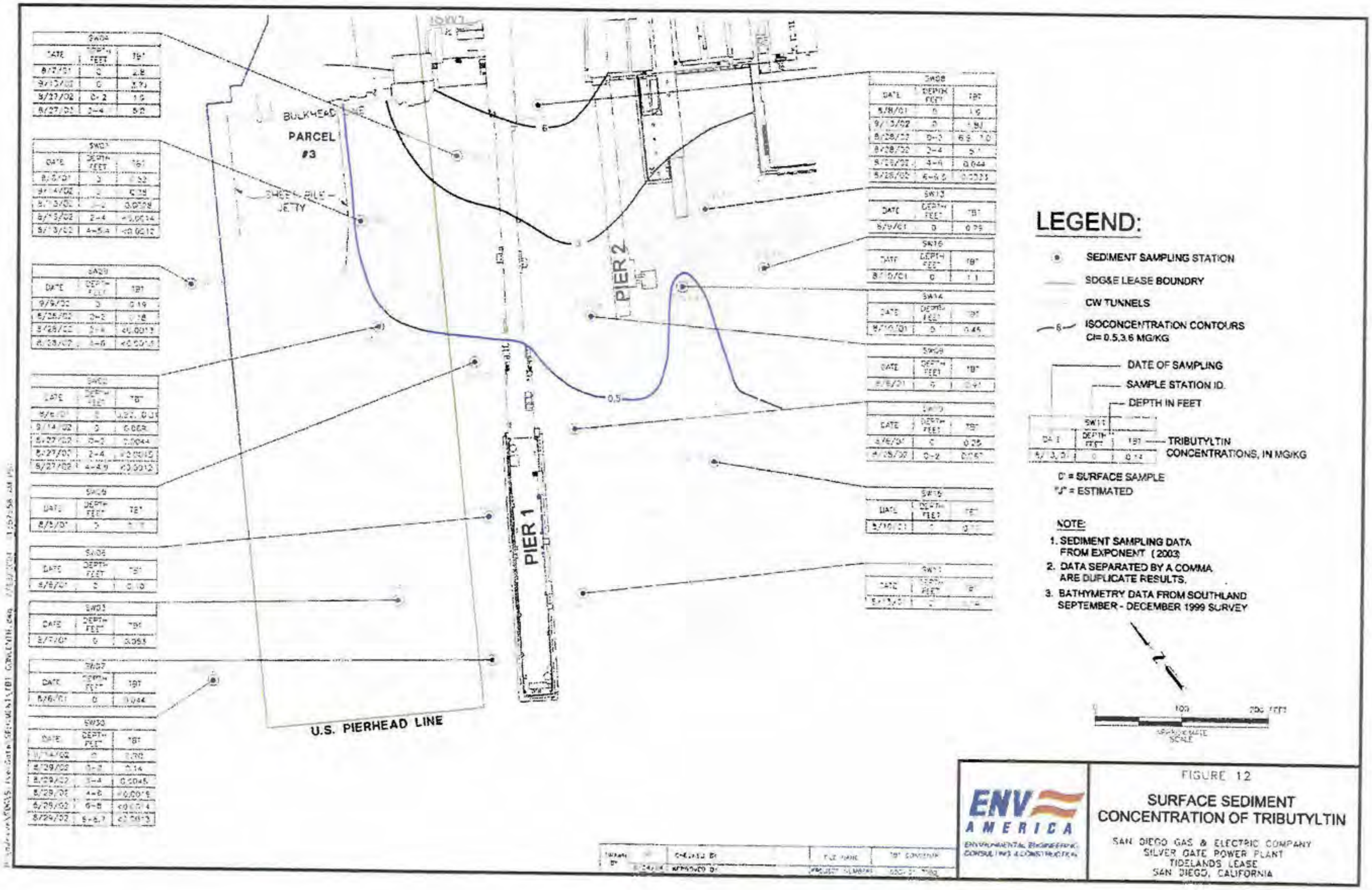
LEGEND:
SEDIMENT SAMPLING STATION
SDG&E LEASE BOUNDRY
CW TUNNELS
ISOCONCENTRATION CONTOUR
CI = 1, 2, 3 MG/KG
DATE OF SAMPLING
SAMPLE STATION ID.
DEPTH IN FEET
CADMIUM CONCENTRATIONS, IN MG/KG
0' = SURFACE SAMPLE
NOTE
1. SEDIMENT SAMPLING DATA FROM EXPONENT (2003)
2. DATA SEPARATED BY A COMMA ARE DUPLICATE RESULTS
3. DATA GIVEN AFTER A SLASH (/) ARE FROM ACID-VOLATILE SULFIDE SIMULTANEOUSLY EXTRACTED METALS ANALYSIS
4. BATHYMETRY DATA FROM SOUTHLAND SEPTEMBER - DECEMBER 1999 SURVEY
PARCEL #3
PIER 1
PIER 2
U.S. PIERHEAD LINE
SW01
SW02
SW03
SW04
SW05
SW06
SW07
SW08
SW09
SW10
SW11
SW13
SW14
SW15
SW16
SW29
SW30
APPROXIMATE SCALE
FIGURE 7
SURFACE SEDIMENT CONCENTRATION OF CADMIUM
ENV AMERICA
SAN DIEGO GAS & ELECTRIC COMPANY
SILVER GATE POWER PLANT
TIDELANDS LEASE
SAN DIEGO, CALIFORNIA


SW1
PARCEL
#3
SHEET PILE
PIER 2
PIER 1
U.S. PIERHEAD LINE
60
90
120
LEGEND:
SEDIMENT SAMPLING STATION
SDG&E LEASE BOUNDRY
CW TUNNELS
ISOCONCENTRATION CONTOURS
CI = 60, 90, 120, MG/KG
DATE OF SAMPLING
SAMPLE STATION ID
DEPTH IN FEET
CHROMIUM
CONCENTRATIONS, IN MG/KG
C' = SURFACE SAMPLE
"J" = ESTIMATED
NOTE:
1. SEDIMENT SAMPLING DATA FROM EXPONENT (2003)
2. DATA SEPARATED BY A COMMA ARE DUPLICATE RESULTS.
3. BATHYMETRY DATA FROM SOUTHLAND SEPTEMBER - DECEMBER 1999 SURVEY
ENV AMERICA
ENVIRONMENTAL ENGINEERING CONSULTING & CONSTRUCTION
FIGURE 8
SURFACE SEDIMENT
CONCENTRATION OF CHROMIUM
SAN DIEGO GAS & ELECTRIC COMPANY
SILVER GATE POWER PLANT
TIDELANDS LEASE
SAN DIEGO, CALIFORNIA



U.S. BULKHEAD LINE
PARCEL #3
PIER 2
PIER 1
U.S. PIERHEAD LINE
LEGEND:
SEDIMENT SAMPLING STATION
SDG&E LEASE BOUNDRY
CW TUNNELS
ISOCONCENTRATION CONTOURS CI = 1, 3, 5 MG/KG
DATE OF SAMPLING
SAMPLE STATION ID.
DEPTH IN FEET
MERCURY CONCENTRATIONS, IN MG/KG
0' = SURFACE SAMPLE
"J" = ESTIMATED
NOTE:
1. SEDIMENT SAMPLING DATA FROM EXPONENT (2003)
2. DATA SEPARATED BY A COMMA ARE DUPLICATE RESULTS.
3. DATA GIVEN AFTER A SLASH (/) ARE FROM ACID VOLATILE SULFIDE SIMULTANEOUSLY EXTRACTED METALS ANALYSIS
4. BATHYMETRY DATA FROM SOUTHLAND SEPTEMBER - DECEMBER 1999 SURVEY
ENV AMERICA
FIGURE 9
SURFACE SEDIMENT CONCENTRATION OF MERCURY
SAN DIEGO GAS & ELECTRIC COMPANY
SILVER GATE POWER PLANT
TIDELANDS LEASE
SAN DIEGO, CALIFORNIA


PARCEL
#3
U.S. BULKHEAD LINE
SHEET PILE JETTY
PIER 2
PIER 1
U.S. PIERHEAD LINE
20
100
LEGEND:
SEDIMENT SAMPLING STATION
SDG&E LEASE BOUNDRY
CW TUNNELS
ISOCONCENTRATION CONTOURS
C= 20,100 MG/KG
DATE OF SAMPLING
SAMPLE STATION ID.
DEPTH IN FEET
NICKEL CONCENTRATIONS, IN MG/KG
0' = SURFACE SAMPLE
"J" = ESTIMATED
NOTE:
1. SEDIMENT SAMPLING DATA FROM EXPONENT (2003)
2. DATA SEPARATED BY A COMMA ARE DUPLICATE RESULTS.
3. DATA GIVEN AFTER A SLASH (/) ARE FROM ACID-VOLATILE SULFIDE SIMULTANEOUSLY EXTRACTED METALS ANALYSIS.
4. BATHYMETRY DATA FROM SOUTHLAND SEPTEMBER - DECEMBER 1999 SURVEY
ENV AMERICA
ENVIRONMENTAL ENGINEERING CONSULTING & CONSTRUCTION
FIGURE 10
SURFACE SEDIMENT CONCENTRATION OF NICKEL
SAN DIEGO GAS & ELECTRIC COMPANY
SILVER GATE POWER PLANT
TIDELANDS LEASE
SAN DIEGO, CALIFORNIA


LEGEND:
SEDIMENT SAMPLING STATION
SDG&E LEASE BOUNDRY
CW TUNNELS
ISOCONCENTRATION CONTOURS
C= 0.5,3,6 MG/KG
DATE OF SAMPLING
SAMPLE STATION ID.
DEPTH IN FEET
TRIBUTYLTIN CONCENTRATIONS, IN MG/KG
0' = SURFACE SAMPLE
"J" = ESTIMATED
NOTE:
1. SEDIMENT SAMPLING DATA FROM EXPONENT (2003)
2. DATA SEPARATED BY A COMMA ARE DUPLICATE RESULTS.
3. BATHYMETRY DATA FROM SOUTHLAND SEPTEMBER - DECEMBER 1999 SURVEY
BULKHEAD LINE
PARCEL
#3
SHEET PILE JETTY
PIER 1
PIER 2
U.S. PIERHEAD LINE
0.5
3
6
ENV AMERICA
ENVIRONMENTAL ENGINEERING CONSULTING & CONSTRUCTION
FIGURE 12
SURFACE SEDIMENT CONCENTRATION OF TRIBUTYLTIN
SAN DIEGO GAS & ELECTRIC COMPANY
SILVER GATE POWER PLANT
TIDELANDS LEASE
SAN DIEGO, CALIFORNIA

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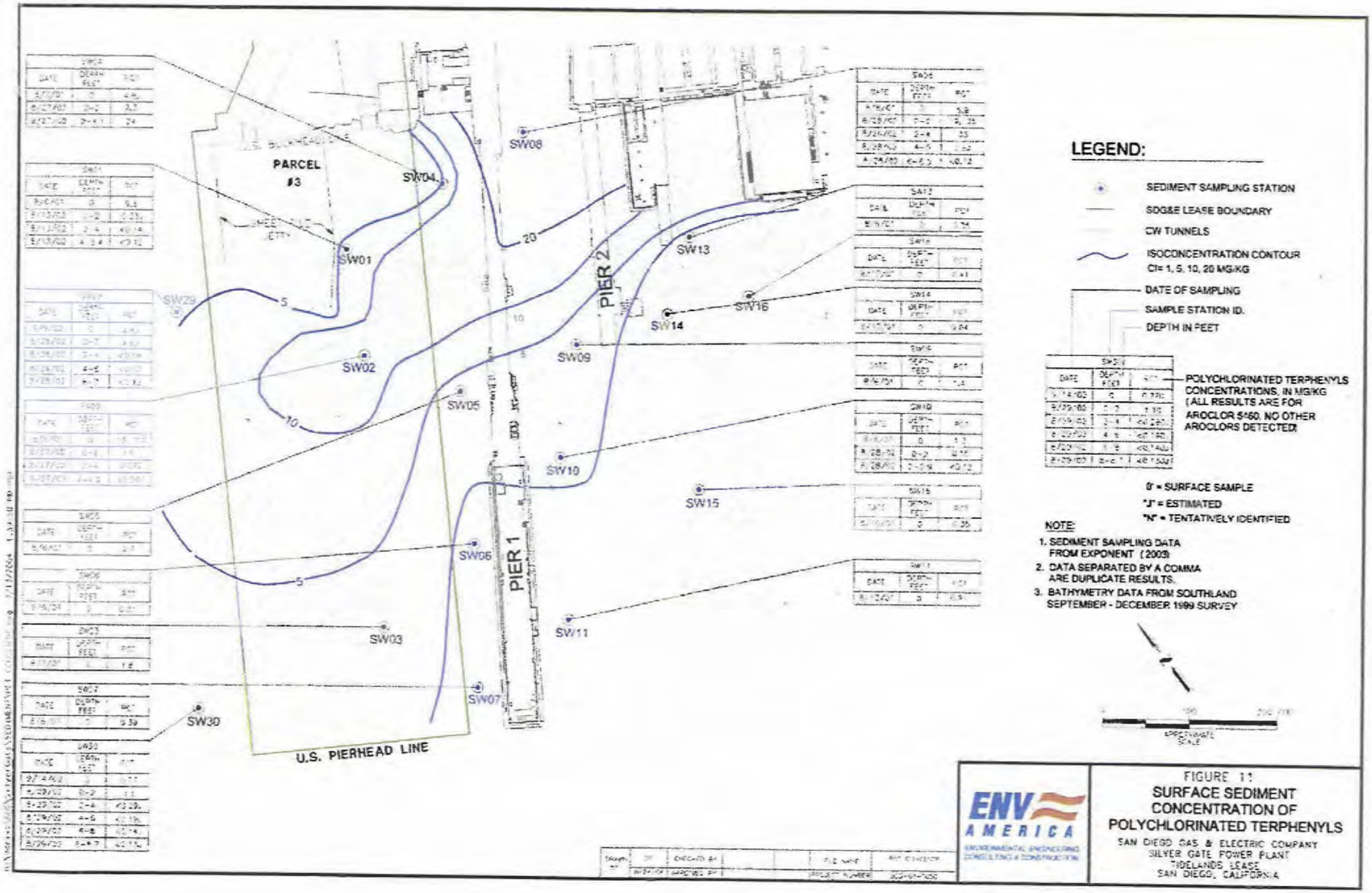
LEGEND:
SEDIMENT SAMPLING STATION
SDG&E LEASE BOUNDARY
CW TUNNELS
ISOCONCENTRATION CONTOUR
CI= 1, 5, 10, 20 MG/KG
DATE OF SAMPLING
SAMPLE STATION ID.
DEPTH IN FEET
POLYCHLORINATED TERPHENYLS CONCENTRATIONS, IN MG/KG (ALL RESULTS ARE FOR AROCLOR 5460, NO OTHER AROCLORS DETECTED)
0' = SURFACE SAMPLE
"J" = ESTIMATED
"N" = TENTATIVELY IDENTIFIED
NOTE:
1. SEDIMENT SAMPLING DATA FROM EXPONENT (2003)
2. DATA SEPARATED BY A COMMA ARE DUPLICATE RESULTS.
3. BATHYMETRY DATA FROM SOUTHLAND SEPTEMBER - DECEMBER 1999 SURVEY
PARCEL #3
U.S. PIERHEAD LINE
PIER 1
PIER 2
SW01
SW02
SW03
SW04
SW05
SW06
SW07
SW08
SW09
SW10
SW11
SW13
SW14
SW15
SW16
SW29
SW30
20
10
5
ENV AMERICA
FIGURE 11
SURFACE SEDIMENT CONCENTRATION OF POLYCHLORINATED TERPHENYLS
SAN DIEGO GAS & ELECTRIC COMPANY
SILVER GATE POWER PLANT
TIDELANDS LEASE
SAN DIEGO, CALIFORNIA

SAR193328

ENV AMERICA

ENVIRONMENTAL

ENGINEERING, CONSULTING

& CONSTRUCTION

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD

SAN DIEGO REGION

IN RE THE MATTER OF)
)
TENTATIVE CLEANUP AND ABATEMENT)
ORDER NO. R9-2011-0001)
)
)
____________________________________)

DEPOSITION OF CRAIG CARLISLE

Volume II, Pages 149 - 359

San Diego, California

February 10, 2011

Reported By: Lynette M. Nelson, CSR No. 11585

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD

SAN DIEGO REGION

IN RE THE MATTER OF TENTATIVE CLEANUP AND ABATEMENT ORDER NO. R9-2011-0001	))))))

DEPOSITION OF CRAIG CARLISLE,

taken by the Attorney for NASSCO, commencing at the hour of 8:09 a.m. on Thursday, February 10, 2011, at 600 West Broadway, Suite 1800, San Diego, California, before Lynette M. Nelson, CSR No. 11585, Certified Shorthand Reporter in and for the State of California.

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San Diego, CA 92106-6146
619-758-7743

I N D E X

E X H I B I T S

1008	A Guide for Ship Scrappers, Tips for Regulatory Compliance, 22 pages	261
1009	National Guidance: Best Management Practices for Preparing Vessels Intended to Create Artificial Reefs, May 2006, six pages	267
1010	Part III Environmental Protection Agency 40 CFR Part 761, December 10, 1999, eight pages	268
1011	Draft Report to the San Diego Regional Water Quality Control Board on Guidelines for the Control of Shipyard Pollutants, 51 pages	269
1012	Southwest Marine NPDES Permit, Annual Report, August 2000, 15 pages	273
1013	Wastes Associated with Shipbuilding and Repair Facilities in San Diego Bay, June 1972, 51 pages	282
1014	October 14, 2005 letter to Lloyd A. Schwartz, two pages	295
1015	November 8, 2005 letter to Lloyd A. Schwartz, one page	296
1016	E-mail from Ruth Kolb to LHonma@waterboards.ca.gov, 11/21/2005, one page	298
1017	Exponent NASSCO and Southwest Marine Detailed Sediment Investigation, Volume I, 27 pages	318
1018	Appendix C, SAIC Sediment Sampling Report - January 13, 1992, 26 pages	320

CRAIG CARLISLE,

having been first duly sworn, testified as follows:

EXAMINATION

BY MS. WITKOWSKI:

Q. Good morning, Mr. Carlisle. My name is Jill Witkowski. I'm the attorney for San Diego Coast Keeper & Environmental Health Coalition.

I was listening in yesterday through the phone, that's why we didn't meet yesterday.

I would just like to remind you you are still sworn and under oath and that oath you took yesterday still carries over.

Yesterday you were asked some questions about your expertise and your areas of expertise. I would like to focus on one area in particular.

I believe I heard yesterday that you said you had experience or training in economics and economic feasibility.

Did I hear that correctly?

A. Yes.

Q. I would like to develop a little further into that. Can you explain to me your experience in those areas?

A. My earliest experience in those areas is to evaluate the economic feasibility of oil exploration and development of oil fields, natural gas fields in California, onshore and offshore in California.

And then when I moved to the environmental field, probably dozens, if not hundreds, of sites evaluating the economic feasibility of alternative remedial alternatives, implementation of remedial alternatives.

Q. Over how many years would you say that you have been involved in these types of analyses?

A. Since 1982.

Q. Have you taken any classes in this area or any other specific training?

A. Well, classes forming a background in those areas include a lot of economic classes in terms of mathematics, statistics, I have had CERCLA training classes and, as you probably know, the CERCLA process requires feasibility studies so I have applied that to a number of projects.

Q. Is there anything else that I hadn't asked about that you think contributes to your expertise or experience in the economic or economic feasibility areas?

A. Well, I think we covered the on-the-job training at a number of projects, large and small ones, working for the Department of Defense, working for private corporations, working for private individuals on a variety of environmental cleanup projects.

Q. Were any of those economic feasibility analyses specifically under State Water Board Resolution 9249?

A. Yes.

Q. About how many would you say?

A. Six.

Q. When was the last one that you did under 9249?

A. The shipyard sediment project. Actually, subsequent to that, we're applying Resolution 9249 to the Mission Valley terminal cleanup, Kinder Morgan project.

Q. Before the shipyard sediment site?

A. A number of small and large projects, gas station cleanups, EZ Serve, ARCOs, because I work on -- I'm the lead technical person and registered professional on all of the underground storage tank projects handled by the Regional Water Quality Control Board and by our LOP, local oversight program, which is the County of San Diego which has a few hundred leaking underground tank sites.

Q. The reason I'm asking you these questions is because I'm hoping you could help me better understand the economic feasibility findings and the analysis that's included in the draft technical report and the appendices. So I'm going to hand you -- you have in front of you Master Exhibit 2 and Master Exhibit 3, which have the complete DTR in there and the appendix for Finding 31. But -- I -- for your convenience, I have printed out a copy for you if that is easier for you to go through and I also brought a few copies for the rest of the people here if that is easier.

For the record, it's -- we'll be looking at DTR Volume II, which is Master Exhibit 2-B starting at Page 31-1 and also the appendix for Section 31, which is Master Exhibit 3 and on the CD it's 3-K.

Let's start at the beginning with this. What's your understanding of why the draft technical report includes an economic feasibility analysis?

A. To evaluate whether it's economically feasible to clean up the background.

Q. And can you explain to me generally, we'll get into the details later, but a general or broad overview of how the cleanup team or the State Water Board analyzed the economic feasibility of cleaning up the background?

MR. CARRIGAN: Objection with respect to "State Water Board." No foundation.

BY MS. WITKOWSKI:

Q. Could we look at Page 31-1 beginning of the second paragraph, it begins with "The State Water Board evaluated a number of criteria."

Could you explain to me why that language says "the State Water Board"?

A. I don't see that.

Q. On Page 31, are we on -- let's make sure we're on the same page. 31-1.

A. I don't see the word "State."

Q. Thank you for correcting me. I meant the San Diego Water Board.

So let me tick back to the original question, it's early in the morning, I'm getting going here -- don't usually work before 8:00.

Can you explain to me why the San Diego Water Board -- well, would you prefer to be talking about the San Diego Water Board or the cleanup team when we are talking about this analysis?

A. Whichever you prefer is fine with me.

Q. Okay. Well --

MR. CARRIGAN: I'm going to object to discussions about the San Diego Water Board to the extent it is the sitting body that will adjudicate this matter. So you can use the term "Water Board" today, but it will apply to the cleanup team which is all Mr. Carlisle is competent to testify about, unless you get into general principles.

MS. WITKOWSKI: I appreciate that clarification.

The reason I had used those terms is because that is the language that's in the draft technical report. So let's talk about the cleanup team since that's how you're involved with it.

BY MS. WITKOWSKI:

Q. And I will go back to the question again, to the general overview.

Can you explain to me generally how the cleanup team analyzed the economic feasibility of cleaning to background levels?

A. How we did it is spelled out in Section 31. How much detail would you like me to repeat that's provided in Section 31?

Q. Well, I would like to walk through step by step, but I thought it might be helpful to me to understand if you had a general overview of the process that you took.

A. Excuse me a moment. And I'm going to put my glasses on.

Q. Okay.

THE WITNESS: Would you mind repeating the question.

MS. WITKOWSKI: Could the court reporter repeat the question, please.

(The record was read.)

THE WITNESS: Thank you.

The overall process is to evaluate the incremental benefit of increasingly stringent cleanup levels versus the incremental cost.

BY MS. WITKOWSKI:

Q. Okay. Let's -- I will refer you to the second paragraph on Page 31-1, again, which I will read correctly this time. It refers to "The San Diego Water Board evaluated a number of criteria to determine the risk, costs and benefits," and I won't read all of this into the record, because the document speaks for itself. But it goes on and lists the criteria that were evaluated and considered.

Do you see where I'm talking about?

A. Yes.

Q. One of these criteria toward the end of the second sentence here is "Effects on recreational, commercial or industrial uses of aquatic resources."

Where can I find the detail in that analysis of the cleanup team's analysis of the economic -- or excuse me, the recreational, commercial or industrial uses of aquatic resources?

A. Part of that, you will find in the section on human health risk assessment.

MR. RICHARDSON: This is Handmacher dialing in, I think.

Hi, this is Kelly.

MR. HANDMACHER: Hi, Kelly, this is Jim.

MR. RICHARDSON: Hi, Jim, we have the whole group here and we're just getting started.

MR. HANDMACHER: All right, thanks.

BY MS. WITKOWSKI:

Q. Could you continue your answer, please.

THE WITNESS: Could you repeat back the beginning of my answer, please.

(The record was read.)

THE WITNESS: In addition, the section on ecological -- the sections on ecological risk assessment. And then I believe there is additional details in one of the subsequent chapters in the DTR.

Would you like me to look for those chapters?

BY MS. WITKOWSKI:

Q. Yes, please. If you can find it in a brief amount of time.

A. Section 32.

Q. Is there a specific portion of that section that you are referring to?

A. It looks like -- I'm just looking at the --

MR. HANDMACHER: Did I lose you?

MR. CARRIGAN: No, we're here.

MR. RICHARDSON: Jim, you there?

MR. HANDMACHER: Yeah, I can hear you now.

MR. RICHARDSON: Apparently all of the mikes have to be on, no one use a single mike. Just so everybody knows in the room knows, the mikes are live.

THE WITNESS: Just looking at the table of contents, looks like all of the sections in 32 are used to evaluate the various criteria you are referring to.

BY MS. WITKOWSKI:

Q. Would it be fair to say, then, for each of these criteria listed in the second sentence of the second paragraph on Page 31-1 would be contained elsewhere in the draft technical report?

A. I'm not positive. It's a large report. I wouldn't want to limit my answer to the way you characterized it.

Q. Okay. Well, let's -- let's take another one in particular, then.

What about the criteria of long-term effects on beneficial uses?

A. I think my answer is similar. Some of the answer to that is in Section 31. Some of it's in 32. And probably some of the other earlier sections on human health and ecological risk assessment.

Q. Is it your recollection that the sections, say on human health and risk assessment, individually evaluates no action, cleanup to background and the alternative cleanup levels?

A. No.

Q. What's your understanding of how that -- which of those is not included in the assessment?

A. I didn't quite follow the beginning of your question.

Q. All right. Let me kind of explain where I'm going so that you can understand better.

The first sentence talks about evaluating -- the cleanup team evaluating a number of criteria related to no action, cleanup to background and the alternative cleanup levels. And when I asked you about one of the specific criteria listed in the next sentence, you had referred me to the section of human health risk assessment.

So my question to you was that section on human health risk assessment, did that individually evaluate no action, cleanup to background and then alternative cleanup levels?

A. I think you can answer most of that within those sections. I'm not sure if it covers it in the same way you described. For example, no action would be the current site conditions. Might not explicitly spell that out. I would have to refer back to those previous sections we mentioned.

Q. So you can't say for sure, then, that the human health risk assessment individually looked at the impacts or the benefits of cleaning to background?

MR. CARRIGAN: Misstates testimony.

THE WITNESS: Not without referring back to those sections.

BY MS. WITKOWSKI:

Q. Would you like to take a moment and look at the sections?

A. It would take more than a moment. But I'm willing to if you would like me to.

Q. We don't have to spend time on that right now. We may come back to it.

Let's turn the page, I will refer you to Page 31-2. This is where I'm going to need some help from you, because it seems to me this is really the area where -- that explains how the cleanup team walked through into this economic analysis and I want to make sure that I understand it thoroughly before we go into the hearing about it so I can fairly evaluate it.

The first sentence on the top of the page talks about economic feasibility was assessed by ranking the 65 shipyard sediment stations according to contaminant levels found in surficial sediment samples.

Could you point to me where that chart ranking, the individual sediment stations would be found?

A. Part of that is on Page 33-6, Table 33-2, remedial footprint polygon ranked by SS-MEQ.

Q. What page was that again you were looking at?

A. 33-6.

Q. Okay. From my -- you said part of that was included on this chart.

Is there another place where the remainder of the stations would be located?

A. Well, referring back to your citing of Page 31-2.

Q. Yes.

A. You read the first sentence, I believe, the second sentence says this process used triad data and site-specific median effects quotient (SS-MEQ), period.

And I just pointed you to Table 33-2 on Page 33-6 and that covers the SS-MEQ portion of that process, cited on Page 31-2. I would have to do some more digging to find out where the triad data ranking shows. But I don't believe they actually ranked the triad data because not all stations had triad data. So I assume, without digging further, we could find out, but I assume they incorporated the triad data as available.

Q. From my read of Table 33-2, it doesn't include all 65 sediment stations. Does that comport with your reading of Table 33-2 as well?

A. Yes.

Q. Could you tell me where I could find the rest of the 65 stations that aren't listed in Table 33-2?

MR. CARRIGAN: Asked and answered.

BY MS. WITKOWSKI:

Q. As it relates to the SS-MEQ?

MR. CARRIGAN: Asked and answered.

THE WITNESS: I can dig further. So you are asking, to clarify what the question is, you are asking where's the rest of the stations?

BY MS. WITKOWSKI:

Q. Exactly.

MR. CARRIGAN: Where's the triad data for the rest of the stations.

BY MS. WITKOWSKI:

Q. Nowhere is the SS-MEQ data for the rest of the stations?

A. Let's both look at the bottom of Page 33-5.

Q. Okay.

A. I'm just refamiliarizing myself with this. And if you give me a moment, I will read that paragraph which might answer your question.

And that paragraph explains that what's in Table 33-2 are the stations without full triad data, i.e., chemistry data only. So maybe you could refresh my memory of what your question was and what still remains to be answered.

Q. What I'm looking to see is, according to my read of 31-2, that all 65 shipyard sediment stations were ranked based on triad data and SS-MEQ. And what I would like to see is if it exists, is there a list where all of the 65 stations are ranked?

A. I don't know off the top of my head. Perhaps, perhaps not. Probably have to take quite a bit of time going through the last few sections in this report to refresh my memory on whether that's there or not.

Q. I couldn't find it either. That's why I was asking, because when trying to evaluate the cleanup team's assessment, what I would like to do or what I would like an expert to do is look at the ranking based on the SS and the MEQ and confirm that it was indeed correct. From my read of this document, I haven't been able to do that.

Do you have any suggestions of how I could do that confirmation?

A. What I suggest is that these are -- this area we are talking about is ranking based on sediment chemistry for the nontriad stations. Triad stations had other data that could be used to evaluate whether those polygons should be considered for remediation or not.

So my recollection of the process is that we ranked the nontriad stations via this table we are talking about, Table 30 -- which table are we on -- 33-2. It looks like 33-1 is a similar table.

The -- then we went on to check if we generated a tentative remedial footprint about first stations, which one should be cleaned up first, we went on to look at any triad data polygons, i.e., stations, that would suggest that needs remediation, too. And then do, you know, additional evaluation about whether to bring those in or out of the footprint.

Q. So it sound like you were taking different information that you had for different polygons and kind of bringing them together to make a ranking -- worst-first ranking based on the triad data and the SS-MEQ; is that correct?

A. I wouldn't exactly describe it that way.
Q. Okay. Where did I get it wrong?
A. We used the SS-MEQ, the chemistry data, via the SS-MEQ process to rank stations based on sediment chemistry, mixtures. And then we -- you could develop a potential remedial footprint via that methodology, but then if you had a polygon or a station outside that potential remedial footprint and the triad data shows that that polygon or station should be considered for cleanup also, so it was a separate step not all rolled into one step.
Q. So how -- it seems to me you were talking about the actual analyzing the data available to create the footprint. From my read of the economic feasibility analysis, it was a different -- sort of a different type of ranking where all of the sites were ranked from 1 to 65 of worst contaminated to least contaminated. And what I'm trying to find out is how -- where I can find the work for that ranking. And if I'm incorrect in understanding that that 1-to-65 ranking was done, please let me know. But this first two sentences on 31-2 leads me to believe that there is some 1-to-65 ranking.
A. Again, I would have to refamiliarize myself with the entire report to see if I can answer that.
MR. CARRIGAN: Can we go off the record for

just a minute?

MS. WITKOWSKI: Sure.

MR. CARRIGAN: Let's take a quick break.

(8:33 a.m.)

(A brief recess was taken.)

(8:41 a.m.)

(The record was read.)

BY MS. WITKOWSKI:

Q. I saw -- going back, I saw that after the break, you were reading through the -- paging through the DTR again.

Have you located that 1-to-65 ranking?

A. I will assume it's not in here.

Q. Is it somewhere other than the DTR?

A. I don't know.

Q. Do you know if a 1-to-65 ranking was created?

A. I don't know.

Q. Let's move on then.

If you could please look at Table A 31-2, which is in Appendix 31, I printed it out for you. It's that long chart, but it's also Page 3 and 4 of Appendix 31. There is also a bigger version printed out.

MR. CARRIGAN: This one is easier to read and it looks true to the copy. So go ahead.

THE WITNESS: Okay.

BY MS. WITKOWSKI:

Q. Are you familiar with this chart?

A. No.

Q. Have you ever seen it before?

A. Not that I recall.

Q. Did you work on the economic feasibility analysis for this shipyard sediment economic feasibility analysis?

A. Yes.

Q. But you don't recall seeing this chart?

A. Correct.

Q. Okay. Well, since you have significant experience in doing economic feasibility analysis, maybe you can help me understand this in some way.

If we look at this chart, which is Table A, 31-2, entitled "Data Used For Table A 31-1," it looks to me to be a 1-to-66 ranking, at least in the chart or the first column says "Rank" and it's got zero to 66, and then the next column says "polygon" and it has listing of the polygons.

Does this look like it could be a 1-to-65 ranking of the polygons?

A. Yes.

Q. And you don't know where this ranking came from?

A. I didn't see that.

Q. Do you know where this ranking came from?

A. You asked if I have ever seen it.

Q. Okay. So you have never seen it? Do you know where this ranking came from?

A. I assume it came from the analysis done for the preparation of the DTR.

Q. Do you know where that analysis can be found?

A. I think the person most knowledgeable about that will be Tom Alo.

Q. Tom Alo.

One of the column headings I have trouble understanding and I was wondering if you understood it and could explain it to me, there are two columns, one that says "Volume Per Polygon - Inside" and one that says "Volume Per Polygon - Outside."

Do you know what the "Volume Per Polygon - Outside" represents?

A. Not off the top of my head.

Q. Did you provide any information to have this chart filled in?

A. No.

Q. Did you ever review this chart?

A. No.

Q. Okay.

A. This table, you mean? When you say "chart," you mean Table 31-2?
Q. Yes, thank you for correcting me.
Do you know where the information in this table came from?
A. Some of it came from Anchor.
Q. Excuse me, I didn't hear you?
A. Anchor.
Q. Anchor. Could you explain what that is?
A. It is a subcontractor that does this sort of work.
Q. And how were they involved in this chart?
A. I -- I don't know. I just recall hearing during some of the work we have done that we had data provided by Anchor.
Q. Do you know where that underlying data can be found?
A. I would assume it's in the administrative record.
Q. You don't know for sure?
A. I think it's extremely likely it's in the administrative record.
Q. Why would it be in the administrative record and not in the appendix?
A. Probably due to a size limitation

consideration. We are reaching, what, 2-, 3,000 pages or something over 1,000 pages.

Q. Do you have any idea how I could go about locating within the administrative record, which is quite voluminous, this data?

A. You could search for the word "Anchor." You could search for volume calculations, area calculations. You could go to the Excel file that's within the hard drive, the original administrative record. And you can sort on the columns, the "to," the "from."

As a matter of fact, I recommend trying via the Excel file, which is an easier search method.

Q. Is there -- you referred to the Excel file. Is there only one that you recall in the administrative record?

A. On the hard drive, in the main folder, as I recall, there is one Excel file.

Q. Okay.

A. It's an index that can be sorted, searched.

Q. I had not looked through that whole thing yet so I appreciate you directing me there.

Is Anchor spelled in the traditional way?

A. Yes.

Q. A-n-c-h-o-r?

A. Yes.

Q. So you believe that some of this data in this Table A 31-2 came from Anchor?
A. That's my understanding.
Q. Do you know where the -- do you know which of the data would have come from Anchor?
A. No. And again, I would refer you to Tom Alo, the person most knowledgeable about some of these calculations.
Q. Do you know of anywhere else where this data may have come from other than Anchor?
A. Possibly NASSCO or BAE or their consultants or some of the other parties and their consultants.
Q. And that would also be in the administrative record?
A. Yes.
Q. Looks to me like this Table A 31-2 depicts for each polygon the total dredging volume and area to clean up to background; is that your understanding?
A. Well, area is just two dimensional.
Q. Right.
A. So that wouldn't be cleanup to background. Then you would have to assume a depth. And then you could get a volume. And that's my understanding. As a matter of fact, there is a column showing you the depth, showing the plus 1 foot over depth or with 1 foot over

depth so they added a foot to that. And then so as you probably know, you multiply area times height by width by depth and you get a volume. So I think this could even be scaled off of a map if you had an accurate way to scale the surface area and then just multiply it by these depth numbers and the polygons are in a number of figures. So that's just geometry, multiplication.

Q. I see that we have cumulative volume on this table and also cumulative dredging area. What's the significance of a cumulative dredging area?

A. Well, it looks like this table feeds back into Section 31 where the economic feasibility broke it down into steps. If you first remove the six worst polygons, you could see on row, indicated by Rank 6, you're up to, you know, some volume and so every six here highlighted so you know how much additional volume to take another six polygons out, et cetera. And from that, you could figure out the cost associated with incrementally increasing the remediation volume.

Q. Great. That's exactly what I was hoping you could explain to me.

How would you go about figuring out the cost from the volume, cumulative volume numbers we have here on Table A 31-2?

A. I would -- and which is what I assume they did, talk to a remediation contractor or an entity such as BAE or Southwest -- BAE or NASSCO and get your best estimate of current costs of dredging, staging, dredging, transporting and disposing of dredge material.

Q. Do you know where those assumptions on costs are located?

A. No. Some of it, apparently, is in Section 31. And some of it might be in the appendix for 31. I have to start looking.

Q. Could you -- would you mind taking a quick look at -- looks like Section 31 is only a few pages and the same thing for the appendix for Section 31. I wasn't able to locate that. So if you could find it, I would appreciate it.

A. Looks like there is some cost numbers on Table 31-1.

Q. All right. Are you referring to the table that's entitled "Plot Data"?

A. Yes.

Q. Do you know where those incremental cost numbers come from?

A. My guess is it came from Anchor.

MR. CARRIGAN: No guessing. Do you know.

THE WITNESS: I don't have anything better than a guess.