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July 12, 2013

California Energy Commission
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Ms. Patricia Kelly
California Energy Commission
1516 Ninth Street
Sacramento, CA 95814-5512

Subject: Redondo Beach Energy Project (12-AFC-03)
Staff Query 1 – Geotechnical Reference Reports

Dear Ms. Kelly:

As requested via email by Gabriel Roark on June 6, 2013, attached please find the final two items requested as Staff Query 1 – Geotechnical Reference Reports:

1. Additional Phase II Field Investigation Report, Redondo Beach Generating Station, Redondo Beach, California. March 2000.
   - Section 3, 4, 5, and 6 Tables are not being provided.
   - Appendix B is not being provided.
2. Site Investigation Report for Soil and Groundwater, Redondo Beach Generating Station, Redondo Beach, California. April 1998.
   - Figures 1-1 and 4-1 are not being provided.
   - Section 2, 4, 5 and 6 Tables are not being provided.
   - Appendices A through F are not being provided.

Due to size, copies of the documents have been provided electronically on CD. Additional copies of the reports can be provided upon request.

If you have any questions about this matter, please contact me at (916) 286-0249 or Mr. Jerry Salamy at (916) 286-0207.

Sincerely,

CH2M HILL

Sarah Madams
AFC Project Manager

Attachment
cc: S. O'Kane, AES
G. Wheatland, ESH
J. Salamy, CH2M HILL

March 2000, Additional Phase II Field Investigation Report

FINAL REPORT

ADDITIONAL PHASE II FIELD INVESTIGATION REPORT

Redondo Generating Station
Redondo Beach, California

Prepared for

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March 2000

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1. Introduction

CH2M HILL initially had performed a Phase II Environmental Site Assessment (ESA) at the Redondo Generating Station (RGS) (Figure 1-1) in May 1997 to evaluate soil and groundwater conditions at the RGS which were identified as areas of potential concern.

In November 22, 1997 Southern California Edison (SCE) and AES Corporation (AES) entered into an Asset Sale Agreement (Agreement) for the purchase of RGS by AES. However, the Agreement did not include the sale of the EPTC AST Area and the 66-kV Switchyard, which were retained by SCE. Currently, AES is in the process of purchasing the AST Area and the 66-kV Switchyard from SCE. AES's intention is to decommission these facilities and redevelop the land.

To assist SCE and AES in the asset sale, CH2M HILL and URS Greiner Woodward Clyde (URSGWC) entered into an agreement to conduct an Additional Phase II Investigation at the AST Area and 66-kV Switchyard. This investigation was conducted from August 16 through August 20, 1999. In addition, selected areas within the AST Area and 66-kV Switchyard were resampled on February 1 and 3, 2000. These areas were resampled as the soil and groundwater results for TPH (extractables) and VOCs analysis from the Additional Phase II Investigation were rejected during data validation because of laboratory QA/QC not meeting project quality control objectives.

1.1 Objectives and Scope of Work

The primary objective of the Additional Phase II Investigation was to provide adequate site characterization data from the AST Area and 66-kV Switchyard to help SCE and AES value the property and complete the asset sale. A second objective was to comply with the recommendations of the Los Angeles Regional Water Quality Control Board (LARWQCB) discussed during a meeting with SCE and AES on July 22, 1999.

To achieve these objectives the following scope of work was performed:

- Subsurface survey for underground utilities
- Perimeter soil and groundwater sampling at each of the five ASTs
- Soil and groundwater sampling beneath Fuel Tank 2
- Soil and groundwater sampling at the 66-kV Switchyard
- Prepare a report summarizing the results of the investigation
- Prepare remediation cost estimate to mitigate impacted soil to levels consistent with regulatory agency criteria.

1.2 Site Location and Description

The AST Area is located to the east and south of the RGS, and the 66-kV Switchyard is located to the east of Plant 1 (Units 1 through 4) and surrounded by the RGS (Figure 1-2). The AST Area includes each of the fuel storage tanks (Tanks 1 through 5), the displacement oil tank, and the land extending to the earthen berms surrounding each AST. The 66-kV Switchyard includes the utilities and land within the fence that surrounds this switchyard.

2. Previous Investigations

Presented below is a summary of some of the previous investigations conducted within the AST Area and the 66-kV Switchyard. The summaries were developed based on the review of the following reports.

- Report Baseline Environmental Study Tanks 1 through 4, Redondo Generating Station prepared by SCE (April 1997)
- Report Baseline Environmental Study Tank 5, Redondo Generating Station prepared by SCE (May 1997)
- Final Addendum to Baseline Environmental Study Fuel Oil Tank 5 - Redondo Generating Station prepared by CH2M HILL (August 1998)
- Redondo Generating Station Phase II Environmental Site Assessment prepared by CH2M HILL (June 1997).
- Annual Groundwater Monitoring Report, Redondo Generating Station prepared by SCE (February 1999)

A summary of the soil and groundwater analytical data from previous investigations is provided in Table 2-1 and Figures 2-1 through 2-3.

2.1 Soil Investigations

From 1997 to 1998, SCE conducted two phases of sampling within the basin of Tanks 1 through 4 and three phases of sampling within the basin of Tank 5. In 1997, SCE conducted the Baseline Environmental Study of Tanks 1 through 4 and a separate Baseline Environmental Study of Tank 5. SCE contracted CH2M HILL in 1998 to conduct additional sampling at the AST Area as part of the Phase II investigation of the RGS. Soil sampling within the AST Area was generally limited to the collection of discrete and/or composite soil samples along the perimeter of Tanks 1 through 5. However, the final addendum investigation of Tank 5 also included the collection of discrete soil samples through the Tank 5 bottom.

Soil samples collected from borings and trenches as part of SCE's baseline environmental studies of the AST Area were analyzed for total recoverable petroleum hydrocarbons (TRPH). In addition, composite samples of the most highly contaminated samples from the borings and trenches were analyzed for the following chemical parameters:

- Total petroleum hydrocarbons - carbon chain analysis (TPH-cc)
- Benzene, toluene, ethylbenzene, xylenes (collectively referred to as BTEX)
- Title 22 Metals,
- Polychlorinated biphenyls (PCBs)
- Reactive cyanide
- Ignitability
- pH

Soil samples collected from the AST area during CH2M HILL's Phase II investigation were analyzed for TPH in the diesel range (TPH-d) with a carbon chain breakdown (TPH-cc).

TRPH/TPH-d/TPH-cc concentration ranges detected in soil at each tank area during this investigation are summarized as follows:

- Tank 1: up to 10,300 milligrams per kilogram (mg/kg) TRPH and up to 6,800 mg/kg TPH-d. TRPH concentrations >1,000 mg/kg were detected in 5 samples at depths ranging from 0.5 feet bgs to 2 feet bgs.
- Tank 2: up to 7,600 mg/kg TRPH and up to 2,900 mg/kg TPH-d; TRPH concentrations >1,000 mg/kg were detected in 13 samples at depths ranging from 0.5 feet bgs to 4.5 feet bgs.
- Tank 3: up to 11,000 mg/kg TPH-cc in composite sample and up to 3,500 mg/kg TPH-d; TRPH concentrations >1,000 mg/kg were detected in 3 samples at depths ranging from 0.5 feet to 2.5 feet bgs.
- Tank 4: up to 542 mg/kg TRPH and 25 mg/kg TPH-d.
- Tank 5: up to 582,000 mg/kg TRPH and up to approximately 50,000 mg/kg TPH-cc. TRPH concentrations >100,000 mg/kg in 6 trench samples at depths ranging from 0.5 feet bgs to 2 feet bgs.

BTEX and PCBs were not detected above the laboratory detection limits in the composite soil samples analyzed from each tank area. PCB detection limits for samples analyzed from the Tank 2 area ranged from 33 mg/kg to 67 mg/kg (Alocor 1221). Some of these detection limits are above the Federal Toxic Substance Control Act (TSCA) industrial cleanup threshold for PCBs of 50 mg/kg.

SCE reported that the metals concentrations were below the total threshold limit concentrations (TTLC) and less than 10 times the soluble threshold limit concentrations (STLC) for the characterization of hazardous wastes per California Code of Regulations, Title 22.

The assessment of the 66-kV Switchyard was conducted during CH2M HILL's Phase II investigation. Soil samples were limited to borings advanced on the perimeter of the fenced switchyard. Soil samples were not collected within the switchyard. Soil samples were analyzed for TPH-d and PCBs. Up to 83 mg/kg TPH-d were detected in shallow soil samples collected along the fence of the switchyard. PCBs were not detected above laboratory detection limits.

2.2 Groundwater Investigations

Hydropunch groundwater samples were collected from boring locations within the basins of Tanks 1, 2, 3 and 5. Depth to groundwater ranged between 5 and 7 feet below ground surface. Groundwater samples were analyzed for TPH-d. Concentrations ranged from non detect (detection limit at 0.5 milligrams per liter [mg/L]) to 40 mg/L at Tank 5. In addition, a groundwater sample from Tank 1 was analyzed for VOCs. The groundwater sample reported concentrations below detection limits.

TPH-d and PCBs were not detected in two groundwater samples collected along the perimeter of the 66-KV switchyard (depth to groundwater ranged from 10 to 13 feet). Groundwater samples were not collected within the switchyard.

SCE has been investigating groundwater in the vicinity of the North and South Retention Basins (see Figure 1-2) under a Consent Order from the Department of Toxic Substances Control (DTSC). This work is to support Resource Conservation and Recovery Act (RCRA) closure of the retention basins. Chemicals of Concern (COC) in groundwater in the vicinity of the retention basins include VOCs and

Title 22 metals. Based on the review of the 1998 Annual Ground Water Monitoring Report for RGS, it appears that groundwater in the vicinity of the retention basins is drawn toward the AST Area by the three dewatering wells located within the AST Area (see Figure 1-2). SCE recently completed groundwater sampling within the AST Area to assess the nature and extent of COCs identified in groundwater in the vicinity of the retention basins. No analytical data has been provided by SCE at the time of this report preparation.

2.3 Conclusions

2.3.1 Soil

The conclusions from the baseline environmental studies conducted by SCE and CH2M HILL indicate that TPH-impacted soil appears to be confined to areas beneath the tanks. Past SCE practice at the AST Area called for the placement of oil mixed with sand as a base before a tank was constructed. The oil-containing sand provides corrosion protection for the AST.

Based on the review of the above reports and the analytical data, the following conclusions are made:

- TPH have been detected above LARWQCB (May 1996) screening levels, as referenced in the baseline studies of the AST area
- The lateral extent of TPH may be reasonably estimated from the perimeter of the ASTs
- TPH above screening criteria have been detected in groundwater at Tanks 1, 3, and 5

2.3.2 Groundwater

Based on the review of the groundwater analytical data from sampling conducted with the AST Area and the 66-kV Switchyard, the following conclusions are made:

- TPH concentrations in groundwater ranged from non-detect to 40 mg/L
- VOCs and PCBs concentrations were below detection limits
- Metal analysis for the 66-kV Switchyard samples indicated de minimus concentrations

3. Site Description and Field Activities

This section provides a description of local topography including the general geologic and hydrogeologic setting, site description, and a brief summary of the field activities conducted at the site during the Additional Phase II Investigation and resampling. All field activities were conducted in conformance with the work plan titled *"Work Plan for Additional Site Investigation Redondo Generating Station Redondo Beach, California, dated August 1999"* prepared for this investigation.

3.1 Site Topography, Geology, and Hydrogeology

The topography at the RGS facility is generally flat with the surrounding area topography sloping to the west. RGS was a former marsh and low lying area that was filled and re-graded to provide the present, relatively flat configuration. Three lithologic units are present, consisting of the Old Dune Sand aquifer, the marsh deposits that form an aquitard, and the underlying Gardena-Silverado aquifer.

The Old Dune Sand aquifer consists of medium-dense, fine-to-medium sand overlying fine-to-medium sand with minor gravel deposits. This aquifer is approximately 20 feet thick. Fill material placed in depressional zones of the Old Dune Sand formation is difficult to distinguish due to its similar sandy characteristics and color. Perched groundwater exists within this formation due to the low permeability of the underlying marsh deposits.

The marsh deposits form an aquitard composed of soft clay, silt, and peat. This low-permeability confining layer is up to 6 feet thick. Over the western portion of the RGS, this confining layer separates the perched groundwater in the Old Dune Sand aquifer from the confined groundwater of the Gardena-Silverado aquifer. However, the marsh deposits are discontinuous along the eastern portion of the RGS, where the Old Dune Sand aquifer is in direct contact with the underlying Gardena-Silverado aquifer.

The Gardena-Silverado aquifer consists of interbedded fine-to-coarse, dense sand with gravel, pebbles, and occasional wood fragments. This deposit is about 140 to 150 feet thick.

The municipal water district operates groundwater injection wells in the vicinity of the RGS. The resulting rise in the water table due to the injection well program has created a need for Edison to operate dewatering wells at the RGS. Currently, groundwater at the site is approximately 5 to 7 feet below ground surface (bgs) in the AST Areas, where the ground surface elevation is about +8 feet to +12 feet mean sea level (msl). However, within the power block areas, where the average ground surface elevation is about +19 feet msl, groundwater is encountered at depths of about 10 to 13 feet bgs.

Natural groundwater flow in the area of the RGS has been altered because of the operation of groundwater dewatering systems. The dewatering systems are designed to remove perched groundwater from the fuel tank and pump station areas. Prior to operation of these systems, groundwater flow was westerly, towards the ocean. Currently, however, shallow groundwater flows in a southeastern direction. Since the groundwater in the area is brackish, no potable water wells are located in the vicinity of the RGS.

3.2 Site Description

As mentioned earlier, the site under investigation included the AST Area and the 66-kV Switchyard. The following paragraphs will provide a brief description of each of these areas.

3.2.1 AST Area

The AST area has five ASTs and one displacement oil tank. The AST area is located on the east side of the RGS within a bermed area. The following table provides information about the ASTs.

Name	Capacity	Characteristics
Fuel Tank 1	100,000 barrels	Constructed of steel and located within a concrete covered earthen dike with an unlined bottom. Out of service since 1993.
Fuel Tank 2	100,000 barrels	Constructed of steel and located within a concrete covered earthen dike with an unlined bottom. Out of service since 1993.
Fuel Tank 3	140,000 barrels	Constructed of steel and located within a concrete covered earthen dike with an unlined bottom. Out of service since 1993.
Fuel Tank 4	218,374 barrels	Constructed of steel and located within a concrete covered earthen dike with an unlined bottom. Out of service since 1993.
Fuel Tank 5	312,817 barrels	Constructed of steel and located within a concrete covered earthen dike with an unlined bottom. Currently inactive.
Displacement Oil Tank	32,000 barrels	Constructed of steel and located north of Fuel Tank 1 within the same bermed area. Used for storing cutter stock oil and is currently active.

3.2.2 66-kV Switchyard

The 66-kV Switchyard is located east of the Plant 1 Area (Units 1 through 4) and west of the hazardous waste storage area. The 66-kV Switchyard is surrounded by AES Redondo Generating Station property, which is considered to be adjoining property for the purposes of this report. The 66-kV Switchyard is asphalt paved throughout and completely contained within a barbed wire fence.

All transformers and power transmission equipment is set on concrete slabs throughout the Switchyard. Visible cracking of the asphalt was observed at the time of the site reconnaissance. A series of three approximately 2-inch aboveground pipes were observed to be traversing the 66-kV Switchyard. The pipes were connected to the transformers throughout the Switchyard. The pipelines formerly conveyed used and fresh transformer oil to and from the individual transformers from two former ASTs located to the north of the 66-kV Switchyard. The transformer oil exchange was necessary during transformer maintenance.

3.3 Field Activities

Field activities consisted of underground utility clearance, soil and groundwater sampling, decontamination, and management of investigation derived waste. A description of these activities is

presented in the following sections. The Additional Phase II Investigation was conducted from August 16 through 20, 1999 and the resampling activities on February 1 and 3, 2000.

3.3.1 Underground Utility Clearance

Prior to sampling, an underground utility locator service was utilized to determine the location of the buried utilities adjacent to sampling locations at the 66-kV Switchyard. The underground locator service utilized a combination of ground penetrating radar and magnetometers to locate buried utilities. Some of the pre-marked boring locations at this site had to be moved on the basis of survey results. During resampling at the 66-kV Switchyard, underground utility clearance was not required as the boring were located adjacent to the former locations.

Underground utility clearance was not utilized at the AST Area since all soil borings were drilled using hand augers up to a maximum depth of 5 feet bgs.

3.3.2 Field Sampling

Field sampling (soil and groundwater) was conducted around the perimeter of the fuel tanks in the AST Area and within the 66-kv Switchyard. At the AST Area, sampling was also conducted beneath Fuel Tank 2 (6 locations). Sample locations are shown on Figure 3-1. The field sampling was conducted using a combination of hand auger and a direct-push (geoprobe) sampling rig. As mentioned above, sampling at the AST Area was conducted using hand auger while at the 66-kV Switchyard it was done with a combination of hand auger and a geoprobe.

The following table is a summary of the field sampling activities. Further details can be found in Table 3-1. Soil boring logs were prepared for each boring location at the site and a copy of the logs is provided in Appendix A. No boring logs were completed during resampling, as the borings were located adjacent to the former locations.

Site	Number of Borings		Boring Depth (ft.)	Number of groundwater samples		Type of Boring
	Add. Phase II	Resample		Add. Phase II	Resample	
Fuel Tank 1	5	2	1-4.5	2	NA [3]	Hand auger
Fuel Tank 2	9 [1]	2	1-6	5 [2]	NA	Hand auger
Fuel Tank 3	2	2	1-3	2	NA	Hand auger
Fuel Tank 4	2	2	1-10	NA	NA	Hand auger
Fuel Tank 5	4	3	1-10	3	NA	Hand auger
66-kV Switchyard	10	5	1-10	8	5	Hand auger/ geoprobe

Notes:

(1) Includes 6 borings beneath Fuel Tank 2

(2) Includes 3 groundwater samples beneath Fuel Tank 2

(3) Groundwater samples were not collected

Hand auger samples were collected in 4-oz glass jars while geoprobe samples were collected in 2"x6" stainless steel liners. Groundwater samples were collected in appropriate containers (as per chemical analysis). Each sample was given a unique identification number which was logged daily in field

logbooks. The samples, after capping and labeling, were sealed in Ziploc-type bags and stored in an ice chest pending delivery to the analytical laboratory.

Samples were delivered daily to the analytical laboratory under chain-of-custody procedures. The samples from the Additional Phase II Investigation were sent to Crosby Laboratories, Inc. located in Placentia, California while those from resampling were sent to Calscience Environmental Laboratories, Inc. located in Garden Grove, California. Both of the laboratories are California-State Certified. The samples were analyzed for the following chemical parameters.

- Total Petroleum Hydrocarbons (TPH) - soil and groundwater samples
- Volatile Organic Compounds (VOCs) - soil and groundwater samples
- Polycyclic Aromatic Hydrocarbons (PAHs) – soil samples
- Polychlorinated Biphenyls (PCBs) – soil samples from 66-kV Switchyard
- 17 CAM Metals – soil samples from beneath Fuel Tank 2

3.3.3 Decontamination

Decontamination of soil sampling equipment consisted of wiping equipment of excess soil, washing in a solution of non-phosphate detergent (Liquinox), and rinsing with deionized water. For groundwater sampling, sample tubings were disposed of after each sampling episode. Sampling equipment was cleaned prior to use, between use, and prior to leaving the site. For each soil sampling location, new stainless steel liners were used.

Decontamination of the geoprobe rig consisted of cleaning off-site prior to the commencement of field activities. The subcontractor provided sufficient quantities of equipment so that it reduced the need for on-site decontamination.

3.3.4 Management of Investigation Derived Waste

Water generated during decontamination activities were stored in Department of Transportation (DOT) approved 55-gallon drums, labeled, and stored onsite for appropriate disposal. Soil cuttings generated during geoprobe sampling were also stored in DOT approved 55-gallon drums and stored onsite for appropriate disposal.

4. Investigation Results and Data Validation

This section provides the results of the soil and groundwater sample analysis for the Additional Phase II Investigation and resampling. These results are summarized in Tables 4-1 through 4-7. As mentioned earlier, the results of the TPH-extractables and VOC analysis for both soil and groundwater analyses were rejected because the laboratory QA/QC did not meet the project QC objectives. A copy of the laboratory analytical report is provided in Appendix B. The analytical results provided below are presented by site and sample matrix. This section also provides a report on the data validation conducted on the laboratory analytical results. This data validation was conducted to ascertain whether the laboratory analytical data met project quality control objectives. Any out-of-control items detected during the data validation process are flagged in this report.

4.1 AST Area

A total of 50 soil samples and 14 groundwater samples were collected from the AST Area during the Additional Phase II Investigation. Of this total, 14 soil samples and three groundwater samples were collected from beneath Fuel Tank 2. In addition, 27 soil samples were collected from the AST Area during resampling. The results of the laboratory analyses are discussed below by sample matrix.

4.1.1 Soil

The soil samples were analyzed for TPH, VOCs, PAHs and metals (only samples collected from beneath Tank 2). TPH analysis included both volatile and extractable fractions. The volatile fractions were compared against gasoline standard, while the extractable fractions were compared against diesel fuel and motor oil standard. For TPH-gasoline range, all the soil samples reported concentrations those were below the detection limit of 0.5 mg/kg. For TPH-diesel range, the soil samples also reported concentrations those were below the detection limit of 5 mg/kg (below 200 and 250 mg/kg for two soil samples). For the TPH-motor oil range, 10 soil samples had reportable concentrations that were qualified as estimated (see Data Validation report for details). The concentration ranged from 48 mg/kg to 4,700 mg/kg. The highest concentration was detected in a soil sample collected from boring RGS02-01A. This sample was collected at a depth of 5 feet bgs. The shallower sample from the same boring had the second highest concentration. This sample had a concentration of 3,100 mg/kg.

VOCs were detected in the soil samples collected from the AST area. These include acetone (qualified as not detected as it was indicated as laboratory contamination), 2-butanone, chlorobenzene, and 1,1-dichloroethane. Acetone was detected in six soil samples at concentrations ranging from 0.054 mg/kg to 0.360 mg/kg. 2-butanone, chlorobenzene, and 1,1-dichloroethane were each detected once in three different soil samples at concentrations of 0.064 mg/kg, 0.0095 mg/kg and 0.046 mg/kg, respectively. None of the detected VOCs were above industrial preliminary remediation goals (PRGs) published by EPA Region IX.

PAHs were detected in soil samples collected from Fuel Tanks 1 and 2. The detected PAHs included benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, indeno(1,2,3,-cd)pyrene, acenapthene, bezno(ghi)perylene, fluoranthene, naphthalene, phenanthrene, and pyrene. The PAHs were mostly detected in shallow samples (1-foot bgs). The soil sample with the highest number of detected PAHs was RGS01-01-01, which was collected adjacent to the displacement oil tank located north of Fuel Tank 1. Three PAHs were detected above industrial PRGs. These PAHs include benzo(a)anthracene, benzo(a)pyrene, and dibenzo(a,h)anthracene.

Metal concentrations above detection limits were reported for arsenic, copper, nickel, selenium, and zinc. These concentrations were all below industrial PRGs.

4.1.2 Groundwater

Groundwater samples from the Additional Phase II Investigation were analyzed for TPH and VOCs. TPH analysis included both volatile and extractable fractions. The volatile fractions were compared against gasoline standard, while the extractable fractions were compared against diesel fuel and motor oil standard. For the TPH-gasoline range, all the groundwater samples reported concentrations those were below the detection limit of 0.1 mg/L. However, the results for TPH-extractables (diesel fuel and motor oil range) and VOCs were rejected during data validation due to laboratory QA/QC not meeting project objectives.

During resampling, no groundwater samples were collected for TPH-extractable and VOCs analysis from the AST Area.

4.2 66-kV Switchyard

A total of 29 soil samples and eight groundwater samples were collected from the 66-kV Switchyard. In addition, 14 soil samples and six groundwater samples were collected during resampling. The results of the laboratory analysis are discussed below by sample matrix.

4.2.1 Soil

The soil samples were analyzed for TPH, VOCs, PCBs and PAHs. TPH analysis included both volatile and extractable fractions. The volatile fractions were compared against gasoline standard, while the extractable fractions were compared against diesel fuel and motor oil standard. For TPH-gasoline range, all the soil samples reported concentrations those were below the detection limit of 0.5 mg/kg and 0.1 mg/kg. For TPH-diesel range, the soil samples also reported concentrations those were below the detection limit of 5 mg/kg. For the TPH-motor oil range, two soil samples had reportable concentrations that were qualified as estimated (see Data Validation for details). The concentrations for these two samples were 91 mg/kg and 170 mg/kg.

VOCs and PCBs were not detected in any of the soil samples collected in the 66-kV Switchyard.

PAHs were detected in six samples. The detected PAHs included benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, indeno(1,2,3,-cd)pyrene, acenapthene, bezno(ghi)perylene, fluoranthene, naphthalene, phenanthrene, and pyrene. The soil samples with the highest number of detected PAHs were RGS06-11-05, RGS06-11-10 and RGS06-12-05 collected from depths of 5 feet bgs and 10 feet bgs. Only benzo(a)pyrene was detected above the industrial PRG value.

4.2.2 Groundwater

Groundwater samples from the Additional Phase II Investigation were analyzed for TPH and VOCs. TPH analysis included both volatile and extractable fractions. The volatile fractions were compared against gasoline standard, while the extractable fractions were compared against diesel fuel and motor oil standard. For the TPH-gasoline range, all the groundwater samples reported concentrations those were below the detection limit of 0.1 mg/L. However, the results for TPH-extractables (diesel fuel and motor oil range) and VOCs were rejected during data validation due to laboratory QA/QC not meeting project objectives.

Groundwater samples collected during resampling were analyzed for TPH-extractable and VOCs. The extractable fractions were compared against diesel fuel and motor oil standards. For TPH-diesel fuel range, all the groundwater samples reported concentrations those were below the reporting limit of 1 mg/L and 10 mg/L (Sample RGS06-01A). For TPH-motor oil range, only one sample reported concentration that was above the reporting limit of 20 mg/L. However, this result was qualified as estimated as no methylene chloride blank correction was done as required by the method.

Only toluene was detected during VOC analysis. Five out of six groundwater samples collected at the 66-kV Switchyard had concentrations that were above the reporting limit. The concentrations ranged from 1 ug/L to 1.5 ug/L.

4.3 Data Validation

Data validation of the laboratory analytical data were conducted by CH2M HILL's project chemist as per EPA data validation guidelines. Quality control parameters were reviewed for 100 percent of the data while raw data checks were carried out for 10 percent of the data. The following sub-sections presents a summary of the of the data validation for each of the analytical method. The detailed data validation report is provided in Appendix C.

4.3.1 TPH by EPA Method 8015 Modified

The laboratory analytical data generated for TPH analysis from the Additional Phase II Investigation had deviations that resulted in the data being qualified as follows:

- All positive results for TPH as diesel and TPH as motor oil in all soil and water samples have been qualified as estimated, and non-detects have been rejected due to non-performance of calibrations and calibration verifications concurrently with the sample analyses.
- Based on responses recorded for method and rinsate blanks, the field sample results equal to or less than 5 times the equivalent highest blank concentration have been qualified as not detected. These qualifications would also address the calculation biases at the low concentrations reported, as discussed in the detailed data validation report provided in Appendix C.

Since the TPH analytical data for the Additional Phase II Investigation was qualified as estimated because of the non-performance of calibrations and concurrent calibration verification by the laboratory, CH2M HILL resampled selected locations at the AST Area and the 66-kV Switchyard. These data were accepted with few qualifications that are presented below:

- TPH-diesel results for soil samples were all accepted without any qualifications. However groundwater sample, RGS06-01A, that initially reported TPH-diesel concentration above the reporting limit of 10 mg/L, was qualified as false positive and hence reported as non-detect.
- All TPH-motor oil results were qualified as estimated for both soil and groundwater samples because they were detected below calibration range (soil samples) and no methylene chloride blank corrections (soil and groundwater samples)

4.3.2 VOCs by EPA Method 8260

The laboratory analytical data generated for VOC analysis were accepted with few qualifications that are presented below:

- One soil sample, RGS06-02-05, was analyzed outside the holding time. All positive results have been qualified as estimated and all detects as estimated at the reporting limits.

- Target analyte such as methylene chloride for most of the samples were not reported even though they were detected in the samples analyzed. The laboratory reported it being laboratory contamination without providing proper documentation.
- Four samples had low concentrations of several VOCs that were not reported by the laboratory in the original report. These VOCs included toluene, total-xylenes, ethylbenzene, 1,2,4-trimethylbenzene, chloromethane, bromomethane, and acetone.

Because of the qualification of the VOCs analytical data as estimated, CH2M HILL resampled selected locations at the AST and the 66-kV Switchyard Areas. These data were accepted with few qualifications that are presented below:

- Acetone, which was indicated as detected in the laboratory report, has been qualified as not detected because acetone was identified as low-level laboratory contamination.

4.3.3 PAHs by EPA Method 8310

The laboratory analytical data generated for PAH analyses were of acceptable quality.

4.3.4 PCBs by EPA Method 8082

The laboratory analytical data generated for PCB analyses were of acceptable quality.

4.3.5 17 CAM Metals by EPA Method 6010/7000

The laboratory analytical data generated for 17 CAM Metal analysis were of acceptable quality except for the following qualifications:

- No calibration verifications were performed during analysis of arsenic and selenium
- Matrix effects could not be assessed for any of the target analytes, except mercury, as the laboratory did not use a project-specific sample for analysis of matrix spikes.

5. Human Health Risk Evaluation

This section of the report summarizes the results of the human health risk assessment (HHRA) for the Fuel Storage Tank and 66 kV Switchyard areas associated with the RGS. The objectives of the risk assessment were to evaluate potential human health and environmental impacts associated with the presence of chemicals detected in the soil and to provide information necessary to make informed decisions regarding the site that will be protective of human health and the environment.

This evaluation follows the basic procedures outlined in the U.S. Environmental Protection Agency (EPA) *Risk Assessment Guidance for Superfund: Volume I—Human Health Evaluation Manual (EPA, 1989)* and the California Department of Toxic Substances Control (DTSC) *Supplemental Guidance for Human Health Multimedia Risk Assessments of Hazardous Waste Sites and Permitted Facilities (DTSC, 1992).* Other guidance documents consulted in completing the risk assessment include:

- *Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual, Supplemental Guidance, "Standard Default Exposure Factors". Interim Final, March, 1991 (EPA, 1991).*
- *Preliminary Endangerment Assessment Guidance Manual (DTSC, 1994)*
- *Region IX Preliminary Remediation Goals (EPA 1998)*

The remainder of the risk assessment is organized as follows:

- Chemicals of Potential Concern, this section summarizes the available data and selects the chemicals of potential concern (COPC) to be evaluated in the HHRA.
- Exposure Assessment, identifies potential pathways by which exposure could occur; characterizes the potentially exposed populations; and estimates the magnitude, frequency, and duration of exposure.
- Toxicity Assessment, evaluates the toxicity of the COPCs and the magnitude of exposure and adverse effects.
- Risk Characterization, integrates the toxicity and exposure assessments to estimate the potential risks to human health from exposure to site chemicals.
- Conclusions, highlights the decision points presented in this evaluation.
- Uncertainty Analysis discusses the uncertainties in the risk assessment process and how these uncertainties influence the characterization of health risks.

5.1 Chemicals Of Potential Concern

Data collected from multiple soil sampling events were evaluated in this risk assessment. The COPC identified at RGS include metals, semivolatile, and volatile organic compounds. Five of the six exposure units (Fuel Tank 1, Fuel Tank 2, Fuel Tank 3, Fuel Tank 5 and the 66-kV Switchyard) had detectable concentrations of COPC. A summary of the COPC are presented in Tables 5-1(a, b, c, d and e) along with summary statistics.

Exposure point concentrations used in the risk assessment for reasonable maximum exposures (RME) to soil COPCs are based on the 95th percentile upper confidence limit (UCL) of the arithmetic mean (EPA, 1992b). The purpose for using the 95th percentile UCL instead of the average concentration is to account for the uncertainty associated with estimating the true average concentration at a site. For each COPC the soil matrix data gathered during the field sampling program was compiled. For the purposes of conducting statistical analysis, one-half the reported sample quantitation limit (SQL) was used for samples reported as less than the SQL (EPA, 1989). Only samples with detected concentrations of a given COPC were used in the statistical analysis for that COPC. This procedure will result in exposure point concentrations that overestimate the average contacted soil concentrations for a given area, because the procedure essentially assumes that contact only occurs in areas containing detectable concentrations of COPCs.

For normally distributed data, the 95th percentile UCL was calculated using the following equation (EPA, 1992b; Gilbert 1987):

$$UCL = \mu + t\left(\frac{s}{\sqrt{n}}\right)$$

where:

UCL = 95th percentile upper confidence limit
μ = mean of the data
t = Student-t statistic (from Gilbert, 1987)
s = standard deviation of the data
n = number of samples

A normal approximation to the binomial distribution was used to determine the 95th percentile UCL (Gilbert, 1987). The calculation of the 95th percentile UCL is then based on the size of the sample, the t (Student-t statistic), the mean of the data, and the standard deviation of the data set. The result of the equation is the number of the observation corresponding to the 95th percentile UCL concentration.

5.2 Exposure Assessment

Exposure refers to the potential contact of an individual with a chemical. The exposure assessment identifies the pathways and routes by which an individual may be exposed to the COPC and estimates the magnitude, frequency, and duration of that potential exposure. Human exposure to chemicals is typically evaluated by estimating the amount of a chemical that could come into contact with the lungs, gastrointestinal tract, or skin during a specified period of time. This section describes the assumptions, data, and methods used to evaluate potential exposure in the risk assessment.

5.2.1 Exposure Units

Initially, six exposure units were identified for the present study. The first five exposure units consisted of the Fuel Storage Tanks 1 through 5. The sixth exposure unit consists of the surface and subsurface soils associated with the 66-kV Switchyard Area. Sampling and analysis of the AST Area revealed that the surface and subsurface soils associated with Fuel Storage Tanks 4 had no detectable concentrations of site related COPCs. Therefore, Fuel Storage Tank 4 were eliminated as exposure units for the HHRA. The remaining fuel storage tanks and the 66-kV Switchyard area were evaluated in the HHRA.

exposure factor has a range of possible values. To the extent possible, the risk assessment has selected values for the exposure factors that result in an estimate of the RME scenario (i.e., 95% UCL contaminant concentrations).

In this risk assessment, the exposure factors used to evaluate the on-site worker to COPCs in soil are the default values recommended by the Region IX EPA (EPA, 1998). The exposure factors for the on site visitor are based on Region IX EPA values and professional judgement. The mathematical algorithms used to estimate exposure are presented below.

Incidental Ingestion of Soil

Ingestion intake		=	C*IR*EF*ED*CF/(BW*AT)
Where:	C	=	Constituents concentration in soil, mg/kg
	IR	=	Intake rate (mg/day)
	EF	=	Exposure frequency (day/year)
	ED	=	Exposure duration (years)
	CF	=	Conversion factor (10-6kg/mg)
	BW	=	Body weight (kg)
	AT	=	Averaging time (days)

Dermal Contact with Soil

Dermal Intake		=	C*ABS*SA*AF*EF*ED*CF/(BW*AT)
Where:	C	=	Chemical concentration in soil (mg/kg)
	SA	=	Skin surface area available for contact (cm2)
	ABS	=	Absorption factor (unitless)
	AF	=	Adherence factor (mg/cm2/day)
	EF	=	Exposure frequency (days/year)
	ED	=	Exposure duration (years)
	CF	=	Conversion factor (10-6kg/mg)
	BW	=	Body weight (kg)
	AT	=	Averaging time (days)

Intake from Inhalation Pathway (Soil)

Intake		=	C*PA*IR*EF*ED*ET*CF/(BW*AT)
Where:	C	=	Concentration of constituent in soil (mg/kg)
	PA	=	Particulate concentration in air (0.05 mg/m3)
	IR	=	Inhalation rate (m3/day)
	EF	=	Exposure frequency (days/year)
	ED	=	Exposure duration (years)
	ET	=	Exposure time (hrs/day)
	CF	=	Conversion factor (10-6kg/mg)
	BW	=	Body weight (kg)
	AT	=	Averaging time (days)

5.3 Toxicity Assessment

The toxicity assessment involves identifying the COPC that may cause adverse health effects in exposed individuals. The toxicity assessment consists of two components:

- Hazard Identification—the process of determining what adverse human health effects, if any, could result from exposure to a particular COPC.
- Dose-Response Evaluation—a quantitative examination of the relationship between the level of exposure and the incidence of adverse health effects in an exposed population.

Health effects are divided into two categories: non-cancer and cancer effects. This division is based on the different mechanisms of action associated with each category. Chemicals with non-cancer effects may have cancer effects, too. These chemicals are assessed in both categories.

5.3.1 Noncarcinogenic Effects

For most noncarcinogenic effects, the body's protective mechanisms must be overcome before an adverse effect is manifested. Once these protective mechanisms, or thresholds, have been exceeded, adverse health effects may occur. Noncarcinogenic health effects include a variety of toxicological end points and may include effects on specific organs and systems, such as the kidney, the liver, the nervous system, and the lungs. Organisms may have adaptive mechanisms that must be overcome before a toxic effect can be detected. The systemic toxicity of a chemical is assessed through a review of toxic effects noted in short-term (acute) animal studies, long-term (chronic) animal studies, and epidemiological investigations describing effects on humans.

5.3.2 Carcinogenic Effects

Carcinogenesis is generally thought to be a phenomenon for which risk evaluation based on presumption of a threshold is inappropriate. For carcinogens, it is assumed that a small number of molecular events can evoke changes in a single cell that can eventually lead to cancer. This hypothesized mechanism for carcinogenesis is referred to as "nonthreshold" because there is assumed to be essentially no level of exposure to such a chemical that does not pose a finite probability, however small, of generating a carcinogenic response.

The primary source for cancer slope factors (CSFs) for this investigation was the Office of Environmental Health Hazard Assessment (OEHHA, 1999) database. Toxicity values (reference dose [RfD] and CSFs) are presented in Table 5-7. The secondary source of toxicity values used in this risk assessment is EPA's Integrated Risk Information Systems database (IRIS). The IRIS database contains up-to-date health risk and EPA regulatory information. IRIS contains only those RfD and CSFs that have been verified by EPA work groups and is considered by EPA to be the preferred source of toxicity information. If a toxicity value was not available through IRIS, the next data source used is the most recently available Health Effects Assessment Summary Tables (HEAST) issued by the EPA's Office of Research and Development. HEAST summarizes interim (and some verified) RfDs and CSFs. No toxicity values are available for the dermal route of exposure. For the HHRA, oral toxicity values are used to evaluate risks associated with dermal exposure.

5.3.3 Evaluation of Petroleum Hydrocarbon Contamination

The presence of petroleum hydrocarbons was measured by total petroleum hydrocarbon (TPH) analyses. The TPH analyses differentiate between gasoline (composed predominantly of carbon C4 to C12 hydrocarbons) and diesel (predominantly C10 to C24 hydrocarbons) fractions. The risk from petroleum hydrocarbons is addressed by evaluating the individual constituents of greatest toxicological concern. For a gasoline mixture, these would include benzene, toluene, ethyl benzene, and xylenes (BTEX), as well as polycyclic aromatic hydrocarbons (PAHs), such as benzo[a]pyrene. For diesel mixtures, only PAHs would be of concern. TPHs presently have no published health criteria (i.e., cancer slope factors or RfDs). Consequently, no potential risk or hazards to human health was quantitatively estimated for TPH data.

5.4 Risk Characterization

Information presented in the exposure assessment and the toxicity assessment is integrated in this section to characterize risk to human health from COPCs at the RGS. This section summarizes the risk estimates (i.e., Hazard Indices [HIs]) for noncarcinogenic COPCs and Excess Lifetime Cancer Risk [ELCR] for carcinogenic COPCs.

ELCR were estimated for carcinogenic chemicals having CSFs. Cancer risks for each COPC were calculated as the product of intake for the chemical (mg/kg-day) and the CSF for that chemical (mg/kg-day). Based on the EPA risk assessment guidelines for carcinogens, cancer risks from exposure to multiple carcinogens via multiple exposure routes were assumed to be additive. Therefore, estimated ELCR for all carcinogens and exposure routes were summed to yield a single estimated cancer risk. The *de minimis* cancer risk is considered to be 1×10^{-6} or one-in-one-million (EPA, 1989)

Risk = Intake x Slope Factor

Non-cancer risks were estimated by comparing the intake for each noncarcinogenic COPC for each exposure route to its reference dose (RfD). The ratio of the intake to the RfD is defined as the Hazard Quotient (HQ). The HQs for the COPCs were combined to estimate the Hazard Index (HI) for each exposure scenario. HIs for the three exposure routes were combined to give an overall HI for both exposure scenarios. When the HI exceeds one, it is a numerical indicator of the transition between acceptable and unacceptable exposure levels, and there might be concern for potential adverse health effects (EPA 1989). Any single chemical with an estimated daily intake greater than the corresponding reference dose will cause the HI to exceed one.

HQ = Intake/RfD

5.4.1 Risk Characterization Results

The risk characterization results for the on-site worker and site visitor scenarios are presented in the following table. Detailed risk calculations by chemical are presented in Tables 5-8 (a, b, c, d, and e) and 5-9 (a, b, c, and d).

The results of the risk assessment indicate that the excess lifetime cancer risk (ELCR) is estimated to be within the EPA risk management range of 10^{-4} to 10^{-6} (EPA, 1989) for all receptors. Each of the chemical contributors to the non-cancer hazard gave a combined hazard index of less than 1.0 which is less than the de minimis hazard index of 1.0 established by US EPA (EPA, 1989) for all receptors.

Excess Lifetime Cancer Risk and Non-cancer Hazard Indices by Receptor

Exposure Unit	Cancer Risk		Hazard Index	
	Worker	Visitor	Worker	Visitor
Tank 1	6.3×10^{-6}	9.8×10^{-7}	<0.1	<0.1
Tank 2	1.2×10^{-6}	2.2×10^{-7}	<0.1	<0.1
Tank 3	NA	NA	<0.1	<0.1
Tank 5	0.0	0.0	<0.1	<0.1
Switchyard	7.3×10^{-7}	1.2×10^{-7}	<0.1	<0.1

5.5 Conclusions

A risk assessment was performed for the specified set of receptors at the RGS. Standard risk analysis procedures and professional judgement were used in the risk assessment. The COPCs were metals, volatile, and semivolatile organic compounds in soil. The potential routes of exposure to human receptors included: ingestion of soil, dermal contact with soil, and inhalation of dust in ambient air.

The cancer and non-cancer risks estimates were calculated for the indicated exposure scenarios using conservative point estimates as described in the exposure assessment. Cancer and non-cancer risks were summed for the total exposure periods for receptors. The ELCR ranged from 10^{-6} to 10^{-7} with all receptors having "point estimate" risks less than the 10^{-5} cancer risk threshold. Non-cancer HQ were added to yield a total HI for the total exposure periods for receptors. The HI for adult exposures were all less than the de minimis non-cancer threshold of 1.0 for all receptors. The risk driver for the site was benzo(a)anthracene which yielded ELCR of 4.7×10^{-6} for the on-site visitor at Fuel Tank 1.

Therefore, assuming that the soil concentrations are at their measured values at the indicated receptors, it is unlikely that adverse cancer and non-cancer health effects would be predicted to occur to populations within the study area for the indicated exposure scenarios.

For this risk assessment, it is assumed that the current site layout would remain unchanged. However, AES has indicated that, for the AST Area, more than 10 feet of imported clean fill would be placed. This would significantly reduce the exposure. Thus it is likely that this risk assessment overestimates the actual future risk. This reinforces the conclusion of no significant risk.

5.6 Uncertainty Analysis

Simplifying assumptions were made to estimate the risks for the RGS sites. Uncertainties in this risk evaluation (and risk assessment in general) are due to uncertainties in the methodologies used to estimate risks, uncertainties in characterizing the site, and uncertainties describing exposure.

The estimates of risk presented above are subject to uncertainty from a variety of sources including:

- Sampling, analysis, and data evaluation
- Fate and transport estimation
- Exposure estimation
- Toxicological data
- Risk estimation methods

Uncertainty associated with sampling and analysis include the inherent variability (standard error) in the analysis, representativeness of the samples, sampling errors, and heterogeneity of the sample matrix. The quality assurance/quality control program used in the investigation serves to reduce these errors; it cannot eliminate all errors associated with sampling and analysis. The degree to which sample collection and analyses reflect real exposure point concentrations will determine the reliability of the resulting risk estimates.

This risk assessment makes simplifying assumptions about the environmental fate and transport of the COPCs, specifically, that no chemical loss or transformation has occurred over time. This assessment also assumes that the chemical concentrations detected in soil remain constant during the assessed exposure duration.

Risk estimation required numerous assumptions to describe potential exposure situations. Several uncertainties exist regarding likelihood of exposure, frequency of contact with contaminated soil, the concentration of chemicals at exposure points, and the time period of exposure. Assumptions used in this risk assessment tend to simplify and approximate actual site conditions.

The toxicological database is also a source of uncertainty. These uncertainties include extrapolation from high to low dose and from animals to humans; species, gender, age, and strain differences in uptake, metabolism, organ distribution, and target site susceptibility; and human population variability with respect to diet, environment, activity patterns, and cultural factors.

6. Remediation Cost Analysis

This section presents a range of estimated costs for remediation of petroleum hydrocarbon impacted soil within the EPTC AST Area. A remediation cost analysis, using non-risk based cleanup criteria, was performed to provide SCE and AES with a range of costs to remediate impacted soil located within the AST Area. The risk assessment performed for the EPTC AST Area, detailed in Section 5 of this report, revealed a less than 10^{-6} carcinogenic risk and less than 1.0 non-carcinogenic HQ associated with PAHs in soil at the AST Area. Therefore risk-based cleanup goals were not warranted for the EPTC AST Area.

There is no EPA guidance or exposure using factors for evaluating the risk's associated with TPH-impacted soil. Although an acceptable risk associated with the PAH-impacted soil was calculated in the risk assessment, cost estimates were generated based on TPH cleanup criteria previously used by regulatory and city agencies in the Los Angeles region. URSGWC and CH2MHILL have considered this non-risk based cleanup levels because the LARWQCB has implemented cleanup goals for TPH-impacted soil similar to those considered in this evaluation.

The following sub-sections present the methodology used, estimated volume of impacted soil, remedial alternative selection, implementation, limitation and assumptions and cost estimate associated with the remediation of impacted soil within the AST Area. The 66-kV Switchyard was not considered in this remedial cost estimate based on the findings of the Additional Phase II Investigation completed in August 1999 and detailed in Sections 3 and 4.

6.1 Methodology

The remedial cost estimate was completed in the following steps; (1) evaluation of potential petroleum hydrocarbon cleanup levels that the LARWQCB may recommend for the AST Area based on current land use, contaminant characteristics, and response actions at similar sites, (2) development of isoconcentration contours depicting the lateral extent of TPH impacted soil for both diesel and motor oil ranges, (3) calculation of estimated volumes of impacted soil based on sampling depths and depth to groundwater, (4) evaluation of potential remedial alternatives based on nature of contamination, feasibility, and schedule, (5) selection of a presumptive remedial alternative, and (6) calculation of potential remedial costs associated with potential likely remedial scenarios.

6.2 Selection of Potential Cleanup Criteria

Potential cleanup criteria for petroleum-hydrocarbon impacted soil were evaluated for the AST Area. For this evaluation, CH2M HILL and URSGWC used LARWQCB, Los Angeles Fire Department (LAFD), and Port of Los Angeles precedence, professional judgement, and experience in similar projects in the region to select conservative non-risk based cleanup levels.

URSGWC and CH2MHILL selected 100 mg/kg and 1,000 mg/kg TPH in the carbon chain range C10-C24 and 1,000 mg/kg and 10,000 mg/kg TPH in the carbon chain range C25-C40 as potential cleanup criteria for the AST Area. LARWQCB and LAFD have used 100 mg/kg and 1,000 mg/kg in the past as a cleanup level for diesel-range hydrocarbons (C10-C24). LARWQCB and LAFD have used 1,000 mg/kg and 10,000 mg/kg are levels in the past as a cleanup level for heavier oil-range hydrocarbons (C25-C40).

6.3 Estimated Volume of Impacted Soil

Isoconcentration contours of approximate lateral extent of TPH-impacted soils above 100, 1,000, and 10,000 mg/kg for carbon chain ranges C10-C24 and C25-C40 were created for depths 0-2 foot bgs, 2-4 feet bgs, and 4-6 feet bgs (Figures 4-1 through 4-6). The isoconcentration contours shown were used to estimate the volumes of impacted soil above 100 mg/kg and 1,000 mg/kg for diesel range hydrocarbons (C10-C24) and above 1,000 mg/kg and 10,000 mg/kg for heavier oil-range hydrocarbons (C25-C40), respectively.

The impacted soil volumes were estimated using previous soil boring data within each of the basins (See Sections 2 and 4). For purposes of estimation, the results of soil samples collected beneath the Tank 2 bottom have been interpolated to represent the conditions beneath Tanks 1, 3 and 4. Isoconcentration contours depicting the extent of petroleum hydrocarbons have used the assumption that conditions beneath Tank 2 are representative of conditions beneath Tanks 1, 3, and 4. Actual conditions beneath Tanks 1, 3 and 4 may vary and must be evaluated upon decommissioning of each tank.

Volume estimates were calculated under two scenarios (1) removal of all impacted hydrocarbons above potential cleanup criteria from 0-6 feet bgs within the respective tank basins, and (2) an alternate calculation involving the removal of impacted soil above potential cleanup criteria from 0-4 feet bgs within Tanks 1 through 4 basins, and from 0 to 9 feet bgs within the Tank 5 basin. The alternate volume calculation is based on the expected depth to groundwater, observed at approximately 4 feet bgs in the Tanks 1 through 4 basins and approximately 9 feet bgs in the Tank 5 basin. Volume estimates for TPH carbon chain range C10-C24 impacted soil above 100 mg/kg and 1,000 mg/kg and for TPH carbon chain range C25-C40 impacted soil above 1,000 mg/kg and 10,000 mg/kg are presented in Tables 6-1 through 6-4.

A summary of the impacted soil volume based on the potential cleanup criteria scenarios for TPH-diesel and motor oil is as follows.

Impacted Soil Volume (Yd^3) [1]					
Potential Cleanup Criteria	**Tank 1**	**Tank 2**	**Tank 3**	**Tank 4**	**Tank 5**
≥ 100 mg/kg C10-C24 (0-6 feet bgs)	360	310	560	0	12,120
≥ 100 mg/kg C10-C24 (Alternate)	0	310	560	0	17,938
≥ 1,000 mg/kg C10-C24 (0-6 feet bgs)	90	0	230	0	11,250
≥ 1,000 mg/kg C10-C24 (Alternate)	90	0	230	0	16,880
≥ 1,000 mg/kg C25-C40 (0-6 feet bgs)	560	980	850	0	11,250
≥ 1,000 mg/kg C25-C40 (Alternate)	560	470	850	0	16,880

Impacted Soil Volume (Yd^3) [1]					
Potential Cleanup Criteria	**Tank 1**	**Tank 2**	**Tank 3**	**Tank 4**	**Tank 5**
≥ 10,000 mg/kg C25-C40 (0-6 feet bgs)	30	0	0	0	7,350
≥ 10,000 mg/kg C25-C40 (Alternate)	30	0	0	0	9,148

Note:
(1) The volume estimates are preliminary and may change during revision to this draft

6.4 Remedial Alternative Selection

For this preliminary remediation cost estimate, soil excavation and offsite disposal/recycle alternative was evaluated. Excavation and offsite disposal/recycle is considered a presumptive remedial alternative for mitigation of petroleum hydrocarbon-impacted soil located at the EPTC AST Area. Other ex-situ remedial alternatives such as aboveground bioremediation, and in-situ remedial alternatives such as bioremediation and bioventing were not considered due to time constraints.

Excavation and offsite disposal/recycle of impacted soil was selected because (1) it is an effective technique in reducing the mass and toxicity of impacted soil, (2) technically feasible to meet remedial action objectives, (3) remedial action objectives may be met in a shorter time period than other alternatives, (4) regulatory agency and community acceptance is usually high, and (5) costs and duration of the excavation and offsite disposal/recycle alternative may be estimated with a higher probability than other ex-situ and in-situ alternatives considered.

6.5 Implementation

Excavation and offsite disposal/recycle of impacted soil can be implemented with common construction equipment, and occur relatively quickly (following mobilization). Offsite disposal is favorable in terms of ability to obtain services, ease of operation and maintenance, ability to monitor system performance, equipment reliability, effects on adjoining property, and ease of permitting.

The proposed excavation and offsite disposal of impacted soil would be completed in the following steps:

- Development of a remedial action workplan for implementation
- Agency review and approval of workplan
- Bid preparation and contractor procurement
- Demolition of existing tanks (concurrent or separate)
- Mobilization of excavation subcontractor
- Excavation of impacted soil
- Transport of impacted soil to soil recycling facility
- Post excavation confirmatory samples

- Backfill and compaction of excavation area
- Final restoration/grading (for future land uses)
- Development of a remedial action closure report
- Agency review and issue letter of closure

6.6 Limitations/Assumptions

Several assumptions and limitations were made during the preparation of this remediation cost range for the EPTC AST Area. Assumptions made during the development of the cost estimate included:

- The decommissioning and removal of the tank structures including foundations and associated piping will be completed prior to remediation activities. Therefore, the remediation cost does not reflect any associated cost for demolition and disposal/recycle of the tanks.
- The remedial alternative presented in this section addresses soil only. Potential costs associated with groundwater monitoring and/or remediation have been omitted from consideration in this cost estimate.
- No suitable overburden will be removed and segregated prior to excavating areas where impacted soil above potential cleanup criteria was observed at depth (i.e. 2-4 ft bgs or 4-6 ft bgs).
- Volume of impacted soil was based on a level ground surface, and depth below ground surface. The bermed areas were not considered in the estimation of soil volumes. The actual volume of soil to be moved/removed may change based on the need to move/remove the berms. Where impacted soil isoconcentration contours extended to the berms, the impacted soil was considered to be from ground surface and deeper. The berms, typically elevated above the tank basin floors, were not considered to be impacted.
- Based on TPH results of samples collected on the perimeter of Tank 4, no soil excavation will be necessary within the Tank 4 basin.
- No sheeting or shoring will be needed to complete the removal of impacted soil to a maximum depth of 9 feet bgs. A 1:1 sidewall slope will be utilized for all excavations to 9 feet bgs, and no sloping of sidewalls will be needed for excavations extending to 4 feet bgs.
- The cleanup criteria used in estimating volumes of soil were based on TPH. The values chosen for this remediation cost estimate are consistent with TPH cleanup levels requested by regulatory agencies for the Los Angeles region.
- Dewatering, if necessary, may be accomplished with the existing dewatering wells located within the AST area. Additional dewatering wells to lower the water table have not been included in this cost estimate.
- Imported backfill estimates were based on restoration of the site to current ground surface elevations and not the amounts of backfill, which may be necessary for future land use scenarios. A 25 percent bulking factor was applied to all volumes of soil that would need to be imported. The placement, compaction and testing of imported backfill are included in the remediation cost estimate.

6.7 Cost

Potential remediation costs were generated based on four scenarios (1) excavation and removal of impacted soil above 100 mg/kg TPH range C10-C24, (2) excavation and removal of impacted soil above 1,000 mg/kg TPH range C10-C24, (3) excavation and removal of impacted soil above 1,000 mg/kg TPH range C25-C40, and (4) excavation and removal of impacted soil above 10,000 mg/kg TPH range C24-C40. The range of costs provided for each scenario represents the two alternatives; (1) removal of all impacted hydrocarbons above potential cleanup criteria from 0-6 feet bgs within the respective tank basins, and (2) an alternate calculation involving the removal of impacted soil above potential cleanup criteria from 0-4 feet bgs within Tanks 1 through 4 basins, and from 0 to 9 feet bgs within the Tank 5 basin.

Breakdowns of costs associated with the remedial cost estimates are included in Tables 6-5 through 6-8. The cost estimates included implementation, mobilization, miscellaneous, and management oversight costs. A ten percent contingency was added to the direct cost for remediation of the impacted soil.

The following table summarizes the preliminary cost estimates:

Remediation Scenario	Table	Cost Range[1]
100 mg/kg TPH C10-C24	6-5	$ 1,600,000 to 2,160,000
1,000 mg/kg TPH C10-C24	6-6	$ 1,410,000 to 1,980,000
1,000 mg/kg TPH C25-C40	6-7	$ 1,660,000 to 2,190,000
10,000 mg/kg TPH C25-C40	6-8	$ 940,000 to 1,130,000

Note:
(1) Cost range represents the 0-6 feet bgs and alternate volume calculation costs. Costs rounded to the nearest ten thousand dollars.

The cost range presented in this section are based on 100 mg/kg, 1,000 mg/kg and 10,000 mg/kg TPH cleanup levels for diesel and heavier oil hydrocarbons. These levels are provided for discussion purposes and have been used by regulatory agencies in the Los Angeles region with oversight over petroleum hydrocarbon impacted soil. They are not risk-based.

Cleanup criteria for the site will need to be negotiated with the lead agency (considered likely to be LARWQCB). Following implementation of a remedial alternative, site closure will also need to be negotiated with the lead agency before redevelopment of the AST Area may commence.

7. Conclusion

CH2M HILL and URSGWC conducted an Additional Phase II Investigation of the AST Area and the 66 kV-Switchyard. The investigation was designed to (1) assess COPCs within the tank basins and 66 kV-Switchyard, (2) delineate the extent of impacted soil that may require remediation under the current industrial land use, and (3) develop a remediation cost estimate to mitigate impacted soil to levels consistent with regulatory agency criteria. In addition selected locations within the AST Area and the 66-kV Switchyard were resampled because previous analytical results for TPH-extractable and VOC analyses were rejected due to the laboratory QA/QC did not meet the project quality control objectives.

A human health risk assessment was conducted based on the results of the Additional Phase II Investigation and resampling. The risk assessment focused on the following exposure pathways: (1) soil ingestion, (2) inhalation of soil particulates, and (3) dermal contact. The risk assessment assumes commercial/industrial land use. Also the risk assessment calculations assume that the AST Area configuration will not change. However, AES has indicated it is likely that more than 10 feet of imported fill will be placed over the AST area to eliminate the need for dewatering. This would significantly reduce the potential exposure to impacted soil. Thus, the risk assessment likely overestimates the health risk posed by the existing soil contamination. Nevertheless, the risk assessment indicates that the site contamination does not pose a significant health risk (carcinogenic and noncarcinogenic); and, risk-based cleanup levels are not warranted.

Cleanup criteria and cleanup precedence used by the LARWQCB and LAFD for commercial/industrial sites within the Los Angeles region were used to estimate the volume of TPH-impacted soil that may need to be remediated. Cleanup criteria used for this report included 100 to 1,000 mg/kg for TPH-diesel-range and 1,000 mg/kg to 10,000 mg/kg for TPH-motor oil.

Based on the results of the Additional Phase II Investigation, the following conclusions are made:

- COPCs were limited to volatile and semivolatile organic compounds, and metals
- Carcinogenic and noncarcinogenic risks did not exceed acceptable levels
- The preliminary estimated costs to remove TPH-impacted soil ranged from $0.9 to $2.2 million, assuming excavation, disposal at a recycling facility, and placement of imported clean fill.

8. References

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Tables

Section 2.0 Tables

Table 2-1
Summary of Previous Investigations
AST Area and 66-kV Switchyard
Redondo Generating Station
Redondo Beach, California

AREA OF CONCERN	SOURCE-DATE	SAMPLE TYPE	ANALYSES PERFORMED	FINDINGS
FUEL OIL STORAGE TANK NO. 1 & CUTTER TANK	SOIL			
	SCE - 1991	Approximately 10 borings and two test pits were advanced	TPH by EPA Method 8015M	Detectable concentrations observed in composite samples collected (Range from 5,000 mg/kg in a composite sample taken at 2 feet bgs to 7,400 mg/kg in a composite sample taken at 6 inches bgs). Carbon range C5 through C15 were not detected in either composite sample analyzed.
	SCE -1997	Borings 1-1 through 1-9, Trenches TR-1 through TR-5. One composited boring and one composited trench sample collected.	Borings & trenches for TRPH. Composites run for TPH - CC, BTEX, Title 22 Metals, PCBs, Reactive Cyanide, Ignitability, and pH [1]	Detectable concentrations (Range from 18 to 10,300 mg/kg [2] in 1-3 @0.5' bgs[3]). Five sample locations exceeded 1,000 mg/kg TRPH (1-3 @ 0.5' bgs, 1-6 @ 0.5' bgs,1-8 @ 0.5' bgs, 1-6 @ 2' bgs, and 1-7 @ 2' bgs) . CC analysis of 10,300 mg/kg sample (C13-C22 = 3,593 mg/kg, C23-C32 = 5,520 mg/kg, >32C = 938 mg/kg). BTEX and PCBs were not detected in composite samples analyzed for these constituents.
	CH2M - June 1997	RBH01, RBH02, RBH58 (TANK 1), RBH15, RBH16 (Displacement Oil Tank)	TPH-d [4]	Detectable concentrations (up to 6,800 mg/kg in RBH02 @ 4' bgs)
	GROUNDWATER			
	CH2M - June 1997	RBH01, RBH15	TPH-d, VOCs (RBH01 only)	RBH01 below detection limits. De minimus concentrations of TPH-d detected in RBH15 (2.1 mg/L C10-C24, 0.63 mg/L C25-C40)

Table 2-1
Summary of Previous Investigations
AST Area and 66-kV Switchyard
Redondo Generating Station
Redondo Beach, California

AREA OF CONCERN	SOURCE-DATE	SAMPLE TYPE	ANALYSES PERFORMED	FINDINGS
FUEL OIL STORAGE TANK NO. 2	SOIL			
	SCE -1997	Borings 2-1 through 2-13, Trenches TR-1 through TR-6, One composited boring and trench sample collected.	Borings & trenches for TRPH. Composites run for TPH - CC, BTEX, Title 22 Metals, PCBs, Reactive Cyanide, Ignitability, and pH	Detectable concentrations (Range from 12 to 7,600 mg/kg in 2-1 @4.5' bgs). Thirteen sample locations exceeding 1,000 mg/kg TRPH (2-2 @0.5' bgs, 2-9 @ 0.5' bgs, 2-10 @ 0.5'bgs, TR-1 @ 0.5' bgs, TR-2 @ 0.5' bgs, TR-3 @ 0.5' bgs, TR-4 @ 0.5' bgs, 2-9 @ 2' bgs, 2-10 @ 2' bgs, 2-11 @ 2' bgs, 2-12 @ 2' bgs, 2-1 @ 4.5' bgs, and 2-2 @ 4.5' bgs) BTEX and PCBs were not detected in composite samples analyzed for these constituents. PCBs detection limit ranged from 33 mg/kg to 66 mg/kg, above PRGs for PCBs.
	CH2M - June 1997	RBH03, RBH04, RBH05, and RBH59	TPH-d	Limited investigation due to restricted access. Corrosion protection oil and some localized spill locations. De minimus concentrations of TPH-d ranging from non detect to 2,900 mg/kg in RBH59 @1.5' bgs.
	GROUNDWATER			
	CH2M - June 1997	RBH04	TPH-d	TPH concentrations below reporting limits of 0.5 mg/L.
FUEL OIL STORAGE TANK NO. 3	SOIL			
	SCE -1997	Borings 3-1 through 3-9, Trenches TR-1 through TR-4. One composited boring and trench sample collected.	Borings & trenches TRPH. Composites run for TPH - CC, BTEX, Title 22 Metals, PCBs, Reactive Cyanide, Ignitability, and pH	Detectable concentrations (Range from 7 to 3,200 mg/kg in 3-6 @0.5' bgs). Three sample locations exceeded 1,000 mg/kg TRPH (3-5 @0.5' bgs, 3-6 @0.5' bgs, and 3-2 @2.5' bgs). Boring composite (C4-C12 = 1,040 mg/kg, C13-C22 = 3,492 mg/kg, C23-C32 = 5,556 mg/kg). Composite samples analyzed for BTEX and PCBs indicated non detects.

Table 2-1
Summary of Previous Investigations
AST Area and 66-kV Switchyard
Redondo Generating Station
Redondo Beach, California

AREA OF CONCERN	SOURCE-DATE	SAMPLE TYPE	ANALYSES PERFORMED	FINDINGS
	CH2M - June 1997	RBH06, RBH08 & RBH60	TPH-d	Limited investigation due to restricted access. Corrosion protection oil and some localized spill locations. De minimus concentrations of TPH-d (up to 3,500 mg/kg in RBH 06 @ 0.5' bgs).
	GROUNDWATER			
	CH2M - June 1997	RBHO7	TPH-d	De minimus concentrations, 0.5 mg/L for C25-C40.
FUEL OIL STORAGE TANK NO. 4	SOIL			
	SCE -1997	Borings 4-1 through 4-9, Trenches TR-1 through TR-6, One composited boring and trench sample collected.	Borings & trenches TRPH. Composites run for TPH - CC, BTEX, Title 22 Metals, PCBs, Reactive Cyanide, Ignitability, and pH	Detectable concentrations (Range from 9 to 542 mg/kg in 4-7 @4.5' bgs). No sample locations exceeded 1,000 mg/kg TRPH. Composite samples analyzed for BTEX and PCBs indicated non detects.
	CH2M - June 1997	RBH09, RBH10, RBH11, and RBH61	TPH-d	De minimus concentrations ranging from 5.4 mg/kg to 25 mg/kg in RBH11 @ 5.5' bgs.
	GROUNDWATER			
	CH2M - June 1997	None		

Table 2-1
Summary of Previous Investigations
AST Area and 66-kV Switchyard
Redondo Generating Station
Redondo Beach, California

AREA OF CONCERN	SOURCE-DATE	SAMPLE TYPE	ANALYSES PERFORMED	FINDINGS
FUEL OIL STORAGE TANK NO. 5	SOIL			
	SCE - May 1997	Borings 5-1 through 5-9, Trenches TR-1 through TR-6. One composited boring and trench sample collected.	Borings & trenches for TRPH. Composites run for TPH - CC, BTEX, Title 22 Metals, PCBs, Reactive Cyanide, Ignitability, and pH	Detectable concentrations (Range from 10 to 284 mg/kg in the borings, and 9 to 582,000 mg/kg in TR-1 @4.5' bgs). No sample locations exceeded 1,000 mg/kg TRPH were observed in the borings. Six trench sample locations exceeded 100,000 mg/kg were observed (TR-1 @ 2 and 4.5' bgs, TR-2 @ 0.5' and 2.0' bgs, TR-3 @0.5' bgs, and TR-6 @0.5' bgs). Four trench sample locations exceeded 10,000 mg/kg were observed (TR-1 @ 0.5' bgs, TR-3 @ 2' and 4.5' bgs, and TR-4 @ 0.5' bgs). Five trench sample locations exceeded 1,000 mg/kg were observed (TR-2 @ 4.5' bgs, TR-4 @ 2.0' bgs, TR-5 @ 0.5' and 2' bgs, and TR-6 @ 4' bgs). Composite samples analyzed for BTEX and PCBs indicated non detects.
	CH2M - June 1997	RBH12, RBH13, RBH14	TPH-d	De minimus concentrations of TPH-d ranging from not detected to 9.7 mg/kg @ 5' bgs.
	CH2M - April 1998	December 1997 - B-1 through B-8 below tank. One composite sample collected.	TPH-CC, Composites run for TPH-d, TPH-g, PCBs, BTEX, Title 22 Metals, Reactive Cyanide, Ignitability and pH.	Detectable concentrations of TRPH in all borings. Highest recovery of TRPH observed in B-1 (27,700 mg/kg @ 6" bgs, 20,300 mg/kg @2' bgs, and 10,500 mg/kg @ 5' bgs. Composite observed TPH-d concentrations of 21,500 mg/'kg, non detect for TPH-g, BTEX, PCBs, and Reactive Cyanide.
		March 1998 - BX-9 through BX-22, Composites taken from each boring	TPH-CC	Detected concentrations of TPH in BX-9 (26,500 mg/kg @0.5' bgs, 43,900 mg/kg @2' bgs, 49,800 mg/kg @5' bgs and 7,590 mg/kg @ 10' bgs). Other borings (BX-10-12) similar in magnitude.

Table 2-1
Summary of Previous Investigations
AST Area and 66-kV Switchyard
Redondo Generating Station
Redondo Beach, California

AREA OF CONCERN	SOURCE-DATE	SAMPLE TYPE	ANALYSES PERFORMED	FINDINGS
	GROUNDWATER			
	CH2M - June 1997	RBH13	TPH-d	De minimus concentrations (3.1 mg/L).
	CH2M - April 1998	BX-11, BX-21	TPH	De minimus concentrations (40 mg/L in BX-11)
66-kV SWITCHYARD	**SOIL**			
	CH2M - June 1997	RBH19, RBH20, RBH21 RBH43, RBH44, and RBH 45	RBH19-21 for TPH-d, PCBs, and Metals. RBH43-45 for TPH-d, and PCBs.	De minimus concentrations of TPH ranging from 10 mg/kg to 83 mg/kg in RBH4 @ 1' bgs, non detect for PCBs in all samples.
	GROUNDWATER			
	CH2M - June 1997	RBH20, RBH21	TPH-d, PCBs, Title 22 Metals	De minimus concentrations of metals detected in samples. PCBs and TPH-d were not detected.

Notes:

1. TRPH - Total Recoverable Petroleum Hydrocarbons
   TPH-CC - Total Petroleum Hydrocarbons Carbon Chain Distribution Analysis
   BTEX - Benzene, Toluene, Ethylbenzene, and Total Xylenes
   Title 22 Metals - 17 regulated metals
   PCBs - Polychlorinated Biphenyls
2. mg/kg - milligrams per kilogram
3. bgs -below ground surface
4. TPH-d - Total Petroleum Hydrocarbons diesel range (C10-C24 and C25-C40)

Appendix A
Boring Logs

Boring Logs
Fuel Tank 1

Project: EPTC TANK FARM Project Location: Redondo Beach Project Number:	**Log of Boring** RGS01-01 Sheet 1 of 1

Date(s) Drilled	8/16/99	Logged By	B. Clancy	Checked By	
Drilling Method	NA	Drill Bit Size/Type		Approx. Surface Elevation (feet)	
Drill Rig Type	"	Drilled By	ENVIRONMENTAL Support Tech (EST)	Total Depth Drilled (feet)	
Groundwater Level (feet, bgs)	First 3.5 Completion: 24 Hours	Number of Samples	Disturbed: Undisturbed:	Sampler Type	
Diameter of Hole (inches)	Diameter of Well (inches)	Type of Well Casing		Screen Perforation	
Type of Sand Pack		Type/Thickness of Seal(s)			
Comments					

Depth, feet	SAMPLES Type	Number	Blows/foot	Graphic Log	MATERIAL DESCRIPTION		DVA (ppm) Headspace	Background	Drilling Rate (time)	REMARKS
0								0	0315	
	☒				Moist, Brown CG Sand w/ Pebbles + Rocks intermittent		3.9			Sample RGS01-01-1
	☒				Becomes more concrete with depth					
					▽ GW @ 3.5' bgs					RGS01-01-3
5					Continued Boring to TD = 5'					
					Set Wellpoint 1" Slotted PVC		1.7			GW Vials collected 1-1L Amber RGS01-.
										Duplicate GW Sample RGS01-01 (VOA Vials) 1-1L Amber
10										
15										
20										
25										
30										

Woodward-Clyde Consultants

Figure ____

Project: EDTC RGS
Project Location: Redondo Beach
Project Number: 995B018

Log of Boring RGS01-02

Sheet 1 of ___

Date(s) Drilled: 8/16/97	Logged By: B. Clancy	Checked By:
Drilling Method: HAND AUGER	Drill Bit Size/Type: —	Approx. Surface Elevation (feet):
Drill Rig Type: " "	Drilled By: EST	Total Depth Drilled (feet): 3'
Groundwater Level (feet, bgs): First 3' Completion 24 Hours	Number of Samples: Disturbed: Undisturbed: 2	Sampler Type:
Diameter of Hole (inches): Diameter of Well (inches):	Type of Well Casing:	Screen Perforation:
Type of Sand Pack:	Type/Thickness of Seal(s): Bentonite Chip	
Comments:		

Depth, feet	SAMPLES Type	SAMPLES Number	SAMPLES Blows/foot	Graphic Log	MATERIAL DESCRIPTION	OVA (ppm) Headspace	OVA (ppm) Background	Drilling Rate (time)	REMARKS
0	☒				Moist, Brown, CG Sand w/ Gravel	0.4	0.3		RGS01-02-01.5
	☒				GW @ 8' bgs	2.0			RGS01-02-2.5
5					HAND AUGER TO 3'				No Water Collected
					END of BORING @ 3'				
10									
15									
20									

Boring Logs
Fuel Tank 3

Project: EPTC REDONDO
Project Location: REDONDO BEACH
Project Number: 95B018

Log of Boring RBH03-01

Sheet 1 of 1

Date(s) Drilled: 8/17/99	Logged By		Checked By
Drilling Method	Drill Bit Size/Type		Approx. Surface Elevation (feet)
Drill Rig Type	Drilled By		Total Depth Drilled (feet)
Groundwater Level (feet, bgs): First	Completion	24 Hours	Number of Samples: Disturbed: Undisturbed:	Sampler Type
Diameter of Hole (inches)	Diameter of Well (inches)	Type of Well Casing	Screen Perforation
Type of Sand Pack		Type/Thickness of Seal(s)	
Comments			

Depth, feet	SAMPLES Type	SAMPLES Number	Blows/foot	Graphic Log	MATERIAL DESCRIPTION	OVA (ppm) Headspace	OVA (ppm) Background	Drilling Rate (time)	REMARKS
0	☒				DRY, BROWN, CG SAND - POORLY SORTED W/ TAN GRAVEL	9.0		0955	RGS03-01-01
	☒				BECOMES MOIST W/DEPTH @ 3'			1005	RGS03-01-2.5
5					HAND AUGERED TO ~6' TD = 6' INSERTED 1" SLOTTED PVC FOR COLLECTION OF H_2O SAMPLE			1015	COLLECTED H_2O SAMPLES 6 VOA 1-LITER AMBER RGS03-01 *DUPLICATE COLLECTED RGS00-02 TIME 07 30 *
10									
15									
20									

Project: EPTC Redondo
Project Location: Redondo Beach CA
Project Number: 9958018

Log of Boring RGS03-02

Sheet 1 of 1

Date(s) Drilled	8/17/99	Logged By	B. Clancy	Checked By	
Drilling Method	Hand Auger	Drill Bit Size/Type	—	Approx. Surface Elevation (feet)	—
Drill Rig Type	" "	Drilled By	EST	Total Depth Drilled (feet)	
Groundwater Level (feet, bgs)	First 3.5' Completion 24 Hours	Number of Samples	Disturbed: Undisturbed: 2	Sampler Type	
Diameter of Hole (inches)	Diameter of Well (inches)	Type of Well Casing		Screen Perforation	0.020"
Type of Sand Pack		Type/Thickness of Seal(s)	Bentonite Chip - Hydrated Upon Placement		
Comments	See Figure				

Depth, feet	SAMPLES Type	Number	Blows/foot	Graphic Log	MATERIAL DESCRIPTION	OVA (ppm) Headspace	Background	Drilling Rate (time)	REMARKS
0					0-6" GRAVEL + DRY, BROWN CG SAND				
					MOIST, GRAY TO BLACK, CG SAND SP	2.9	0.2	1040	RGS03-02-01
					▽ GW ENCOUNTERED @ 3.5' — BECOMES WET				
						3.8	0.2	1045	RGS03-02-3
5					TOTAL DEPTH = 6'			1050	RGS03-02-3.5 - NOT COLLECTED BELOW GW
					INSTALLED SLOTTED 1" PVC FOR H_2O SAMPLE			1105	COLLECTED H_2O SAMPLES - RGS03-02 6-VOA 1-1 LITER AMBER *UNPRESERVED VOA VIAL USED*
10									
15									

Boring Logs
Fuel Tank 2

Project: EDTC RGS
Project Location: Berkeley Blvd.
Project Number: 995B019

Log of Boring RGS02-01

Sheet 1 of 1

Date(s) Drilled	8/16/94	Logged By	BClancy	Checked By	
Drilling Method	Hand Auger	Drill Bit Size/Type	—	Approx. Surface Elevation (feet)	—
Drill Rig Type	" "	Drilled By	EST	Total Depth Drilled (feet)	9.5'
Groundwater Level (feet, bgs)	First 4' Completion — 24 Hours —	Number of Samples	Disturbed: — Undisturbed: 2	Sampler Type	[redacted] PERISTALTIC PUMP
Diameter of Hole (inches)	2"	Diameter of Well (inches)	—	Type of Well Casing	—	Screen Perforation	0.020"
Type of Sand Pack	—	Type/Thickness of Seal(s)	BENTONITE CHIP - HYDRATED ON PLACEMENT		
Comments	SEE FIGURE FOR LOCATION				

Depth, feet	SAMPLES Type	SAMPLES Number	SAMPLES Blows/foot	Graphic Log	MATERIAL DESCRIPTION	PID (ppm) Headspace	PID (ppm) Background	Drilling Rate (time)	REMARKS
0					0-6" - GRAVEL + SAND				
	☒				MOIST, BROWN TO DK. BROWN MG - POORLY [redacted] SAND	1.2		13 10	RGS02-01-1
	☒				2.5' - BLACK TAR-LIKE CONSISTENCY 2" THICK 2.7' - PEAT - MOIST BLACK - ORGANIC	20.0		13 15	RGS02-01-03
					▽ H2O ENCOUNTERED @ 4'				
5					MOIST - BROWN TO TAN SM - SILTY SAND				
					WET - GRAY TO BLACK CG SAND - TPH LIKE ODOR			13 30	[redacted] ATTEMPTED TO COLLECT SAMPLE @ 5.5 - NO RECOVERY + BELOW GW
					▽ TD of [redacted] BORING = 9.5'			14 15	GROUNDWATER SAMPLING
					1" PVC (SLOTTED) TUBE INSTALLED FOR H2O SAMPLING				6 VOA
									1-1 LITER
									* GW IS VERY REACTIVE W/ HCl IN VOA BOTTLES POSSIBLY FROM ORGANIC CONTENT - BUBBLES IN COLD OF VIALS
10									
15									
20									

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Figure ___

Printed: February 24, 1995

Project: EPIC Redondo
Project Location: Redondo Bch
Project Number: 995B018

Log of Boring RGS02-04

Sheet 1 of 1

Date(s) Drilled	8/17/99	Logged By	B. Clancy	Checked By	
Drilling Method	HAND AUGER	Drill Bit Size/Type		Approx. Surface Elevation (feet)	—
Drill Rig Type	—	Drilled By	EST	Total Depth Drilled (feet)	6.5'
Groundwater Level (feet, bgs)	First 6.5' Completion — 24 Hours —	Number of Samples	Disturbed: — Undisturbed: 3	Sampler Type	—
Diameter of Hole (inches)	2" Diameter of Well (inches) —	Type of Well Casing	—	Screen Perforation	—
Type of Sand Pack	—	Type/Thickness of Seal(s)	Bentonite Chip		
Comments	Within TANK 2				

Depth (feet)	SAMPLES Type	Number	Blows/foot	Graphic Log	MATERIAL DESCRIPTION	DIA (ppm) Headspace	DIA (ppm) Background	Drilling Rate (time)	REMARKS
0									
	X 2 TUBES				Brown to Black CG SAND - MOIST - SOME STAINING		1300		
							1305		RGS02-04-01
					BECOMES MOIST, BROWN, CG SAND (SP)				
5	X 2 TUBES					1.5	1315		RGS02-04-4.5
	X 2 TUBES				▽ 6.5 GW ENCOUNTERED				
					END OF BORING TD = 6.5		1325		RGS 02-04-06
10									
15									
20									

Figure ___

Project: _____

Project Location: _____

Project Number: _____

Log of Boring RG502-09

Sheet 1 of 1

Date(s) Drilled	Logged By	Checked By
Drilling Method	Drill Bit Size/Type	Approx. Surface Elevation (feet)
Drill Rig Type	Drilled By	Total Depth Drilled (feet)
Groundwater Level (feet, bgs) First Completion 24 Hours	Number of Samples Disturbed: Undisturbed:	Sampler Type
Diameter of Hole (inches) Diameter of Well (inches)	Type of Well Casing	Screen Perforation
Type of Sand Pack	Type/Thickness of Seal(s)	
Comments		

Depth, feet	SAMPLES Type	Number	Blows/foot	Graphic Log	MATERIAL DESCRIPTION	PID/FID (ppm) Headspace	Background	Drilling Rate (time)	REMARKS
0	X				DRY, LT to DK BROWN CG SAND (SP)			1355	RG502-09-01
5	X			▽	MOIST, LT TAN, CG SAND W/ MOTTLES OF BLK + BROWN GW @ 6'			1350	RG502-09-05
10									
15									
20									

Figure ____

Boring Logs
Fuel Tank 4

Project: EPTC Redondo Project Location: Redondo Beach Project Number: 99SB018	**Log of Boring** RGS04-01 Sheet 1 of 1

Date(s) Drilled	8/17/99	Logged By	B. Clancy	Checked By	
Drilling Method	Hand Auger	Drill Bit Size/Type		Approx. Surface Elevation (feet)	—
Drill Rig Type	" "	Drilled By	EST	Total Depth Drilled (feet)	5'
Groundwater Level (feet, bgs)	First Completion 24 Hours	Number of Samples	Disturbed: Undisturbed: 2	Sampler Type	—
Diameter of Hole (inches)	Diameter of Well (inches)	Type of Well Casing	—	Screen Perforation	—
Type of Sand Pack		Type/Thickness of Seal(s)	Bentonite Chip		
Comments					

Depth, feet	SAMPLES Type	Number	Blows/foot	Graphic Log	MATERIAL DESCRIPTION	OVA (ppm) Headspace	Background	Drilling Rate (time)	REMARKS
0					Dry, tan to brown CG sand - poorly graded				
	☒	~ 1' sample interval						11 50	RGS04-01-01 *
					Becomes moist w/depth				
	☒							12 00	RGS04-01-3.5
5					▽ GW @ 5'				
10									
15									
20					* Spoke w/laboratory - need more soil for reqd analyses - 2 tubes to be collected 1-2'				
25									
30									

Figure ____

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Printed: February 24, 1995

Project: EPTC ReDondo
Project Location: ReDondo Beach
Project Number: 9958018

Log of Boring RG504-02

Sheet 1 of 1

Date(s) Drilled: 8/8/97	Logged By: B. Clancy	Checked By:	
Drilling Method: HSA/Geoprobe	Drill Bit Size/Type:	Approx. Surface Elevation (feet):	
Drill Rig Type: EST Geoprobe	Drilled By: EST	Total Depth Drilled (feet): 10.5'	
Groundwater Level (feet, bgs): First — Completion — 24 Hours —	Number of Samples: Disturbed: Undisturbed:	Sampler Type: —	
Diameter of Hole (inches): —	Diameter of Well (inches): —	Type of Well Casing:	Screen Perforation: —
Type of Sand Pack: —	Type/Thickness of Seal(s):		

Comments: No H_2O SAMPLES TAKEN - BORING IS TO ~ DEPTH OF H_2O IN P-5 ~ 30' N

Depth, feet	SAMPLES Type	SAMPLES Number	SAMPLES Blows/foot	Graphic Log	MATERIAL DESCRIPTION	OVA (ppm) Breathing Zone	OVA (ppm) Background	Drilling Rate (time)	REMARKS
0									
		2-1" TUBES			DK BROWN - MOIST, MG SAND (SW)			14/10	RG504-02-01 * 1.0 / 1.5 TUBE
5		2 1" TUBES			NOTICES OF GRAVEL TURNS BLACK MOIST MG SAND (SW)			14/15	RG504-02-05 - 4.5 / 5.0 TU
		2-1" TUBES			Refusal @ 10.5' bgs - DUE TO OBJECT BLOCKAGE ATTEMPTED TO PUSH FOR 1 MIN - ROCK DUST ON NOSE OF PROBE			14/20	RG504-02-10 9.5 / 10.0 TU
10									
					* CLEARED W/ HAND AUGER BUT SAMPLED @ 1'-5' W/ GEOPROBE NEXT TO CLEARED HAND AUGER - SAMPLES ARE COLLECTED W/ 1" SAMPLER - CALL TO LAB				
15									

Figure ___

Boring Logs
Fuel Tank 5

Project: EPTC REDONDO
Project Location: REDONDO BEACH
Project Number: 9953013

Log of Boring RGS05-01

Sheet 1 of 1

Date(s) Drilled	8/18/99	Logged By	B. CLANCY	Checked By	
Drilling Method	HAND AUGER	Drill Bit Size/Type		Approx. Surface Elevation (feet)	
Drill Rig Type	" "	Drilled By	EST	Total Depth Drilled (feet)	10.5'/30'
Groundwater Level (feet, bgs)	First 10.5 Completion 24 Hours	Number of Samples	Disturbed: Undisturbed:	Sampler Type	—
Diameter of Hole (inches)	Diameter of Well (inches) —	Type of Well Casing		Screen Perforation	—
Type of Sand Pack		Type/Thickness of Seal(s)	BENTONITE CHIPS —		
Comments					

Depth, feet	SAMPLES Type	Number	Blows/foot	Graphic Log	MATERIAL DESCRIPTION	OVA (ppm) Headspace	Background	Drilling Rate (time)	REMARKS
0	☒ 2 TUBES				MOIST, TAN MEDIUM GRAINED SAND (SW)	0.0	0	0750 0800	RGS05-01-01
					MOIST, TAN TO BROWN CLAYEY SAND (SC) - SANDS ARE MG TO FG				
5	☒ 2 TUBES ☒ 2 TUBES				MOIST, TAN TO BROWN MG SAND (SW)			0810 0815	RGS05-01-05 RGS05-01-05.5 — DUPLICATE COLLECTED
					RED BRICK FRAGMENTS OBSERVED IN SOIL HAND AUGER REFUSAL @ 7.5' - CALL PARTNA — USE GEOPROBE RIG				
					MOIST, BROWN TO DK BROWN MG SAND (SP)				
	☒ 2 TUBES				▽ GW ENCOUNTERED @ 10.5' — HAND AUGER REFUSAL BRICK IN HOLE			1030	RGS05-01-10 * ↑ SAMPLE DETERMINED TO BE NOT USABLE DUE TO CAVING/SLOUGHING FROM USING GP/HA
					PUSHED ROD TO ~30' — UPON REMOVAL - CAVE IN TO ~10'				

Figure ___

Project: EPTC Redondo Project Location: Redondo Beach Project Number: 99SB018	**Log of Boring** RGS05-02 Sheet 1 of 1

Date(s) Drilled	8/18/99	Logged By	B. Clancy	Checked By	
Drilling Method	HA / GEOPROBE	Drill Bit Size/Type		Approx. Surface Elevation (feet)	
Drill Rig Type	↓	Drilled By	EST	Total Depth Drilled (feet)	11'
Groundwater Level (feet, bgs)	First 9.5 Completion 24 Hours	Number of Samples	Disturbed: Undisturbed: 4	Sampler Type	Peristaltic / 1/2" Bailer
Diameter of Hole (inches)	— Diameter of Well (inches) 1"	Type of Well Casing		Screen Perforation	0.020"
Type of Sand Pack	—	Type/Thickness of Seal(s)	Bentonite Chip		
Comments	See Figure				

Depth, feet	SAMPLES Type	Number	Blows/foot	Graphic Log	MATERIAL DESCRIPTION	OVA (ppm) Headspace	Background	Drilling Rate (time)	REMARKS
0					MOIST, TAN/BROWN MED GRAINED SAND (SP)				
					3" LENS - 9"-1' OF CLAYEY SAND (SC)				
	☒ 4 TUBES				MOIST, DK BROWN MEDIUM GRAINED SAND			0905	RGS05-02-01
								0910	RGS05-02-01.5 — DUP SOIL
5	☒ 2 TUBES							0915	RGS05-02-04.5
	☒ 2 TUBES				Becoming WET				
					▽ 9.5			1105	RGS05-02-09
					TOTAL DEPTH = 11'				
					1" Slotted PVC Set For H_2O Sampling			1130	Coll. H_2O Sample RGS05-02
15								*0730	Duplicate Sample RGS00-03
									2-1L Amber * 12-VOA
20									
25									
30									

Figure ____

Project: EPTC Redondo
Project Location:
Project Number:

Log of Boring RGS05-03

Sheet 1 of 1

Date(s) Drilled	8/18/99	Logged By	R. Clancy	Checked By	
Drilling Method	HAI	Drill Bit Size/Type		Approx. Surface Elevation (feet)	
Drill Rig Type		Drilled By	EST	Total Depth Drilled (feet)	11'
Groundwater Level (feet, bgs)	First Completion 24 Hours	Number of Samples	Disturbed: Undisturbed:	Sampler Type	Peristaltic Pump / 1/2" Bailer
Diameter of Hole (inches)	Diameter of Well (inches)	Type of Well Casing		Screen Perforation	0.020"
Type of Sand Pack		Type/Thickness of Seal(s)	Bentonite Seal		
Comments					

Depth (feet)	SAMPLES Type	Number	Blows/foot	Graphic Log	MATERIAL DESCRIPTION	PID/FID (ppm) Headspace	Background	Drilling Rate (time)	REMARKS
0					MOIST, BROWN, MEDIUM GRAINED SAND (SP)			1205	RGS05-03-01
5					BECOMES WET – MOTTLES OF BLACK SAND – NO ODOR	0.2		1210	RGS05-03-05
								1220	RGS05-03-010
					TOTAL DEPTH 11' SET 1" SLOTTED PVC FOR COLLECTION OF GW SAMPLE			1300	RGS05-03 GW SAMPLES Coll. 6 VOA 1-1L AMBER
10									

Figure

Woodward-Clyde Consultants

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Project: _____

Project Location: _____

Project Number: _____

Log of Boring RG505-04

Sheet 1 of 1

Date(s) Drilled	8/18/99	Logged By	B. Clancy	Checked By	
Drilling Method	HAND AUGER	Drill Bit Size/Type		Approx. Surface Elevation (feet)	
Drill Rig Type		Drilled By	EST	Total Depth Drilled (feet)	
Groundwater Level (feet, bgs)	First Completion 24 Hours	Number of Samples	Disturbed: Undisturbed:	Sampler Type	
Diameter of Hole (inches)	Diameter of Well (inches)	Type of Well Casing		Screen Perforation	0.020"
Type of Sand Pack		Type/Thickness of Seal(s)			

Comments: LOCATED 15-20' EAST OF RG5 05-01 - ATTEMPT TO GRAB WATER SAMPLE

Depth, feet	SAMPLES Type	SAMPLES Number	SAMPLES Blows/foot	Graphic Log	MATERIAL DESCRIPTION	OVA (ppm) Headspace	OVA (ppm) Background	Drilling Rate (time)	REMARKS
0	2 TUBES				0-6" TAN SAND (SP) - DRY W/ GRAVEL (ROAD BASE)	0.2		1505	RG505-04-01
					REFUSAL @ 4' - BRICK - MOVED OVER 1'				
5	2 TUBES				MOIST, DK BROWN MG SAND (SP) W/ MOTTLES OF BLACK SAND OF THE SAME	0.2		1530	RG505-04-05
					▽ GW @ 9'				
					TOTAL DEPTH = 10.5'	0.2		1600	RG505-04 GW Sample Tube 6 VOA 1-1L AMBER
10									
15									
20									

Figure ___

Boring Logs
66-kV Switchyard

#1

Project: EPTC Redondo
Project Location: Redondo Beach
Project Number: 94SB013

Log of Boring RGS06-01

Sheet 1 of 1

Date(s) Drilled: 8/20/94	Logged By: B. Clancy	Checked By:	
Drilling Method: HSA/Geoprobe	Drill Bit Size/Type:	Approx. Surface Elevation (feet):	
Drill Rig Type:	Drilled By: EST	Total Depth Drilled (feet): 18'	
Groundwater Level (feet, bgs): First 12.5 Completion 24 Hours	Number of Samples: Disturbed: Undisturbed: 4	Sampler Type: Peristaltic 1½" Bailer	
Diameter of Hole (inches): 3" Diameter of Well (inches): 1"	Type of Well Casing:	Screen Perforation: 0.020"	
Type of Sand Pack:	Type/Thickness of Seal(s): Bentonite Chip / Concrete Patch		
Comments:			

Depth, feet	SAMPLES Type	SAMPLES Number	SAMPLES Blows/foot	Graphic Log	MATERIAL DESCRIPTION	OVA (ppm) Headspace	OVA (ppm) Background	Drilling Rate (time)	REMARKS
0					0-3" ASPHALT 3"-1' ORANGE MG SAND (SP) TAN, MOIST MG SAND (SP) - w/ shell fragments & some black sand			13²⁰	RGS06-01-01
5								13³⁰	RGS06-01-05
								13³⁰	RGS06-01-05.5
		9½			TAN, MOIST MG SAND (SP) - NO ODOR, NO STAINING				
		11½						14⁵⁰	RGS06-01-10
					▽ 12.5' GW			15¹⁵	GW SAMPLE COLLECTED RGS06-01 6 VOA 1-1 LITER AMBER
					TOTAL DEPTH = 18'				
20									

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Figure ___

Project: EPIC REDONDO
Project Location: REDONDO BEACH
Project Number: ____

Log of Boring RG506-02

Sheet 1 of 1

Date(s) Drilled	8/20/99	Logged By	B. Clancy	Checked By	
Drilling Method	HA / GEOPROBE	Drill Bit Size/Type		Approx. Surface Elevation (feet)	
Drill Rig Type		Drilled By	EST	Total Depth Drilled (feet)	
Groundwater Level (feet, bgs)	First ____ Completion ____ 24 Hours ____	Number of Samples	Disturbed: ____ Undisturbed: ____	Sampler Type	PERISTALTIC PUMP / 1½" BAILER
Diameter of Hole (inches)		Diameter of Well (inches)	1"	Type of Well Casing	PVC-
Type of Sand Pack		Type/Thickness of Seal(s)	Bentonite Chip / Concrete Patch	Screen Perforation	0.020"
Comments					

Depth, feet	SAMPLES Type	Number	Blows/foot	Graphic Log	MATERIAL DESCRIPTION	OVA (ppm) Headspace	Background	Drilling Rate (time)	REMARKS
0					0-3" ASPHALT				
	2 TUBES				3"-1.5' – ORANGE MED SAND (SP) W/GRAVEL + ROCKS			16:10	
					HAND AUGER REFUSAL – ROCK – PUSHED THRU W/G.P.			16:15	RG506-02-01
5	2-1" TUBES							16:40	RG506-02-05*
									1' RECOVERY for 2' SAMPLE INTERVAL is 4.5-6.5' ATTEMPTED TO COLLECT DUPLICATE SOIL – NO SOIL TO USE
					REFUSAL @ ~ 8' bgs W/PROBE – MOVED BORING 6" N			16:50	
					2ND BORING REFUSAL @ 1.5'				
					3RD BORING REFUSAL @ 1.5'				
									NO H_2O SAMPLE OR 10' SOIL SAMPLE COLLECTED DUE TO REFUSAL
10									
					* RWQCB AUTHORIZED USE OF GEOPROBE BEFORE 5' CLEARANCE :: PUSHED @ 2.5'				
15									
20									

Woodward-Clyde Consultants

Figure ____

Project: EPTC REDONDO
Project Location: REDONDO BEACH
Project Number: 9958018

Log of Boring RGSO6-03

Sheet 1 of 1

Date(s) Drilled: 8/19/99	Logged By: R. Clancy		Checked By:
Drilling Method: NA / GEOPROBE	Drill Bit Size/Type:		Approx. Surface Elevation (feet):
Drill Rig Type:	Drilled By: EST		Total Depth Drilled (feet):
Groundwater Level (feet, bgs): First	Completion: 24 Hours	Number of Samples: Disturbed:	Undisturbed: Sampler Type:
Diameter of Hole (inches):	Diameter of Well (inches):	Type of Well Casing:	Screen Perforation:
Type of Sand Pack:		Type/Thickness of Seal(s):	
Comments:			

Depth, feet	SAMPLES Type	Number	Blows/foot	Graphic Log	MATERIAL DESCRIPTION	OVA (ppm) Headspace	Background	Drilling Rate (time)	REMARKS
0	X		REFUSAL 1ST HOLE / 2ND HOLE / 3RD HOLE		0-4" ASPHALT / GRAVEL HOIST, TAN/ORANGE MG SAND (SP) W/GRAVEL + ROCK HOIST, TAN/GRAY MG SAND (SP) W/ ROCKS, CONCRETE GRAVEL, BRICK OBSERVED (DEMO DEBRIS)			1300 1350	RGSO6-03-01
5									
10					REFUSAL W/ HAND AUGER 3x - @ BETWEEN 2-2.5' DUE TO DEMO DEBRIS (BRICK, ROCK, CONCRETE) IN BORINGS SPOKE TO ROB L. (CULM) 1615 – OK TO PUSH FROM 2.5' IF GEOPHYSICS CLEARED BORING LOCATION				
15									

Figure ___

Project: EPTC Redondo Project Location: Redondo Beach Project Number: 99SB018	**Log of Boring** RGS06-05 Sheet 1 of 1

Date(s) Drilled	8/19/99	Logged By	B. Clancy	Checked By	
Drilling Method	HA / GEOPROBE	Drill Bit Size/Type		Approx. Surface Elevation (feet)	
Drill Rig Type		Drilled By	EST	Total Depth Drilled (feet)	18'
Groundwater Level (feet, bgs)	First Completion 24 Hours	Number of Samples	Disturbed: Undisturbed:	Sampler Type	Peristaltic / 1/2" Bailer
Diameter of Hole (inches)	Diameter of Well (inches)	Type of Well Casing		Screen Perforation	0.020"
Type of Sand Pack		Type/Thickness of Seal(s)	Bentonite Chip / Asphalt Patch		
Comments					

Depth, feet	SAMPLES Type	Number	Blows/foot	Graphic Log	MATERIAL DESCRIPTION	DVA (ppm) Headspace	Background	Drilling Rate (time)	REMARKS
0					3" Asphalt Cover			10:15	Mike w/ SCE Grounded the Geo w/ Cable
	☒ 2 tubes				Moist, Tan to Yellow MG Sand - (SP) w/ Pieces of Asphalt Road Base - Turns to Moist Tan/MG Sand (SP) w/ Bulk	4.0		10:25	RGS06-05-01
					Some Gravel + Rock observed (up to 1 1/2") .. Refusal @ 3.5'*				
5					Obstruction in Borehole @ 5' bgs - Push Through w/ GP			11:00	
	☒ 24" tubes							11:25	RGS06-05-06 1' Rec From
	X							11:35	RGS06-05-10 - 1' Rec From
					GW in 1" PVC @ 12.75' bgs			12:30	GW Samples Collected RGS06-05 6 VOA 1 - 1L Amber
					Pushed Case to 18' - Set 1" Slotted PVC in Case .. Removed Case				
20									3 Total Borings 01 - From 1st Hole 06, 10 } From 3rd Hole H2O - From 1st Hole
					* Moved Boring N 1'				
25									
30									

Figure ____

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Printed: February 24, 1995

Project: EPTC Redondo
Project Location: Redondo Beach
Project Number: 99S8018

Log of Boring RGS06-06

Sheet 1 of 1

Date(s) Drilled: 8/20/99	Logged By: B. Clancy	Checked By:	
Drilling Method: HSA/Geoprobe	Drill Bit Size/Type:	Approx. Surface Elevation (feet):	
Drill Rig Type:	Drilled By: EST	Total Depth Drilled (feet): 18'	
Groundwater Level (feet, bgs): First 12.9' Completion 24 Hours	Number of Samples: Disturbed: Undisturbed: 3	Sampler Type: Peristaltic / 1½" Bailer	
Diameter of Hole (inches): — Diameter of Well (inches): 1"	Type of Well Casing: PVC	Screen Perforation: 0.020"	
Type of Sand Pack:	Type/Thickness of Seal(s): Bentonite Chip / Concrete Patch		
Comments:			

Depth, feet	SAMPLES Type	SAMPLES Number	SAMPLES Blows/foot	Graphic Log	MATERIAL DESCRIPTION	OVA (ppm) Headspace	OVA (ppm) Background	Drilling Rate (time)	REMARKS
0	2 TUBES				0-3" ASPHALT 3"-1' MOIST TAN/ORANGE MG SAND (SP) W/GRAVEL MOIST DK BROWN MG SAND (SP) W/ SOME GRAVEL BRICK PIECES @ 2'			1135 1145	RGS06-06-01
5	2 TUBES							1150	RGS06-06-05
	2-1" TUBES							1200	RGS06-06-10
					▽ GW @ 12.9'			1230	GW - Sample - outer casing left in place to sample due to PVC INSIDE CASING
								1240	No Recharge - Purged well dry
					TOTAL DEPTH 18'				Sample time Says 12:30 Actual Sample time from 12:30 to HYDRAULIC FLUID OBSERVED ON BAILER/GLOVES/PVC FROM DRILL RIG ACCORDING to HARRY/OPER OIL IS VEGETABLE OIL
10									
15									
20									

Project: EPTC Redondo
Project Location: Redondo Beach
Project Number: 995B018

Log of Boring RGS06-07

Sheet 1 of 1

Date(s) Drilled	8/19/99	Logged By	B. CLANCY	Checked By	
Drilling Method	HA/GEOPROBE	Drill Bit Size/Type		Approx. Surface Elevation (feet)	
Drill Rig Type		Drilled By	EST	Total Depth Drilled (feet)	18'
Groundwater Level (feet, bgs)	First 12.7 Completion 24 Hours	Number of Samples	Disturbed: Undisturbed: 3	Sampler Type	PERISTALTIC / 1/2" DISPOS. BAILER
Diameter of Hole (inches)	— Diameter of Well (inches) 1"	Type of Well Casing	—	Screen Perforation	0.020"
Type of Sand Pack		Type/Thickness of Seal(s)	BENTONITE CHIP - ASPHALT PATCH		
Comments					

Depth, feet	SAMPLES Type	SAMPLES Number	SAMPLES Blows/foot	Graphic Log	MATERIAL DESCRIPTION	OVA (ppm) Headspace	OVA (ppm) Background	Drilling Rate (time)	REMARKS
0					0-3" ASPHALT				
	2 TUBES				MOIST, TAN TO LT BROWN MG SAND - NO GRAVEL	0.0		14:10 14:15	RGS06-07-01
5	2 TUBES							14:35	RGS06-07-05
	2-1" TUBES				GRAY MOIST MG SAND - NO GRAVEL - LIKE BEACH SAND			14:50	RGS06-07-10
					▽ GWD 12.7' bgs			15:15	GW SAMPLE) 6 VOAS 1-1L AMBER
					TOTAL DEPTH 18'				
20					INSTALLED 1" SLOTTED PVC WELL POINT				

Figure ___

Project: EPFC Redondo
Project Location: Redondo Beach
Project Number: 995B018

Log of Boring RGS06-08

Sheet 1 of 1

Date(s) Drilled: 8/19/99	Logged By: B. Clarke	Checked By:
Drilling Method: HA / Geoprobe	Drill Bit Size/Type:	Approx. Surface Elevation (feet):
Drill Rig Type:	Drilled By: EST	Total Depth Drilled (feet): 18'
Groundwater Level (feet, bgs): First 12.70' Completion — 24 Hours —	Number of Samples: Disturbed: Undisturbed:	Sampler Type: Peristaltic / 1½" Dist. Bailer
Diameter of Hole (inches): Diameter of Well (inches): 1" PVC	Type of Well Casing:	Screen Perforation: 0.020"
Type of Sand Pack: —	Type/Thickness of Seal(s):	
Comments: See Figure For Location		

Depth, feet	SAMPLES Type	SAMPLES Number	Blows/foot	Graphic Log	MATERIAL DESCRIPTION	OVA (ppm) Headspace	OVA (ppm) Background	Drilling Rate (time)	REMARKS
0					0-3" Asphalt			1440	
					Light tan sand MG (SP) - No Gravel			1450	RGS06-08-01
5								1510	RGS06-08-05
								1510	RGS06-08-05.5 * Duplicate Sample
								1540	RGS06-08-10
					▽ GW @ 12.7' bgs				
								1645	GW Samples Collected 6 VOA 1-1 Liter Amber RGS06-08
					Total Depth = 18'				
10									
15									
20									

Project: EPTC Redondo Beach
Project Location: Redondo Beach
Project Number: 9958018

Log of Boring RGS06-09

Sheet 1 of 1

Date(s) Drilled: 8/19/99	Logged By: B. Clancy	Checked By:
Drilling Method: HA / Geoprobe	Drill Bit Size/Type:	Approx. Surface Elevation (feet):
Drill Rig Type:	Drilled By: EST	Total Depth Drilled (feet):
Groundwater Level (feet, bgs): First Completion 24 Hours	Number of Samples: Disturbed: Undisturbed:	Sampler Type:
Diameter of Hole (inches): Diameter of Well (inches):	Type of Well Casing:	Screen Perforation:
Type of Sand Pack:	Type/Thickness of Seal(s):	
Comments:		

Depth (feet)	SAMPLES Type	SAMPLES Number	Blows/foot	Graphic Log	MATERIAL DESCRIPTION	OVA (ppm) Background	OVA (ppm) Background	Drilling Rate (time)	REMARKS
0									
	2 TUBES				0-3" ASPHALT 3"-1' MOIST TAN/GRN MG SAND (SP) MOIST LT BROWN MG SAND (SD) W/ INTERMITTENT BLACK SAND NO ODOR			1720	RGS06-09-01
5	2 TUBES							1725	RGS06-09-05
	2-1" TUBES							1750	RGS06-09-10
					GWD			1820	GW SAMPLED 6 VOA 1-1L AMBER } TO BE GIVEN LAB
					TOTAL DEPTH 18'				
10									
15									
20									

Woodward-Clyde Consultants

Figure ___

Printed: February 24, 1995

Proj ID: KEY

Project: EPTC Redondo
Project Location: Redondo Beach
Project Number: 99S3018

Log of Boring RG506-11

Sheet 1 of 1

Date(s) Drilled: 8/19/99	Logged By: B. Clancy		Checked By:
Drilling Method: HA/Geoprobe	Drill Bit Size/Type:		Approx. Surface Elevation (feet):
Drill Rig Type:	Drilled By: EST		Total Depth Drilled (feet):
Groundwater Level (feet, bgs): First	Completion 24 Hours	Number of Samples: Disturbed:	Undisturbed:	Sampler Type:
Diameter of Hole (inches):	Diameter of Well (inches):	Type of Well Casing:		Screen Perforation: 0.020"
Type of Sand Pack:		Type/Thickness of Seal(s): Bentonite Chip/Concrete Patch		
Comments:				

Depth, Feet	SAMPLES Type	Number	Blows/foot	Graphic Log	MATERIAL DESCRIPTION	OVA (ppm) Headspace	Background	Drilling Rate (time)	REMARKS
0					0-3" Asphalt 3"-6" Road Base/Gravel			0845	
	ZTubes				6"-1' Tan/Orange MG Sand - Little or No Fines			0855	RG506-11-01
					Moist, Dk Brown/Brown MG Sand (SP)				
					Refusal - move 1' East				
5	ZTubes				Moist, Dk Brown MG Sand (SP) - w/ Rocks + Demo Debris			0920	RG506-11-05
								0930	RG506-11-10
					▽ GW @ 12.4' (Sounded)				
								1000	Collected GW Sample RG506-11 18 VOA 3-1L Amber Volume for MS/MSD Analysis By Lab
10									
15									
20									

Project: EPTC Redondo
Project Location: Redondo Beach
Project Number: 995B018

Log of Boring RG506-12

Sheet 1 of 1

Date(s) Drilled	8/20/99	Logged By	B. Clancy	Checked By	
Drilling Method	HA / Geoprobe	Drill Bit Size/Type		Approx. Surface Elevation (feet)	
Drill Rig Type		Drilled By	EST	Total Depth Drilled (feet)	18'
Groundwater Level (feet, bgs)	First 12' Completion 24 Hours	Number of Samples	Disturbed: Undisturbed: 3	Sampler Type	Peristaltic / 1½" Bailer
Diameter of Hole (inches)	Diameter of Well (inches)	Type of Well Casing		Screen Perforation	0.020"
Type of Sand Pack		Type/Thickness of Seal(s)	Bentonite Chip / Concrete Patch		
Comments					

Depth, feet	SAMPLES Type	SAMPLES Number	Blows/foot	Graphic Log	MATERIAL DESCRIPTION	OVA (ppm) Headspace	OVA (ppm) Background	Drilling Rate (time)	REMARKS
0					0-3" ASPHALT				
					MOIST, TAN/ORANGE MG SAND (SP) W/GRAVEL			10²⁵	RG506-12-01
					MOIST, BROWN/DK BROWN MG SAND (SP) W/SOME BLACK GRAINS - LESS THAN 5%				
5								10⁴⁰	RG506-12-05
								10⁵⁰	RG506-12-10
					▽ GWD 12'			11¹⁵	RG506-12 Groundwater Sample
					TOTAL DEPTH 18'				
20									
25									
30									

Figure ___

Figures

Figure 1-1
Site Vicinity Map
Redondo Generating Station
Edison Phase II ESA

CH2MHILL

m137125.ED.RP.RD redond 6/97

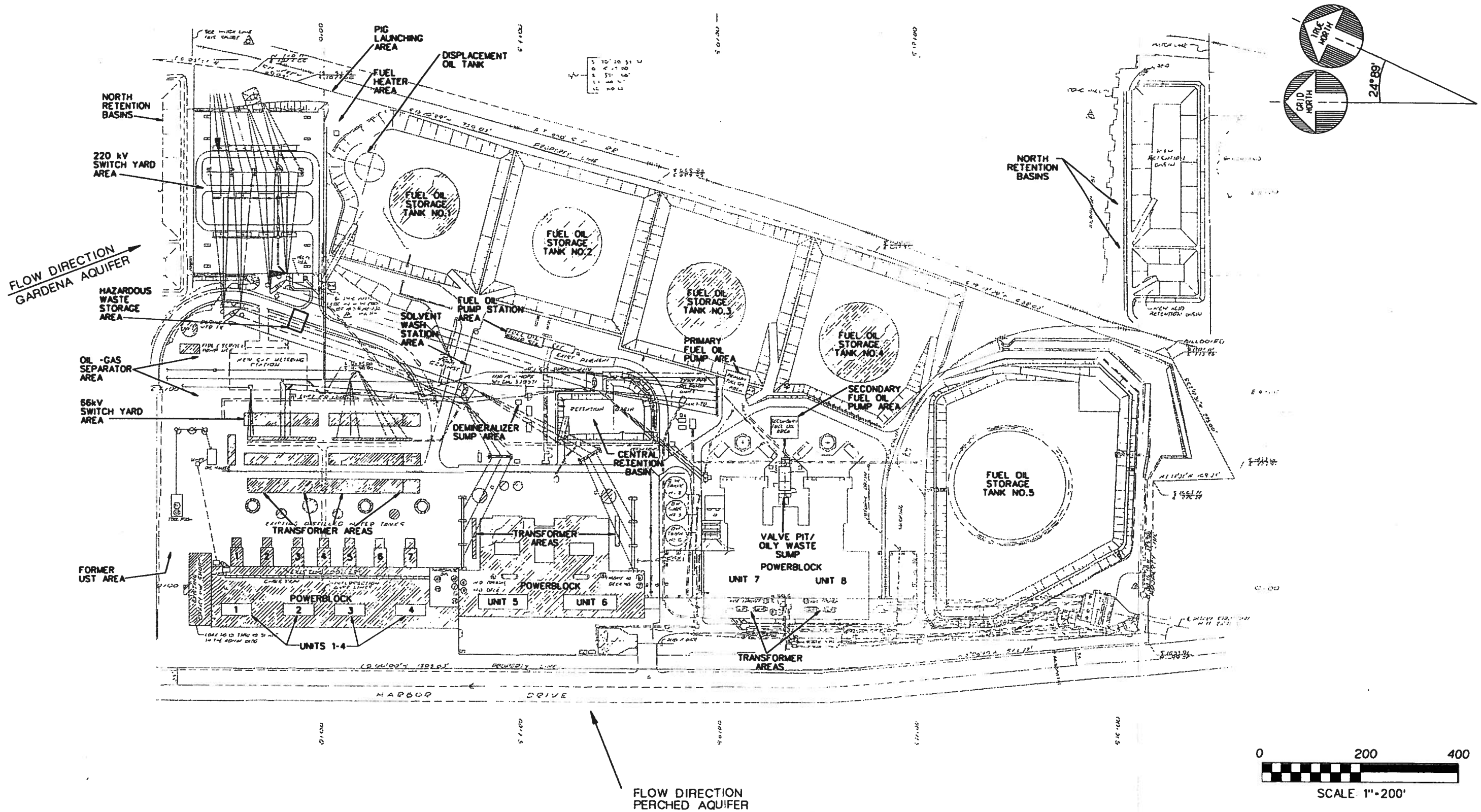

Figure 1-2
Facilities Map
Redondo Generating Station
Edison Phase II ESA

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LEGEND

- SCE BORING - 1997
- CH2M HILL BORING - 1997
- (100) TOTAL PETROLEUM HYDROCARBONS (TPH) OR TOTAL RECOVERABLE PETROLEUM HYDROCARBONS (TRPH) in mg/kg
- (ND) NOT DETECTED ABOVE LABORATORY REPORTING LIMITS
- (NS) NOT SAMPLED

NOTES:

1. ALL BORING LOCATIONS ARE APPROXIMATE.
2. BASE MAP TAKEN FROM A.L.T.A. SURVEY SHEET 1 OF 6 PREPARED BY CAL VADA SURVEYING, INC. DATED NOVEMBER 22, 1996.
3. RESULTS REPRESENT TPH DATA BY MODIFIED EPA METHOD 801.5 FOR CARBON CHAIN RANGE C4 TO C40 AND TRPH DATA BY EPA METHOD 418.1. EPA METHOD 418.1 USED BY SCE FOR SAMPLES COLLECTED FROM TANK BASINS 1 THROUGH 4 (IN GREEN).

CH2M HILL / URS Greiner Woodward Clyde

TPH (C4-C40) AND TRPH CONCENTRATIONS IN SOIL EPTC AST AREA

DEPTH 0-2 FT. BELOW GROUND SURFACE

Proj. No.:	66-99SB018.00	Date:	NOVEMBER 1999
Project:	REDONDO GENERATING STATION REDONDO BEACH, CALIFORNIA	CAD ID.:	RPH4_0-2
		Figure:	Fig. 2-1

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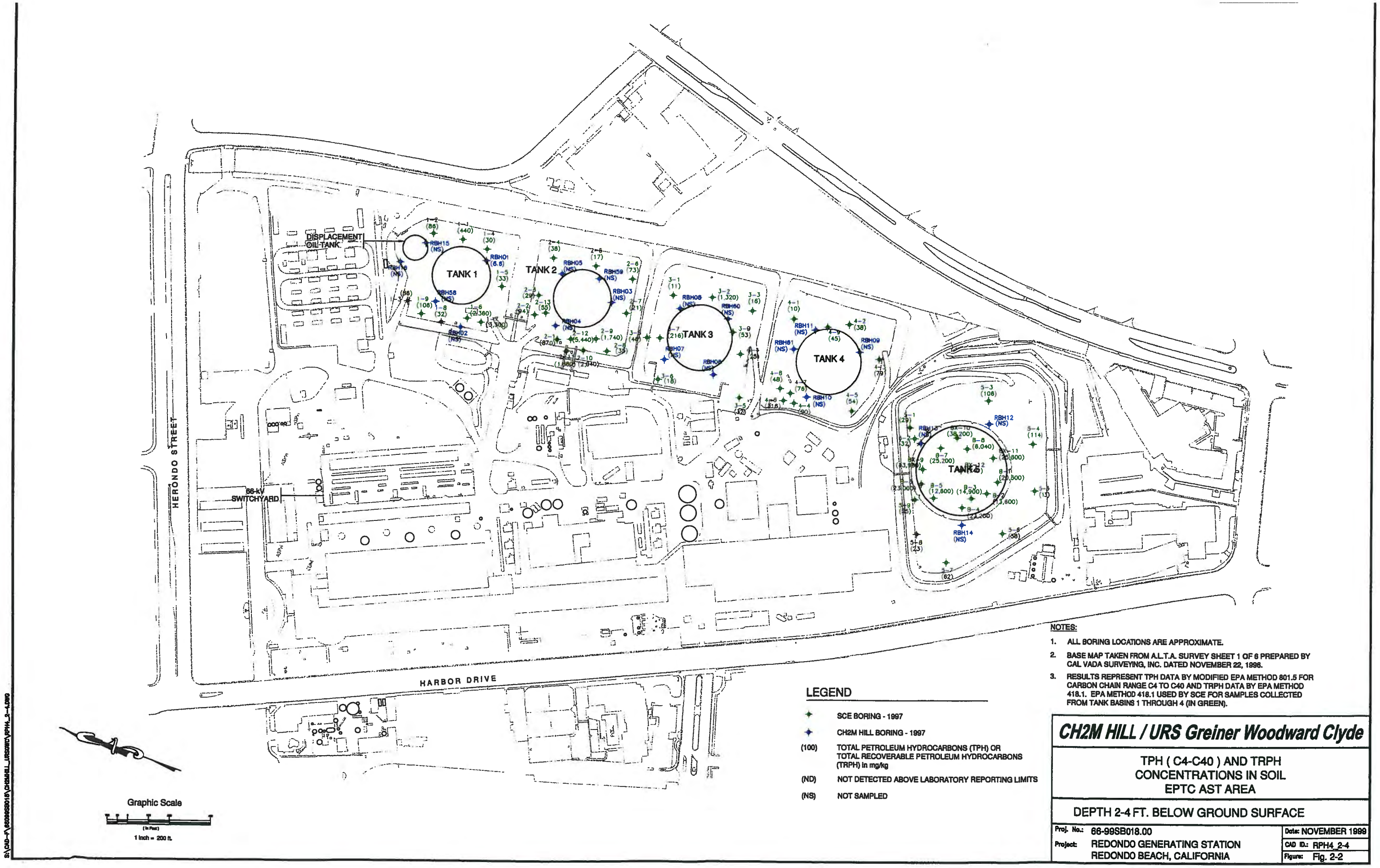

NOTES:

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LEGEND

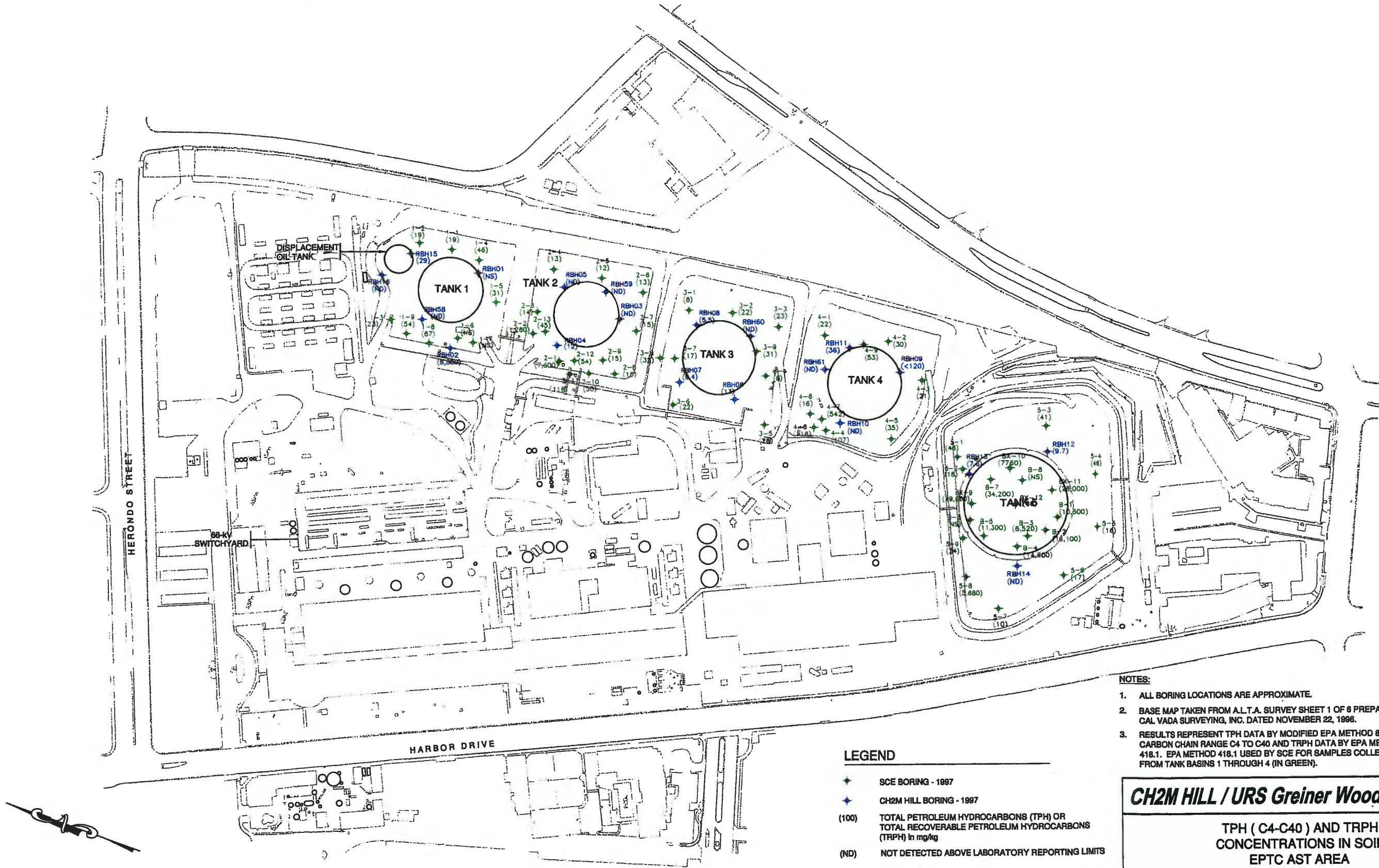
✦	SCE BORING - 1997
✦	CH2M HILL BORING - 1997
(100)	TOTAL PETROLEUM HYDROCARBONS (TPH) OR TOTAL RECOVERABLE PETROLEUM HYDROCARBONS (TRPH) in mg/kg
(ND)	NOT DETECTED ABOVE LABORATORY REPORTING LIMITS
(NS)	NOT SAMPLED

CH2M HILL / URS Greiner Woodward Clyde

TPH (C4-C40) AND TRPH CONCENTRATIONS IN SOIL EPTC AST AREA

DEPTH 2-4 FT. BELOW GROUND SURFACE

Proj. No.:	66-99SB018.00	Date:	NOVEMBER 1999
Project:	REDONDO GENERATING STATION REDONDO BEACH, CALIFORNIA	CAD ID.:	RPH4_2-4
		Figure:	Fig. 2-2



Graphic Scale

1 inch = 100 ft.

LEGEND

- SCE BORING - 1997
- CH2M HILL BORING - 1997
- (100) TOTAL PETROLEUM HYDROCARBONS (TPH) OR TOTAL RECOVERABLE PETROLEUM HYDROCARBONS (TRPH) in mg/kg
- (ND) NOT DETECTED ABOVE LABORATORY REPORTING LIMITS
- (NS) NOT SAMPLED

NOTES:

1. ALL BORING LOCATIONS ARE APPROXIMATE.
2. BASE MAP TAKEN FROM A.L.T.A. SURVEY SHEET 1 OF 6 PREPARED BY CAL VADA SURVEYING, INC. DATED NOVEMBER 22, 1996.
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CH2M HILL / URS Greiner Woodward Clyde

TPH (C4-C40) AND TRPH CONCENTRATIONS IN SOIL EPTC AST AREA

DEPTH 4-6 FT. BELOW GROUND SURFACE

Proj. No.: 66-99SB018.00		Date: NOVEMBER 1999
Project: REDONDO GENERATING STATION REDONDO BEACH, CALIFORNIA		CAD ID.: RPH4_4-6 Figure: Fig. 2-3

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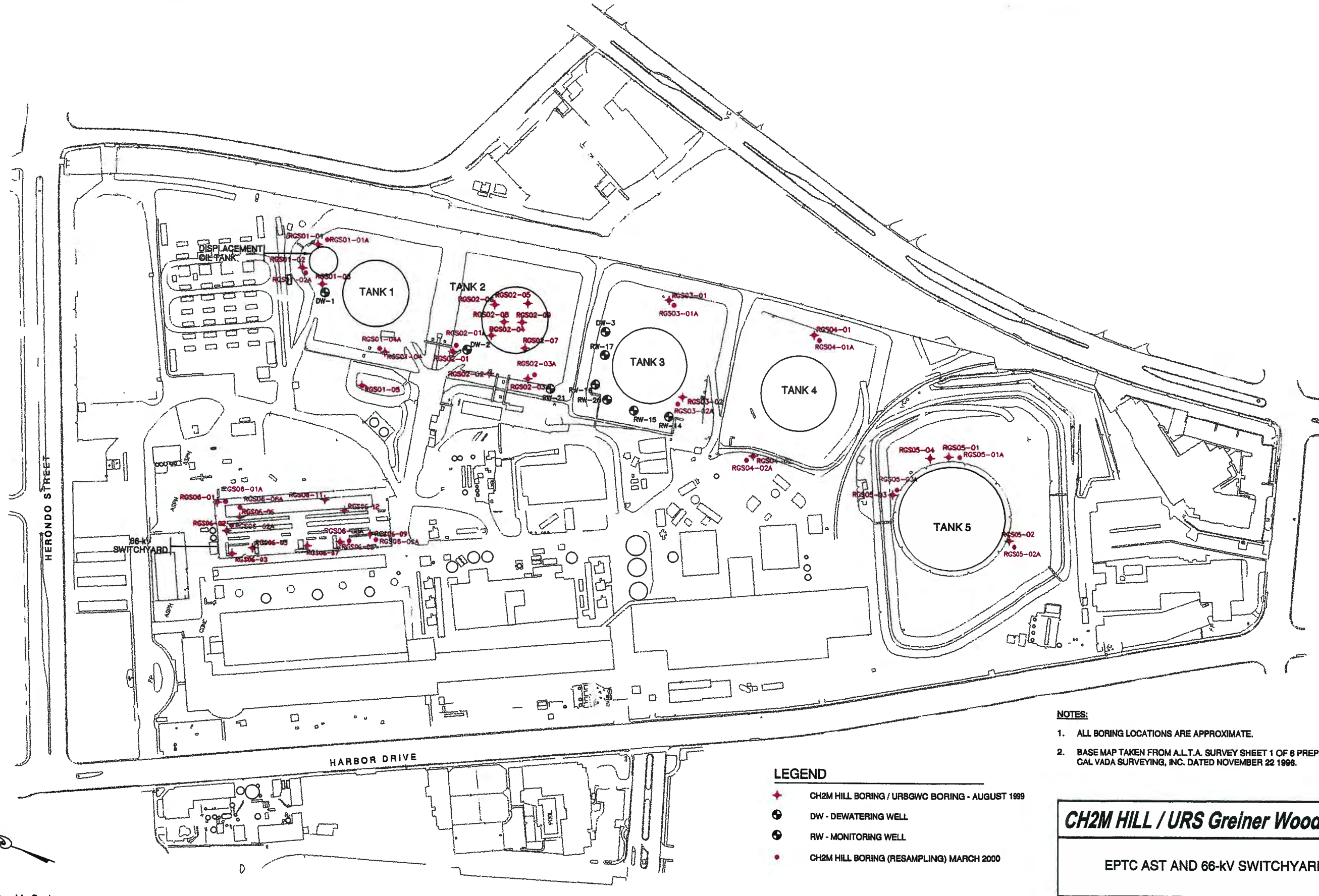

LEGEND

- CH2M HILL BORING / URSGWC BORING - AUGUST 1999
- DW - DEWATERING WELL
- RW - MONITORING WELL
- CH2M HILL BORING (RESAMPLING) MARCH 2000

NOTES:

1. ALL BORING LOCATIONS ARE APPROXIMATE.
2. BASE MAP TAKEN FROM A.L.T.A. SURVEY SHEET 1 OF 6 PREPARED BY CAL VADA SURVEYING, INC. DATED NOVEMBER 22 1996.

Graphic Scale

(In Feet)

1 Inch = 100 ft.

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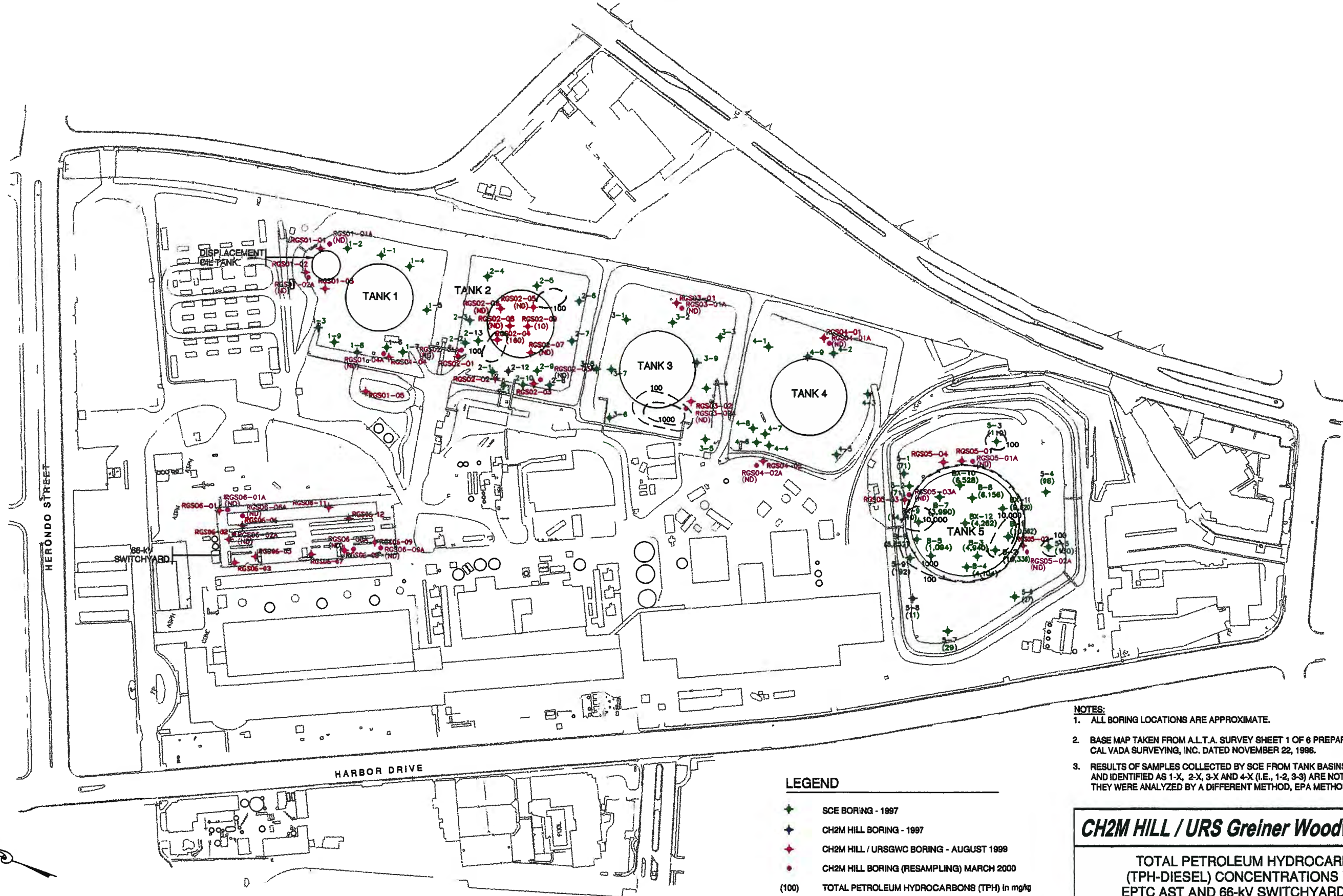
EPTC AST AND 66-kV SWITCHYARD AREAS

SOIL BORING LOCATIONS

Proj. No.:	66-99SB018.00	Date:	MARCH 2000
Project:	REDONDO GENERATING STATION REDONDO BEACH, CALIFORNIA	CAD ID.:	BOR0899
		Figure:	Fig. 3-1



LEGEND

- SCE BORING - 1997
- CH2M HILL BORING - 1997
- CH2M HILL / URSGWC BORING - AUGUST 1999
- CH2M HILL BORING (RESAMPLING) MARCH 2000
- (100) TOTAL PETROLEUM HYDROCARBONS (TPH) in mg/kg
- (ND) NOT DETECTED ABOVE LABORATORY REPORTING LIMITS
- (NS) NOT SAMPLED

NOTES:

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2. BASE MAP TAKEN FROM A.L.T.A. SURVEY SHEET 1 OF 6 PREPARED BY CAL VADA SURVEYING, INC. DATED NOVEMBER 22, 1996.
3. RESULTS OF SAMPLES COLLECTED BY SCE FROM TANK BASINS 1 THROUGH 4 AND IDENTIFIED AS 1-X, 2-X, 3-X AND 4-X (I.E., 1-2, 3-3) ARE NOT SHOWN SINCE THEY WERE ANALYZED BY A DIFFERENT METHOD, EPA METHOD 418.1.

Graphic Scale

(In Feet)

1 inch = 100 ft.

CH2M HILL / URS Greiner Woodward Clyde

TOTAL PETROLEUM HYDROCARBONS (TPH-DIESEL) CONCENTRATIONS IN SOIL EPTC AST AND 66-kV SWITCHYARD AREAS

DEPTH 0-2 FT. BELOW GROUND SURFACE

Proj. No.:	66-99SB018.00	Date:	MARCH 2000
Project:	REDONDO GENERATING STATION REDONDO BEACH, CALIFORNIA	CAD ID.:	PH10_0-2
		Figure:	Fig. 4-1

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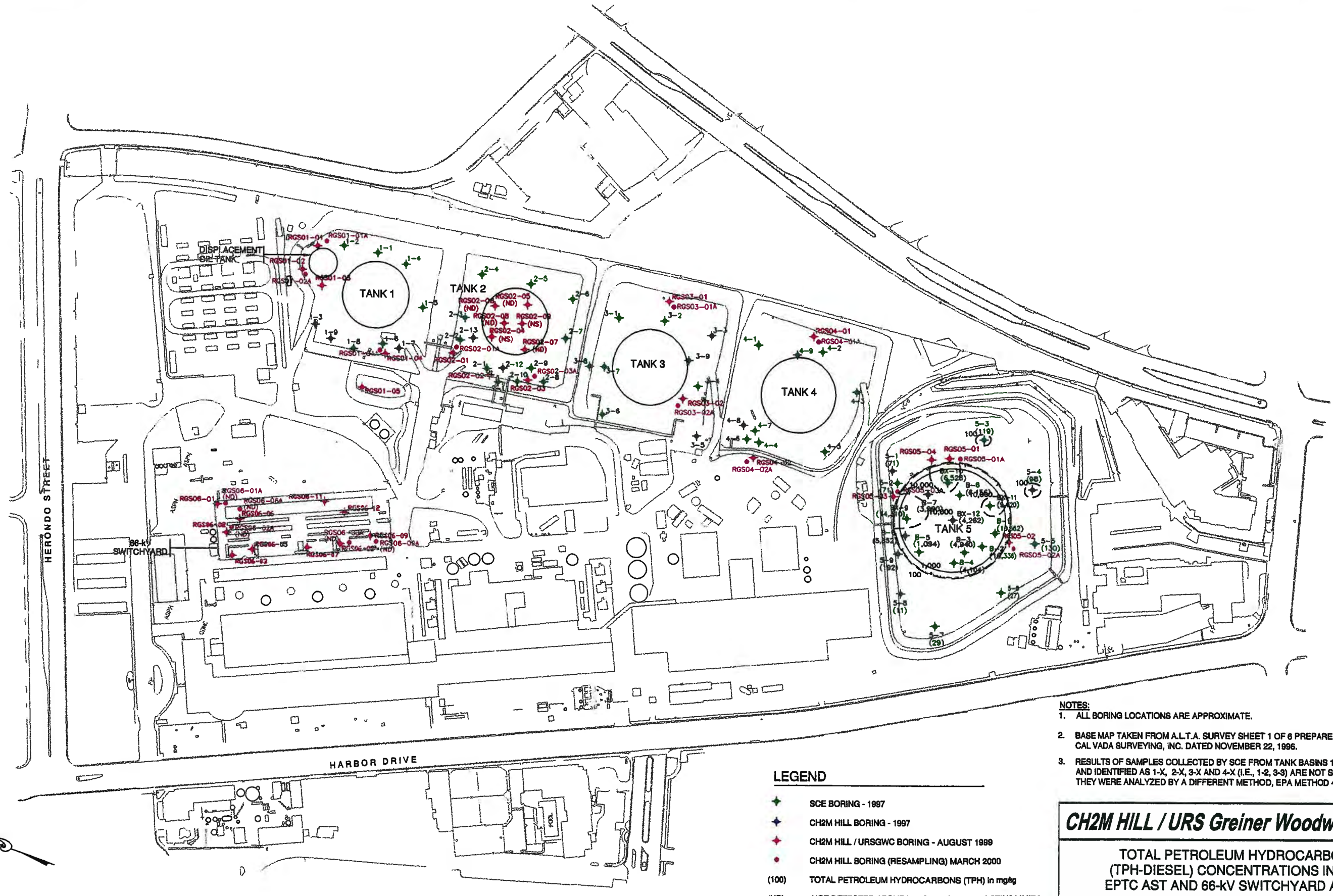

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LEGEND

- SCE BORING - 1997
- CH2M HILL BORING - 1997
- CH2M HILL / URSGWC BORING - AUGUST 1999
- CH2M HILL BORING (RESAMPLING) MARCH 2000
- (100) TOTAL PETROLEUM HYDROCARBONS (TPH) in mg/kg
- (ND) NOT DETECTED ABOVE LABORATORY REPORTING LIMITS
- (NS) NOT SAMPLED

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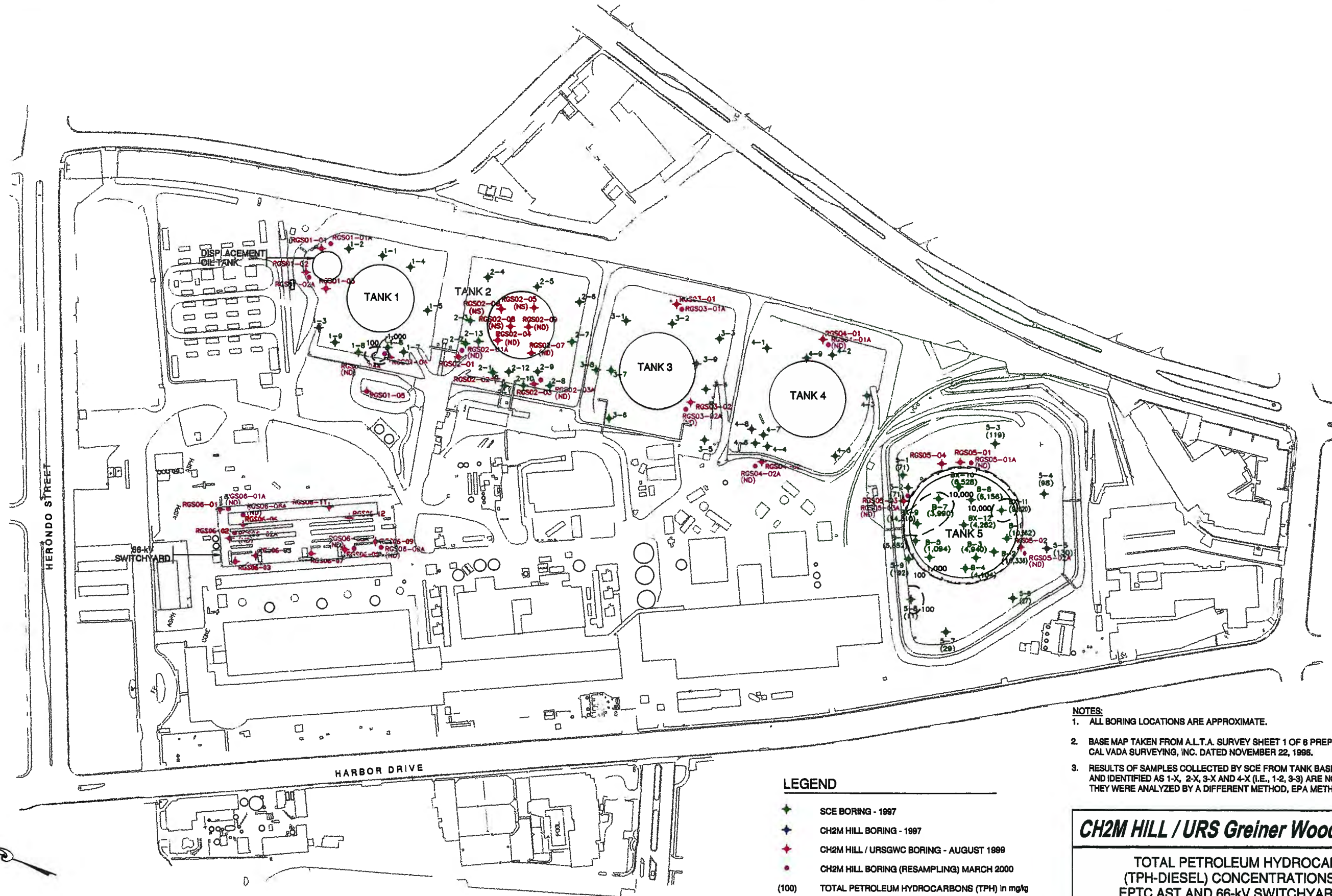
CH2M HILL / URS Greiner Woodward Clyde

TOTAL PETROLEUM HYDROCARBONS (TPH-DIESEL) CONCENTRATIONS IN SOIL EPTC AST AND 66-kV SWITCHYARD AREAS

DEPTH 2-4 FT. BELOW GROUND SURFACE

Proj. No.:	66-99SB018.00	Date:	MARCH 2000
Project:	REDONDO GENERATING STATION REDONDO BEACH, CALIFORNIA	CAD ID.:	PH10_2-4
		Figure:	Fig. 4-2



LEGEND

- SCE BORING - 1997
- CH2M HILL BORING - 1997
- CH2M HILL / URSGWC BORING - AUGUST 1999
- CH2M HILL BORING (RESAMPLING) MARCH 2000
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TOTAL PETROLEUM HYDROCARBONS (TPH-DIESEL) CONCENTRATIONS IN SOIL EPTC AST AND 66-kV SWITCHYARD AREAS

DEPTH 4-6 FT. BELOW GROUND SURFACE

Proj. No.:	66-99SB018.00	Date:	MARCH 2000
Project:	REDONDO GENERATING STATION REDONDO BEACH, CALIFORNIA	CAD ID.:	PH10_4-6
		Figure:	Fig. 4-3

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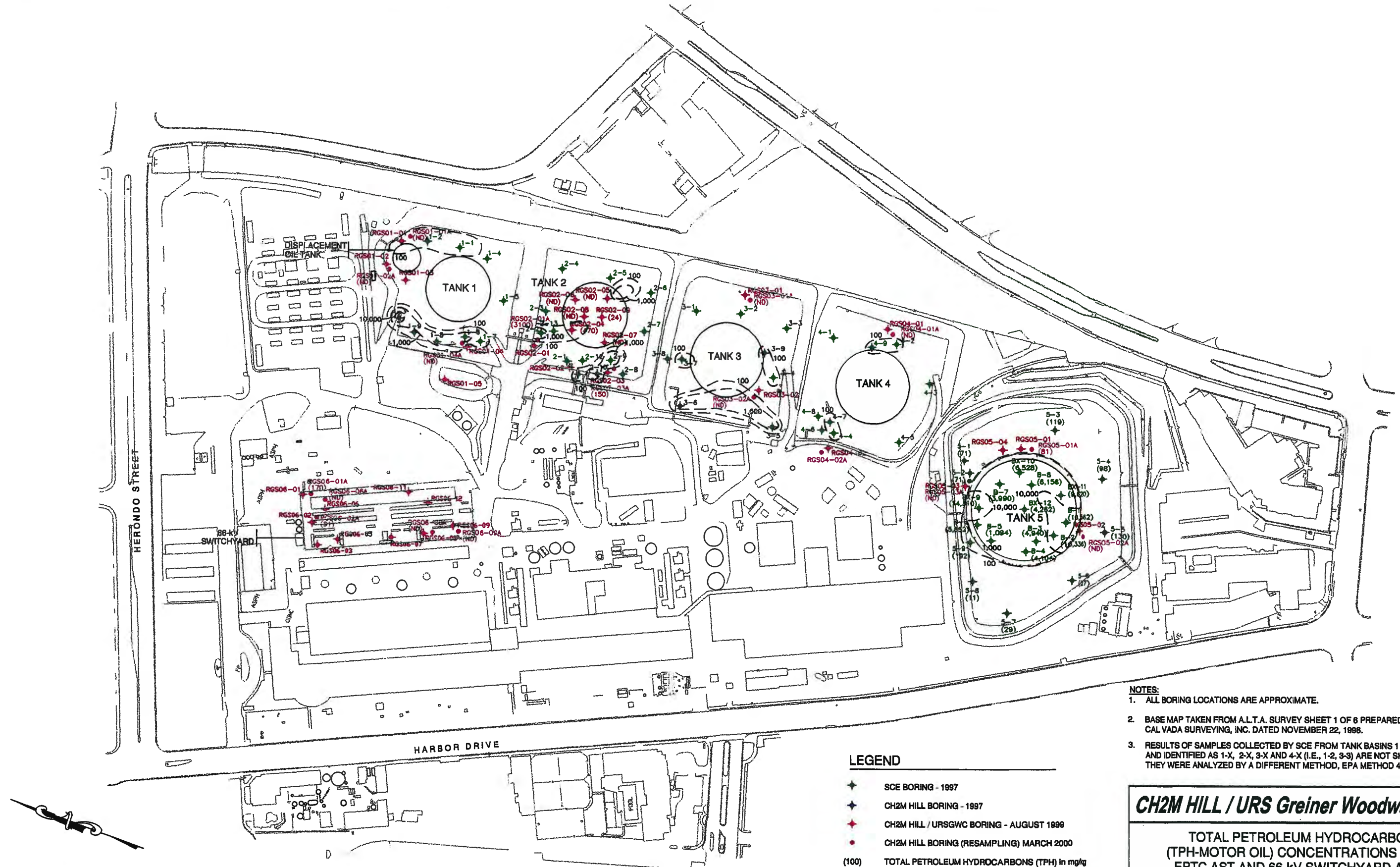

Graphic Scale

(In Feet)

1 inch = 100 ft.

LEGEND

- SCE BORING - 1997
- CH2M HILL BORING - 1997
- CH2M HILL / URSGWC BORING - AUGUST 1999
- CH2M HILL BORING (RESAMPLING) MARCH 2000
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CH2M HILL / URS Greiner Woodward Clyde

TOTAL PETROLEUM HYDROCARBONS
(TPH-MOTOR OIL) CONCENTRATIONS IN SOIL
EPTC AST AND 66-kV SWITCHYARD AREAS

DEPTH 0-2 FT. BELOW GROUND SURFACE

Proj. No.:	66-99SB018.00	Date:	MARCH 2000
Project:	REDONDO GENERATING STATION REDONDO BEACH, CALIFORNIA	CAD ID.:	PH25_0-2
		Figure:	Fig. 4-4

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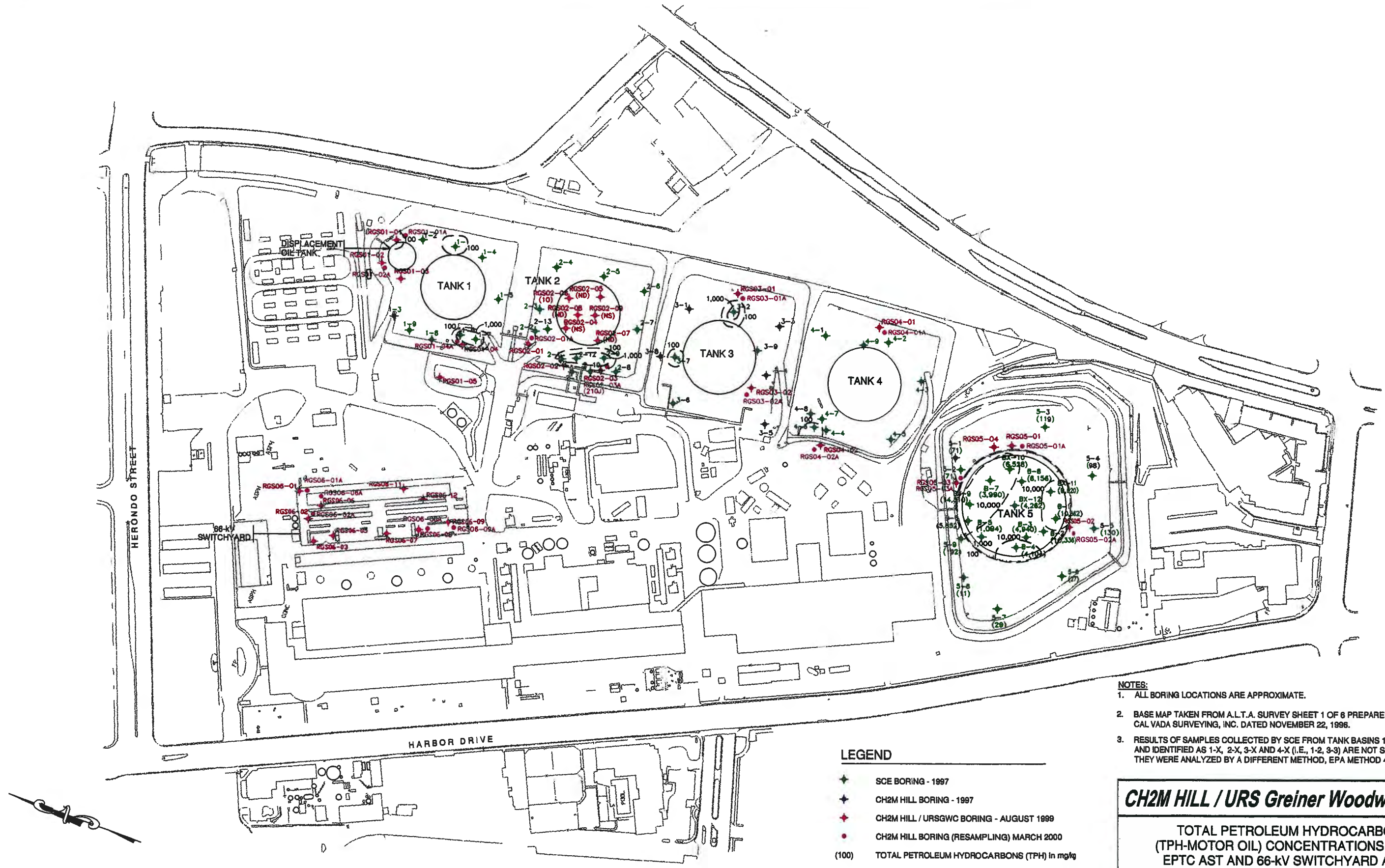

LEGEND

- SCE BORING - 1997
- CH2M HILL BORING - 1997
- CH2M HILL / URSGWC BORING - AUGUST 1999
- CH2M HILL BORING (RESAMPLING) MARCH 2000
- (100) TOTAL PETROLEUM HYDROCARBONS (TPH) in mg/kg
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CH2M HILL / URS Greiner Woodward Clyde

TOTAL PETROLEUM HYDROCARBONS
(TPH-MOTOR OIL) CONCENTRATIONS IN SOIL
EPTC AST AND 66-kV SWITCHYARD AREAS

DEPTH 2-4 FT. BELOW GROUND SURFACE

Proj. No.:	66-99SB018.00	Date:	MARCH 2000
Project:	REDONDO GENERATING STATION REDONDO BEACH, CALIFORNIA	CAD ID.:	PH25_2-4
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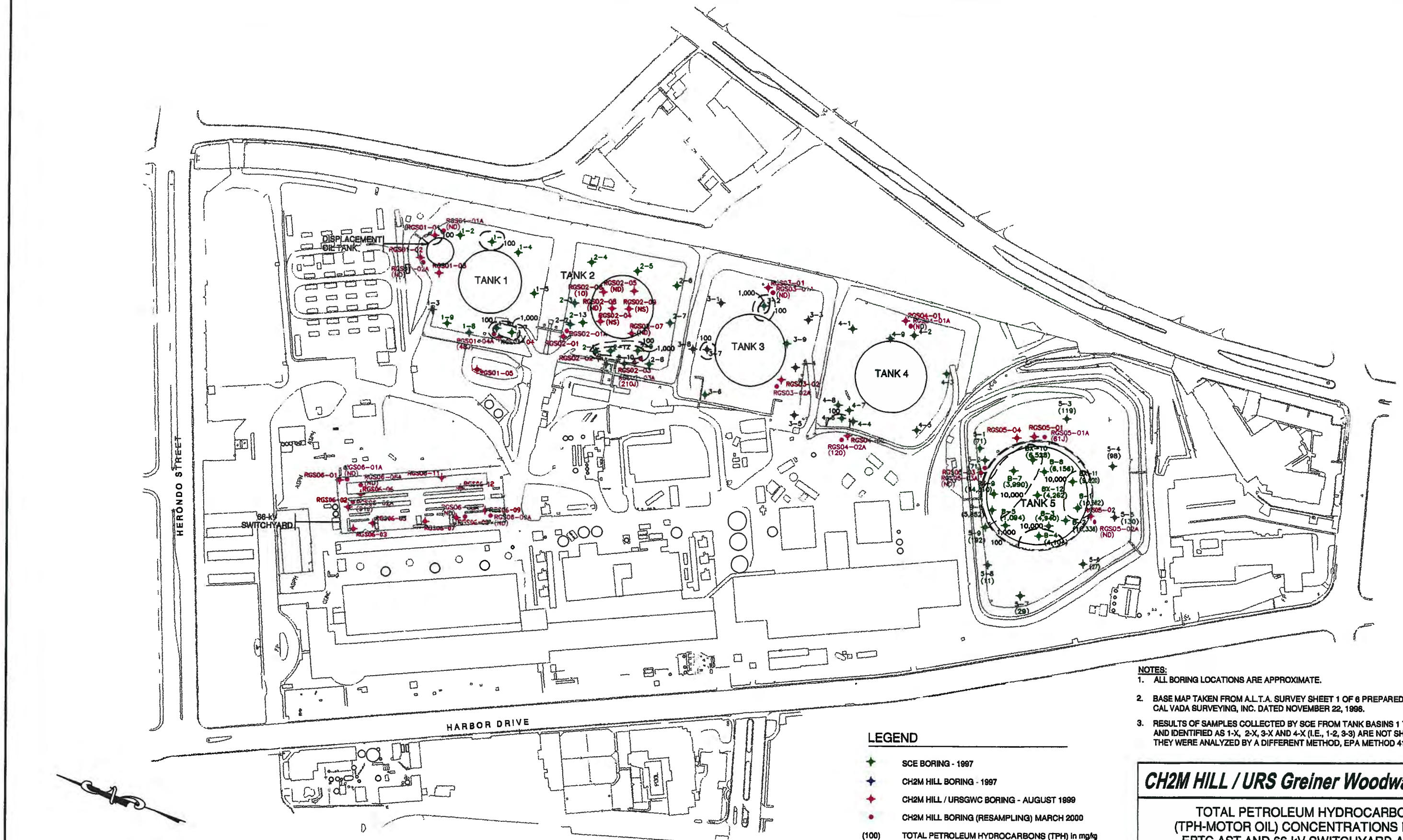

LEGEND

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- CH2M HILL BORING - 1997
- CH2M HILL / URSGWC BORING - AUGUST 1999
- CH2M HILL BORING (RESAMPLING) MARCH 2000
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CH2M HILL / URS Greiner Woodward Clyde

TOTAL PETROLEUM HYDROCARBONS (TPH-MOTOR OIL) CONCENTRATIONS IN SOIL EPTC AST AND 66-kV SWITCHYARD AREAS

DEPTH 4-6 FT. BELOW GROUND SURFACE

Proj. No.:	66-99SB018.00	Date:	MARCH 2000
Project:	REDONDO GENERATING STATION REDONDO BEACH, CALIFORNIA	CAD ID.:	PH25_4-6
		Figure:	Fig. 4-6

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April1998, Site Investigation Report for Soil and Groundwater

FINAL REPORT

PRIVILEGED AND CONFIDENTIAL
ATTORNEY WORK PRODUCT

SITE INVESTIGATION REPORT FOR SOIL AND GROUNDWATER REDONDO BEACH GENERATING STATION REDONDO BEACH, CALIFORNIA

Prepared for
Morrison & Foerster
555 West Fifth Street
Los Angeles, California 90013-1024

May 1998

Woodward-Clyde

Woodward-Clyde
2020 East First Street, Suite 400
Santa Ana, California 92705
97SB044

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SECTIONONE Introduction

1.1 SCOPE AND SITE DESCRIPTION

This Site Investigation Report for Soil and Groundwater (Report) specific to the Redondo Beach Generating Station (RBGS) has been prepared by Woodward-Clyde International-Americas (WCIA) for and authorized by AES Enterprises, Inc. (AES). This Report will be presented to Southern California Edison Company (SCE) pursuant to the Asset Sale Agreement. SCE is the current owner of the RBGS, and sale to AES is pending. This Report is based substantially on the Workplan (January 1998) presented to AES and SCE (Woodward-Clyde, 1997a).

The primary objective of implementing the activities as described in this Report is to investigate areas that were not previously sampled or that the previous sampling programs did not adequately address. Secondary objectives include obtaining additional data for establishing levels of contamination in soil and groundwater at the site at the time of the transfer of property ownership from SCE to AES, and collecting data to confirm a portion of the results of the Phase II Environmental Site Assessment (ESA) was conducted by CH2M HILL in 1997 for SCE. The ESAs were conducted to evaluate soil and groundwater conditions at site features identified as recognized environmental conditions (RECs) and areas of potential concern (AOPCs) (CH2M HILL, 1997a).

RBGS is located at 1100 Harbor Drive in Redondo Beach, California, as shown on Figure 1-1. A site plan of the facility is shown on Plate 1 in Appendix A. The site is located east of King Harbor Marine and the Pacific Ocean. The site is bordered by Hermondo Street to the north and residential and commercial property to the east and north, respectively.

For purposes of this Report, the site is defined as the portion of the property being purchased by AES. AES property is highlighted in yellow on Plate 1 in Appendix A and the portions of the property that are being retained by SCE are highlighted in red.

As provided in the asset sale agreement, the first power plant was constructed on the site in approximately 1906-1907. Generating units became operational between 1907 and 1910. Certain equipment, including but not necessarily limited to the generating units, was dismantled and removed in approximately 1934-1935. The power plant building was demolished in approximately 1946. Equipment, structures or other facilities associated with the above-described power plant, including but not limited to tanks, impoundments, and piping, may have been abandoned in place or demolished and buried in place.

SECTIONONE Introduction

RBGS has been operated by SCE as an electric generating station since 1944. The facility is comprised of eight gas/oil/distillate-fueled electric power generating units.

The predominant structures located on the property include steel aboveground storage tanks (ASTs) for petroleum products, process units that include boilers, tanks, and various mechanical equipment and vessel, retention basins, and buildings for offices and control and maintenance operations. There are eight Powerblocks that are part of the RBGS where energy is converted from a fuel (fuel oil, distillate, or natural gas) to electricity. Contained in the Powerblocks are various structures (such as battery rooms, lube oil rooms, elevators, various sumps, and control rooms) and equipment (such as boilers, pre-heaters, blowers, and turbines) (CH2M HILL, 1997a).

The site is located on a former marsh and low lying area that was filled to the present relatively flat topography (CH2M HILL, 1997b). Dewatering wells are operated by SCE due to the municipal water district operating injection wells in the vicinity of the RBGS. Groundwater is reported at approximately 3 to 5 feet below ground surface (bgs) in the fuel tanks areas and at about 10 feet bgs in the powerblock areas. Currently, the shallow groundwater is reported to flow in a southeastern direction. Prior to the operation of the dewatering system, shallow groundwater flow was westerly, toward the ocean.

2.1 INTRODUCTION

The following section is a summary of the Phase I and Phase II ESA findings (CH2M HILL) for each AOPC and REC identified at RBGS. Table 2-1 lists each AOPC and REC, the Phase I and Phase II Investigation work performed, the Phase II conclusions by CH2M HILL. Sample locations from previous investigations are shown on Plate 1 in Appendix A.

2.2 PREVIOUS SITE AREA INVESTIGATIONS

2.2.1 Displacement Oil Tank Area

The displacement oil tank located at the northeast corner of the site was reported to have been remediated following a spill that occurred from a leak in the tank. The Phase I ESA indicated that based on their review of a SCE report, oil contamination may still exist below the tank.

CH2M HILL collected soil and groundwater samples from two locations near the tank, RBH15 and RBH16. Samples were analyzed for Total Petroleum Hydrocarbons-diesel range (TPH-d). "De minimis" levels were reported in soil. Total TPH-d in groundwater was 2.73 milligrams per liter (mg/L). CH2M HILL recommended no further action at this time and that agency negotiations, additional sampling, and/or remediation may be necessary or appropriate as part of decommissioning.

2.2.2 Retention Basins

Subsurface investigation of surface impoundments, including retention basins, is currently being conducted by SCE in response to a corporate-wide negotiated order from the Department of Toxic Substance Control (DTSC). According to CH2M HILL in the Phase I ESA, past use of the retention basins warranted the ongoing investigation. Because of the ongoing soil and groundwater sampling, investigation or assessment was outside the scope of the Phase II ESA.

2.2.3 Former Underground Storage Tank Area

Three underground storage tanks (USTs) were reportedly removed in 1986 northeast of the administration office. The tanks were reported to contain 250 gallons of kerosene, naphtha, and thinner-product solvents. Previous investigations detected TPH by U.S. Environmental Protection Agency (EPA) Method 418.1 from 106 milligrams per kilogram (mg/kg) to 17,800 mg/kg at 13 feet bgs. TPH in groundwater ranged from 6 mg/L to 9 mg/L.

For the Phase II ESA, two soil borings were sampled (RBH17 and RBH18) and analyzed for TPH-d and benzene, toluene, ethylbenzene, and xylene (BTEX). One groundwater sample (RBH17) was collected and analyzed for TPH-d and BTEX. "De minimis" concentrations of TPH-d in soil and "de minimis" levels of TPH-d and toluene in groundwater were reported by CH2M HILL. CH2M HILL recommended a screening evaluation to demonstrate the safety of the site for industrial use and/or obtain a letter from a regulatory agency that confirms no risk management or remediation is needed for continued industrial use.

2.2.4 Fuel Oil Storage Tank 1 and Fuel Oil Heater Area

In the Phase I ESA, CH2M HILL indicated that SCE reported elevated levels of diesel fuel and heavy hydrocarbons in soil. SCE reportedly removed the contaminated soil except for approximately 15 cubic yards that remain directly below the heater unit.

The fuel oil storage tank 1 and fuel oil heater were investigated as part of the Phase II ESA. Three soil borings were advanced (RBH01, RBH02, and RBG58). Soil samples were analyzed for TPH-d and one groundwater sample was collected at RBH01 and analyzed for TPH-d and volatile organic compounds (VOCs). "De minimis" levels were reported (up to 6,800 mg/kg total TPH-d) in soil and below detection limits in groundwater. CH2M HILL recommended no further action at that time and that agency negotiations, additional sampling, and/or remediation may be necessary or appropriate as part of decommissioning.

2.2.5 Fuel Oil Storage Tank 2

The Phase II ESA (CH2M HILL, 1997b) reported that corrosion protection oil and some localized spill locations are present in fuel oil storage tank 2 area. Four soil borings were advanced (RBH03, RBH04, RBH05, and RBH59) near the storage tank. Eight soil samples and one duplicate sample were collected and analyzed for TPH-d. One groundwater sample and one duplicate sample were collected at RBH04 and analyzed for TPH-d. The investigation was reported limited due to restricted access. "De minimis" concentrations of TPH-d was reported in soil. CH2M HILL recommended no further action at this time and that agency negotiations, additional sampling, and/or remediation may be necessary or appropriate as part of decommissioning.

2.2.6 Fuel Oil Storage Tank 3

The Phase II ESA (CH2M HILL, 1997b) reported that corrosion protection oil and some localized spill locations are present in fuel oil storage tank 3 area. Four soil borings were advanced (RBH06, RBH07, RBH08, and RBH60) near the storage tank. Eight soil samples were collected and analyzed for TPH-d. One groundwater sample was collected at RBH07 and analyzed for TPH-d. The investigation was reported limited due to restricted access. "De minimis" concentrations of TPH-d were reported in soil (total TPH-d up to 3,500 mg/kg) and groundwater. CH2M HILL recommended no further action at this time and that agency negotiations, additional sampling, and/or remediation may be necessary or appropriate as part of decommissioning.

2.2.7 Fuel Oil Storage Tank 4

The Phase I ESA indicated that SCE reported that the number 4 fuel oil storage tank had overflowed in the past. The date of the spill is unknown and was reportedly cleaned up. No documentation describing the spill cleanup was available for the Phase I ESA.

For the Phase II ESA, four soil borings were advanced (RBH09, RBH10, RBH11, and RBH61) near the storage tank. Eight soil samples and one duplicate were collected and analyzed for TPH-d. No groundwater sample was collected at fuel oil storage tank 4. The investigation was reported limited due to restricted access. "De minimis" concentrations of TPH-d were reported in soil. CH2M HILL recommended no further action at this time and that agency negotiations, additional sampling, and/or remediation may be necessary or appropriate as part of decommissioning.

2.2.8 Fuel Oil Storage Tank 5

The Phase II ESA (CH2M HILL, 1997b) reported that corrosion protection oil and some localized spill locations are present in fuel oil storage tank 5 area. Three soil borings were advanced (RBH12, RBH13, and RBH14) near the storage tank. Six soil samples and one duplicate sample were collected and analyzed for TPH-d. One groundwater sample was collected at RBH13 and analyzed for TPH-d. The investigation was reported limited due to restricted access. "De minimis" concentrations of TPH-d were reported in soil and groundwater (3.1 mg/L). CH2M HILL recommended no further action at this time and that agency

negotiations, additional sampling, and/or remediation may be necessary or appropriate as part of decommissioning.

2.2.9 Oil/Gas Separator Area (Natural Gas Pit Area)

The Phase I ESA reported that a previous investigation of soil in the oil/gas separator area concluded that low levels of soil contamination exist that do not require immediate remedial action. The Phase I ESA reported discrepancies between the laboratory data and the field screening results. Field notes indicated a strong odor of an unknown substance within the top 5 feet of the ground surface adjacent to the oil/gas separator.

Four borings were advanced in the general area of the separators (RBH54 through RBH57) and selected soil and groundwater samples were analyzed for TPH-d, TPH carbon range C4-C10, VOCs and polychlorinated biphenyls (PCBs). PCBs were not reported above detection limits in soil and groundwater samples. Benzene was detected at 740 micrograms per kilogram (µg/kg) at 13 to 13.5 feet bgs at RBH54 and 640 µg/kg at 15 to 15.5 feet bgs at RBH57. Benzene was detected in one out of four groundwater samples at 550 µg/L at RBH54. Other VOCs were detected including toluene (610 µg/kg), butylbenzene (5,740 µg/kg), trans-1,2-dichloroethene (2,520 µg/kg), ethylbenzene (34,000 µg/kg), isopropylbenzene (3,720 µg/kg), naphthalene (11,406 µg/kg), propylbenzene (11,800 µg/kg), and xylene (12,000 µg/kg). VOCs detected in groundwater include ethylbenzene (460 µg/L), isopropylbenzene (40 µg/L), naphthalene (167.6 µg/L), propylbenzene (95 µg/L), toluene (12 µg/L), and xylene (180 µg/L). TPH was detected in the C4-C10 range at 4,400 mg/kg at RBH54 at 13 to 13.5 feet bgs. TPH in the C10 to C24 range was detected at 16,000 mg/kg and in the C25 to C40 range at 8,300 mg/kg at RBH57 at 15 to 15.5 feet bgs. TPH detected in groundwater includes TPH in the C25 to C40 range at 380 mg/L at RBH55.

Based on the results of the Phase II ESA, CH2M HILL recommended a screening evaluation to demonstrate the safety of the site for industrial use and/or obtain a letter from a regulatory agency that confirms no risk management or remediation is needed for continued industrial use.

2.2.10 Valve Pit/Oily Waste Sump at Units 7 and 8

The Phase I ESA indicated that a subsurface investigation was conducted by SCE for the valve pit/oily waste sump at Units 7 and 8. The investigation indicated that leakage had occurred with contamination in the subsurface soils below the valve pit. Measures were reportedly taken by

SCE to stop the leakage, but the contamination was left in place due to the reported nonhazardous material characteristics of the soil and the difficulty of remediation.

No samples were collected for the Phase II ESA in the valve pit/oily waste sump. The Phase II ESA indicates that no constituents of potential concern were identified in the area and that there is no evidence that soil beneath the valve pit has been impacted by TPH below the pit bottom. CH2M HILL recommended no further action at this time and that agency negotiations, additional sampling, and/or remediation may be necessary or appropriate as part of decommissioning.

2.2.11 Transformers

The Phase I ESA reported that the transformers are documented to contain less than 50 parts per million (ppm) PCBs. The transformers were reported to have contained higher concentrations of PCBs before 1976. No records of releases of oil were discovered in the Phase I ESA.

The main transformer areas located near Units 1 through 4 and Units 5 and 6 were investigated as part of the Phase II ESA. Wipe samples, soil samples (RBH19 through RBH21, RBH23, RBH24, RBH27, and RBH28) and three groundwater samples were collected. PCBs were nondetect in all samples. CH2M HILL recommended no further action.

2.2.12 Powerblocks

According to the Phase I ESA, oil staining was observed on the floors of the powerblocks around oil-containing equipment such as pumps and tanks (CH2M HILL, 1997a). No records of soil sampling or spills were reported for the powerblocks. Because the oil could have seeped through cracks or joints in the concrete or through the pores in the concrete, the Phase I ESA concluded that is was possible that there may be contaminated soils beneath the powerblock area.

Three powerblock areas (Units 1 through 4, Units 5 and 6, and Units 7 and 8) were investigated as part of the Phase II ESA. The investigation was limited to the perimeter of the powerblocks. Near Units 1 through 4, four soil borings (RBH19 through RBH22) were advanced. Soil samples were collected at 1 and 5 feet bgs and analyzed for TPH-d and metals. TPH-d and metals were at "de minimis" levels. Two groundwater samples were collected and analyzed for TPH-d and metals. TPH-d was not detected above detection limits in the groundwater samples. Thallium and mercury were detected above the maximum contaminant levels (MCLs).

Near Units 5 and 6, four soil borings were advanced (RBH23 through RBH26) and analyzed for TPH-d and metals. Eight soil samples and two duplicates were collected down to a depth of 6 feet bgs. TPH-d and metals were at "de minimis" levels. Two groundwater samples were collected and analyzed for TPH-d and metals. TPH-d was not detected above detection limits in the groundwater samples. Thallium was above MCLs.

Four soil borings (RBH27 through 30) were advanced near powerblock Units 7 and 8. Nine soil samples and one duplicate were collected and analyzed for TPH-d and metals. One sample was analyzed for VOCs. Tetrachloroethylene was detected at 81 µg/kg (below EPA Region IX Industrial Preliminary Remediation Goals [PRGs]) at 10 feet bgs. No other VOCs were detected in the sample. TPH-d was detected at "de minimis" levels (up to total TPH-d of 265 mg/kg) in soil. A groundwater sample was collected and analyzed for TPH-d and metals. TPH-d was not above detection limits. Seven metals were above MCLs in the groundwater sample from RBH29. CH2M HILL recommended no further action at this time and that agency negotiations, additional sampling, and/or remediation may be necessary or appropriate as part of decommissioning.

2.2.13 Pipelines

The Phase I ESA identified the pipelines as an area of potential concern. Subsurface and aboveground pipelines have been used to convey fuel oil from the tanks to the powerblocks and they have never been leak tested.

No samples were collected for the Phase II ESA because there was no visual evidence that the pipelines had leaked or documentation of leaks or spills. Selected pipelines were investigated with other site features such as the pump and transfer stations. CH2M HILL recommended no further action for the pipelines.

2.2.14 Primary Fuel Oil Pumping Area

The Phase I ESA indicated that the primary fuel oil pumping area was reported by SCE to be a location of potentially contaminated soils. No known investigations or remediation had been completed in this area.

The primary fuel oil pumping area was investigated in the Phase II ESA due to the potential for leaks to the subsurface. One soil boring, RBH38, was advanced and a sample and a duplicate

were collected at 13 feet bgs and analyzed for TPH-d. "De minimis" levels were reported. One groundwater sample was collected at 11 feet bgs and analyzed for TPH-d. TPH in groundwater was below detection limits. Soil samples were not collected above the shallow groundwater. CH2M HILL recommended no further action at this time and that agency negotiations, additional sampling, and/or remediation may be necessary or appropriate as part of decommissioning.

2.2.15 Fuel Oil Pipeline

The Phase I ESA reported that the fuel oil pipeline located on the north side of the central retention basin was reported by SCE to have undergone repair and subsurface soil remediation in the past. It was reported that the south side of the retention basin may still have some contamination as a result of the pipeline leak. There was no documentation available from SCE regarding the leak and remediation for the Phase I ESA.

No sampling of the fuel oil pipeline in the area of the central retention basin was conducted as Part of the Phase II ESA because investigation of this area is included within the retention basin investigation currently being conducted by SCE in response to a DTSC order. CH2M HILL made no recommendation for the fuel oil pipelines.

2.2.16 Resin Tanks

The Phase I ESA reported that the resin tanks located near the central retention basin was reported by SCE to have potential for subsurface contamination.

No sampling of the resin tanks in the area of the central retention basin was conducted as part of the Phase II ESA because investigation of this area is included within the retention basin investigation currently being conducted by SCE in response to a DTSC order. CH2M HILL made no recommendation for the resin tanks.

2.2.17 Hazardous Waste Storage Area

The hazardous waste storage area is located west of the 220 kilovolt (kV) switchyard. The area was identified in the Phase II as an area where spills of hazardous waste may have occurred that may have resulted in potential impacts to soil and groundwater. Two borings (RBH32 and RBH62) were advanced and soil and groundwater samples were analyzed for TPH-d, metals, PCBs, and VOCs. In soil, PCBs were nondetect. There was one elevated concentration of lead

at 2,550 mg/kg at 5.4 to 6 feet bgs in RBH62. Methylene chloride, 1,1,1-trichloroethane, toluene, 1,2,4-trimethylbenzene, and 1,3,5 trimethylbenzene were detected at RBH62 in the 0.5 to 1.2 foot bgs sample. TPH-d was at "de minimis" levels (total TPH-d at 64 mg/kg). In groundwater the following VOCs were detected below MCLs: 1,1-dichloroethane, toluene, carbon tetrachloride, chloroethane, 1,1-dichloroethene, 1,1,1 trichloroethane, trichlorofluoromethane. Four metals (beryllium, cadmium, lead, and mercury) were above MCLs. CH2M HILL recommended no additional sampling or remediation at this time and that agency negotiations, additional sampling, and/or remediation may be necessary or appropriate as part of decommissioning.

2.2.18 Secondary Fuel Pumping Area

The secondary fuel pumping area was investigated in the Phase II ESA due to the possibility of potential leaks and oil observed on soil and concrete in the area. Two soil borings (RBH39 and RBH40) were advanced and analyzed for TPH-d. "De minimis" levels of TPH-d was detected in soil and groundwater (total TPH-d 1.3 mg/L). CH2M HILL recommended no further action.

2.2.19 Fuel Oil Pumping Station

The fuel oil pumping station was investigated in the Phase II ESA due to the possibility of potential releases and oil observed on soil and concrete in the area. Two soil borings (RBH41 and RBH42) were advanced and four samples were analyzed for TPH-d. Total TPH-d was detected up to 3,900 mg/kg at 0.5 to 1 foot bgs. TPH-d was not above detection limits in groundwater. CH2M HILL recommended no additional sampling or remediation at this time and that agency negotiations, additional sampling, and/or remediation may be necessary or appropriate as part of decommissioning.

2.2.20 Switchyard

Two switchyard areas, the 66 kV and the 220 kV switchyards, were investigated in the Phase II ESA due to the possibility of potential releases. The switchyards are on the portion of the site that SCE is retaining. Three soil borings (RBH43 through RBH45) were advanced around the perimeter of the 66 kV switchyard and four borings (RBH46 through RBH49) were advanced around the perimeter of the 220 kV switchyard. Samples were analyzed for TPH-d and PCBs. PCBs were below detection limits. "De minimis" concentrations of TPH-d in soil were reported;

total TPH-d was 1,154 mg/kg at RBH49. CH2M HILL recommended no additional sampling or remediation at this time and that agency negotiations, additional sampling, and/or remediation may be necessary or appropriate as part of decommissioning.

2.2.21 Demineralizer Sump Area

The demineralizer sump area was investigated as part of the Phase II ESA. One soil boring (RBH51) was advanced and analyzed for metals only. Two soil samples and one duplicate was analyzed from 10 to 10.5 feet bgs and from 12 to 12.5 feet bgs. Soil boring RBH50 was not advanced due to subsurface obstruction. One groundwater sample was collected and analyzed for metals. "De minimis" concentrations in soil were reported. CH2M HILL recommended no additional sampling or remediation at this time and that agency negotiations, additional sampling, and/or remediation may be necessary or appropriate as part of decommissioning.

2.2.22 Solvent Wash Station

The solvent wash station was investigated as part of the Phase II ESA. The solvent wash station was reported by SCE to be no longer in use. Three soil boring s (RBH52, RBH63, and RBH64) were advanced and analyzed for TPH-d, VOCs, and metals. The samples were collected from approximately 0.5 foot bgs and 5.0 feet bgs. VOCs and TPH-d were detected in the soil. VOCs in soil included methylene chloride, tetrachloroethene (PCE), trichloroethene (TCE), and toluene. In groundwater the following VOCs were detected below MCLs: benzene, dichloroethene, PCE, toluene, 1,1,1-trichloroethane, and TCE. TPH was detected in groundwater above detection limits. Three metals (lead, mercury, and thallium) were detected above their MCLs. CH2M HILL recommended no additional sampling or remediation at this time and that agency negotiations, additional sampling, and/or remediation may be necessary or appropriate as part of decommissioning.

2.2.23 Pig Launching Area

The pig launching area was investigated as part of the Phase II ESA due to the possibility of leaks in the past. The pig launching area is on the portion of the site that is not being sold by SCE. One soil boring, RBH53, was advanced to approximately 4.5 feet bgs and sampled for TPH-d. "De minimis" levels of TPH-d were reported. CH2M HILL recommended no further action.

2.2.24 Other Areas of Concern

At the end of February 1998, AES was notified by SCE of an additional site, the Service Water Tank Area near Units 1 through 4, that may have regulatory environmental issues with regard to total lead. It was reported by CH2M HILL, the SCE consultant, that total lead at this site was detected at a concentration of 2,600 mg/kg, which exceeded the Phase II ESA screening level criteria of 1,000 mg/kg.

3.1 GEOLOGY

3.1.1 Regional Geology

The RBGS is located in the central section of the southwestern block of the Los Angeles Structural Basin, which forms a transition between the northern portion of California's Peninsular Ranges Geologic Province and the southern portion of the Transverse Ranges Geologic Province (Yerkes, et. al., 1965). The Peninsular Ranges Province is characterized by northwest-trending mountains and valleys formed largely by a system of active right-lateral, strike-slip faults with a similar trend. The Transverse Range Province is characterized by east-west trending mountains and intervening valleys that were formed by a series of east-west trending fold belts and active left-lateral reverse and thrust faults. Over geologic time, the region has been influenced by fluvial, marine, and littoral depositional processes as sea levels have risen and fallen and as tectonic forces have changed the regional landscape.

The southwestern block of the Los Angeles Structural Basin is the exposed portion of a much larger tract, most of which is beneath the Pacific Ocean (Yerkes, et. al., 1965). The block primarily consists of a low plain that extends from the Santa Monica Mountains at the northwest to Long Beach to the southeast. The Palos Verdes Hills represents the southwestern extremity of the structural element and is the predominant topographic feature of the southwestern block. Major structural elements of this block include a southward plunging anticline occurring between the Palos Verdes Hills Fault Zone (PVHFZ) and Newport-Inglewood Structural Zone (NISZ). Both the PVHFZ and the NISZ are considered active faults by the California Division of Mines and Geology. The PVHFZ is characterized by both strike slip and vertical movement and is considered capable of generating earthquakes at least as strong as the NISZ. The NISZ is characterized by a series of northwest-trending folded sedimentary units and off-set predominantly right lateral strike slip faults (and associated normal and reverse faults) passing on-shore at Newport Beach and continuing to the vicinity of Santa Monica (Barrows, 1974).

The structurally deformed sediments in and around both the PVHFZ and the NISZ are expressed at the surface by a series of low hills (e.g. Signal Hill and Dominguez Hills) and in the subsurface by the development of oil fields associated with anticlineal structures. The RBGS is situated over the northern end of the Wilmington Oil Field. The NISZ is seismically active and is associated with the 1933 Long Beach earthquake (Richter magnitude of 6.3). The State of California Fault Map indicates the active subsurface trace of the PVHFZ passes about 2 miles to

the southwest of the RBGS and the NISZ passes approximately 6 miles to the northeast of the RBGS. Due to the proximity of both these zones and other known seismically active faults in the Los Angeles area, the nature of the sediments below the site, and the proximity of the groundwater table to the surface, the RBGS would be likely prone to liquefy under conditions of long duration strong seismic shaking.

3.1.2 Local Geology

The RBGS site is situated in a gently rolling coastal area within the City of Redondo Beach, just north of the Palos Verdes Hills. The RBGS was built over coastal sand dunes and filled wetland area. The USGS topographic map indicates the RBGS is between 20 feet above mean sea level (msl) at the north end of the generating station and less than 9 feet above msl at the south end of the station.

The site is underlain by a thick, interbedded sequence of Quaternary clays, silts, sands, and gravels. These Quaternary deposits are underlain by Tertiary sedimentary rocks, including claystones, siltstones, and sandstones. Schist and gneissic basement rocks lie beneath the sedimentary rocks at depths of about 6,700 feet.

The youngest and uppermost deposits within the Quaternary sequence consist of late Pleistocene sands that form the sand hills on which the site lies. These deposits are referred to in the literature as geologically Recent (State of California Department of Water Resources, 1961).

Old Dune Sands are apparently remnants of an ancient offshore sand bar and ancient dune field. The dune sands are underlain by fine-grained coastal wetland deposits that, in turn, are underlain by a thick sequence of Tertiary marine and continental formations. These formations were originally deposited in the subsiding Los Angeles Basin, have been folded and locally faulted, and lie beneath the Pleistocene deposits. This complex structure present in the Tertiary rocks resulted in the formation of traps for the extensive oil reserves underlying many parts of the Los Angeles Basin.

3.2 HYDROGEOLOGY

The DTSC has jurisdiction over remediation activities at the RBGS. With regard to groundwater issues, RBGS is situated on the seaward side of a the Los Angeles Flood Control District (LAFCD) / Orange County Water District (OCWD) hydraulic barrier project.

3.2.1 Regional Hydrogeology

The RBGS site is located within the West Coast Ground Water Basin, which is bordered by the Newport-Inglewood Fault on the east, Santa Monica Bay on the west, the Ballona Gap on the north, and the Palos Verdes Hills on the south. The site vicinity is underlain by three relatively shallow aquifers (to a depth of approximately 100 feet bgs). Each of the aquifers is composed of sand and gravel and each is separated from one another by an aquitard consisting of clay. The aquitards act as barriers to the migration of groundwater between the aquifers.

The upper, unconfined aquifer is the Old Dune Sand Aquifer. Groundwater is generally present in the Old Dune Sand Aquifer at depths ranging from approximately 12 to 20 feet bgs in the site vicinity. The base of the Old Dune Sand Aquifer is located approximately 60 feet bgs. It is underlain by the fine-grained wetlands sediments that act as an aquitard in the area of the site. This aquitard separates the Old Dune Sand Aquifer from the underlying Gage Aquifer and is approximately 5 feet thick at the site. The Gage Aquifer is generally believed to be less than 50 feet thick in this area (State of California Department of Water Resources, 1961).

The Gage Aquifer is separated from the underlying Silverado Aquifer by the El Segundo Aquitard. This aquitard is also a few feet thick and may be absent in some areas. The Silverado Aquifer is a fresh water source contained in subsurface sedimentary deposits. The potentiometric surface in wells completed in the Gage and Silverado Aquifers have been reported to be higher than those for wells completed in the Old Dune Sand Aquifer, indicating the presence of an upward vertical groundwater gradient between the aquifers.

3.2.2 Local Hydrogeology

Previous site investigations by CH2M HILL (1997a,b) have indicated that three lithologic units are present, consisting of the Old Dune Sand aquifer, the wetland deposits that form an aquitard, and the underlying Gage and Silverado aquifers.

The Old Dune Sand aquifer consists of medium-dense, fine-to-medium sand overlain with minor gravel deposits. This aquifer is approximately 20 feet thick. Fill material placed in depressional zones of the Old Dune Sand formation is difficult to distinguish due to its similar sandy characteristics and color. Perched groundwater exists within this formation due to the low permeability of the underlying wetland deposits.

The wetland deposits form an aquitard composed of soft clay, silt, and peat. This low-permeability confining layer is up to 6 feet thick. Over the western portion of the RBGS, this confining layer separates the perched groundwater in the Old Dune Sand aquifer from the confined groundwater of the Gage and Silverado aquifers. However, the wetland deposits are discontinuous along the eastern portion of the RBGS, where the Old Dune Sand aquifer is in direct contact with the underlying Gage aquifer.

The Gage and Silverado aquifers consists of interbedded fine-to-coarse, dense sand with gravel, pebbles, and occasional wood fragments. These units are about 140 to 150 feet thick.

The municipal water district operates groundwater injection wells in the vicinity of the RBGS. The resulting rise in the water table due to the injection well programs has created a need for SCE to operate dewatering wells at the RBGS. Currently, groundwater at the site is approximately 3 to 5 feet bgs in the fuel tank areas, where the ground surface elevation is about +8 feet to +12 feet msl. However, within the power block areas, where the average ground surface elevation is about +19 feet msl, groundwater is encountered at depths of about 10 to 13 feet bgs. Natural groundwater flow in the area of the RBGS has been altered because of the operation of groundwater dewatering systems. The dewatering systems are designed to remove perched groundwater from the fuel tank and pump station areas. Prior to operation of these systems, groundwater flow was westerly, toward the ocean. Currently, however, shallow groundwater flows in a southeastern direction (CH2M HILL, 1997b).

4.1 INTRODUCTION

The Phase I and Phase II ESAs, and the Woodward-Clyde Workplan identified and discussed a total of 21 AOPCs. Based on the discussion/rationale presented in the Woodward-Clyde Workplan, the following areas were not considered for additional sampling under this scope of work:

Area	Description
4	Fuel Oil Storage Tank 1 and Fuel Oil Heater Area
5	Fuel Oil Storage Tank 2
6	Fuel Oil Storage Tank 3
7	Fuel Oil Storage Tank 4
8	Fuel Oil Storage Tank 5
11	Transformer Area
18	Secondary Fuel Pumping Area
20	Switchyard
21	Demineralizer Sump Area
23	Pig Launching Area

Other site areas have also been deferred from further investigation until additional documents can be obtained from SCE and reviewed. Due to the compressed timeframe for production of this Report, documentation requested from SCE was either received too late for sampling to occur or has not been received as of the date of this Report. Further due diligence of the following sites may be recommended based on a review of the additional data:

Area	Description
2	Retention Basins
16	Resin Tank Area
24	Natural Gas Pit Area
SWT	Service Water Tank Area

Thus, the site areas where additional sampling and analysis occurred during field investigations were as follows:

Area	Description
3	Former UST Area
9	Oil/Gas Separator Area
10	Valve Pit/Oily Waste Sumps Units 7 and 8
12	Powerblocks
14	Primary Fuel Oil Pumping Area
15	Fuel Oil Pipeline
17	Hazardous Waste Storage Area
22	Solvent Wash Station

An additional boring/hydropunch location, termed Baseline Data Point, was also installed due east of the switchyard as shown on Figure 4-1.

4.2 SAMPLING AND ANALYSIS PLAN

Woodward-Clyde implemented sampling and analysis for collection of additional soil and groundwater data at eight site areas. Table 4-1 summarizes the sampling and analysis rationale, sample locations, depths, numbers of samples, and laboratory analysis types and sampling rationale for soil in each Site Area that was investigated. Table 4-2 summarizes the sampling depths for each medium. Figure 4-1 shows the location of all samples taken by Woodward-Clyde during the field investigation.

In areas that were previously sampled, proposed sampling locations for the RECs and AOPCs were selected based on the following rationale: (1) if significant contamination in soil and/or groundwater was found during the Phase II investigation; (2) if analysis was incomplete (i.e., no metals, VOCs, SVOCs, etc.), and (3) if the sampling location was not adequate (i.e., sample location was not adjacent or downgradient to REC or AOPC and/or sampling depth was too shallow for adequate characterization).

Soil samples were generally collected every 5 feet to the total depth of the Geoprobe and monitoring well borings for stratigraphic descriptions. Soil samples collected at approximately

5 feet bgs and to a depth of 11 feet bgs were analyzed to assess chemical constituents present in the vadose zone above the water table. Soil samples collected above the water table at the time of sampling but within the capillary fringe can provide information on chemical concentrations emanating from groundwater. Because the site is located on sand to silty sand, sample depths were selected to extend to the groundwater. Transport of chemicals would be predicted to be fairly rapid with insignificant horizontal spread due to the high permeability sand to silty sandy soil. Many of the soil RECs and AOPCs have been located on site for 50 years.

4.3 FIELD INVESTIGATION METHODS AND PROCEDURES

4.3.1 Pre-Investigation Activities

Prior to conducting the field investigation, Woodward-Clyde prepared a site-specific health and safety plan (HSP) (Woodward-Clyde, 1997b) for use by Woodward-Clyde field personnel and its subcontractors. The HSP was prepared in accordance with the applicable sections of 29 Code of Federal Regulations (CFR) 1910.120. A tailgate meeting was conducted with SCE personnel on March 16, 1998 to review health and safety issues, emergency response procedures, communication procedures, and underground utility locations.

During the 3rd week in February 1998, Woodward-Clyde marked proposed soil sample location and contacted Underground Service Alert (USA). USA is an information center that notifies members who operate underground utilities at the RBGS of the proposed drilling program. A tailgate meeting was requested with the USA members to review sample locations and the locations of nearby public utilities. As an additional precaution, each proposed soil sampling location was cleared of underground utilities utilizing a geophysics subcontractor (Sub Surface Surveyors) prior to beginning intrusive activities (refer to Appendix B, Field Procedures, Section B.3).

On March 16, 1998, a tailgate meeting was conducted by Woodward-Clyde to familiarize field personnel with the HSP and the RBGS health and safety procedures prior to initiating drilling and soil sampling. The meeting was attended by Woodward-Clyde, their subcontractors, and CH2M HILL representatives who were present to witness all sampling.

4.3.2 Geoprobe and Hydropunch Direct Push Sampling

Hydropunch borings were advanced at locations shown on Figure 4-1 using a Geoprobe rig operated by Vironex, Inc. The drilling method employs direct-push technology that minimizes drill cuttings and allows for relatively undisturbed soil sample collection. In addition, this drilling method has been modified such that an outer casing is driven ahead of the sampler barrel and well casing, thereby minimizing the potential for cross-contamination from the overlying strata. Soil samples were collected generally at two levels: one sample close to the surface (e.g., 1 to 3 feet bgs) and one above the water table (e.g., 9 to 11 feet bgs).

The Geoprobe borings were advanced to depths ranging from 14 to 31 feet bgs, using a 1-1/2-inch outer diameter (OD), stainless steel drive casing. Sample cores were collected in stainless steel tubes over 2-foot intervals approximately every 5 feet bgs to the total depth of the boring. The ends of the sample cores were covered with a Teflon sheet and capped. The samples were labeled and placed in an insulated cooler with ice and transported under chain-of-custody procedures to the analytical laboratory.

Prior to drilling each boring, all non-disposable equipment that entered the borehole was steam-cleaned or washed in a non-phosphate solution, followed by three tap water rinses. The soil borings were logged by Woodward-Clyde personnel working under the direction of a California Registered Geologist.

The soil borings were backfilled with bentonite chips (hydrated during placement) to approximately 3 feet bgs and capped with asphalt or concrete, as appropriate, in paved areas.

4.3.3 Hydropunch Sampling

Groundwater samples were collected from the Geoprobe borings using a Hydropunch in situ sampling device, with the exception of boring GP-4. The Hydropunch consisted of a 3-foot-long, stainless steel screen concealed within a steel rod. Upon reaching the desired sampling depth, the push rods were retracted 2 to 3 feet to open the device. Groundwater entered the device through a screen and water was collected for analysis. When the Hydropunch sampler was not used direct push soil borings were converted to monitoring wells by installing 1-inch-diameter PVC casings, screened over the lower 10 to 20 feet.

The groundwater samples were promptly sealed, labeled, and packed with ice in an insulated cooler that was transported under chain-of-custody procedures to Quanterra Incorporated in Santa Ana, California for analysis.

The Hydropunch sampling device and other reusable equipment were decontaminated following use by washing in a non-phosphate detergent solution followed by rinsing twice with distilled water.

4.4 LABORATORY METHODS

4.4.1 Soil Analysis

Soil chemical analyses were performed by Quanterra Analytical, a state-certified laboratory. Soil samples were analyzed for TPH - carbon chain distribution, VOCs, SVOCs, California Code of Regulations (CCR) Title 22 metals, and PCBs. The following laboratory methods were used to analyze the selected soil samples:

- TPH-carbon chain distribution modified EPA Method 8015 for diesel and motor oil range hydrocarbons
- VOCs by EPA Method 8260A
- SVOCs by EPA Method 8270B
- CCR, Title 22 Metals by EPA Method 6010A, with the exception of arsenic (EPA Method 7060) and mercury (Method SW7471A)
- PCBs by EPA Method 8081

4.4.2 Groundwater Analysis

Groundwater chemical analyses were performed by Quanterra Analytical, a state-certified laboratory. Groundwater samples were analyzed for TPH-carbon chain distribution, VOCs, SVOCs, CCR Title 22 metals, and PCBs. The following laboratory methods were used:

- TPH-carbon chain distribution by EPA Method 8015 for diesel and motor oil range hydrocarbons
- VOCs by EPA Method 8260A

- SVOCs by EPA Method 8270B
- CCR, Title 22 Metals by EPA Method 6010A, with the exception of mercury (Method SW7470A)
- PCBs by EPA Method 8081

The laboratory detection limits were below state and federal MCLs as described in EPA Method "VOCs in Water by Purge and Trap Capillary Column GC/MS (EPA 600/4-88/039)." Groundwater analytical results in Section 5.0 (Tables 5-3b through 5-3d) include a comparison of state and federal MCLs with the practical quantitation limits reported by Quanterra Analytical.

4.4.3 Quality Assurance/Quality Control (QA/QC) Program

Field and laboratory QC samples were analyzed by the laboratory. A complete data review report, including assessment of the laboratory QC results, is included with the analytical laboratory reports in Appendix C. The QC samples originating in the field included equipment blanks, trip blanks, and duplicates of field samples. Descriptions of the field QC samples, the frequency of collection, and the criteria by which they were evaluated are presented below.

Equipment Rinsate Blanks

Equipment rinsate blanks were used to evaluate the effectiveness of decontamination procedures. At sampling locations where dedicated or disposable sampling equipment were used, the rinsate blanks were collected by pouring distilled or organic-free water directly into sampling bottles (bottle blanks).

The equipment blanks were collected and submitted for analysis to the laboratory under the same chain-of-custody documentation and procedures used for other water samples. Equipment blanks were collected at a rate of 10 percent of the total number of soil and groundwater samples.

Field Duplicates

Field duplicate samples were collected sequentially from the same location using identical methods. The duplicate samples were intended to equally represent the medium being sampled and provide information on the variance of chemicals at a sample location and the consistency of field techniques. Field duplicates were collected for soil and groundwater samples.

Due to limited sample volume in the soil sampling sleeves, duplicate samples were sometimes collected from an adjacent location or the next sampling depth. Duplicate groundwater samples were collected by filling the bottles for each analytical group or analysis sequentially for both the original and duplicate sample. Field duplicate samples were collected at a rate of at least 10 percent of the total number of soil and groundwater samples.

Trip Blanks

Trip blanks are samples of organic-free water prepared at the laboratory. They are shipped with the sample bottles from the laboratory, remain with the sample bottles during sampling, and returned to the laboratory on a daily basis. Trip blanks were analyzed for VOCs; the data were used to evaluate if contamination had occurred during shipment or storage. Trip blanks were shipped in coolers containing samples to be analyzed for VOCs.

5.1 SOIL ANALYTICAL RESULTS FOR SITE AREAS

A summary of soil sample analytical results is provided in this section by site area and chemical suite. Soil sample analytical results for TPH, VOCs, SVOCs, and metals are provided in Tables 5-1a through 5-1d, respectively. Copies of laboratory data sheets and chain-of-custody forms are provided in Appendix C. Comparison of analytical results with potential soil screening levels is provided in Section 6.0.

5.1.1 Former UST Area

Two borings were installed near the former UST area (Borings 3A and 3B). Soil samples were collected from boring 3A at depth intervals of 2 to 4 feet and 8 to 10 feet. Soil samples were collected from boring 3B at depth intervals of 2 to 4 feet, 8 to 10 feet, and 12 to 14 feet.

5.2.1.1 Organics

TPH

No TPH was detected in any samples collected from this area.

VOCs

No VOCs were detected in any samples collected from this area.

SVOCs

Trace amounts of benzo(a)athracene (81 µg/kg), benzo(a)pyrene (76 µg/kg), benzo(b)flouranthene (180 µg/kg), chrysene (84 µg/kg), flouranthene (84 µg/kg), and pyrene (110 µg/kg) were detected in boring 3A at the 2- to 4-foot depth. Trace amounts of flouranthene (51 µg/kg) was detected in the same boring at the 8- to 10-foot depth. No SVOCs were detected in boring 3B.

5.1.1.1 Metals

Metals values obtained from the analysis of soil samples in this area were compared against background metals concentrations in California (Kearney, 1996) No metals concentrations detected exceeded these values.

5.1.2 Oil/Gas Separator Area

Three borings were installed in this area. Soil samples from boring 9A were collected at 2 to 4 foot, 5 to 7 foot, and 8 to 10 foot depth intervals. Soil samples from borings 9B and 9C were collected at 2 to 4 foot and 8 to 10 foot depth intervals.

5.1.2.1 Organics

TPH

Trace amounts of hydrocarbons in the C25-C30 range (13 mg/kg), C30-C35 range (16 mg/kg), and C35-C40 range (14 mg/kg) were detected in the soil sample from boring 9C at the 8- to 10-foot depth interval TPH was not detected in other samples from this area.

VOCs

1,1,1-Trichloroethane (1.1 µg/kg), 1,2,4-trimethylbenzene (8.1 µg/kg), 1,3,5-trimethylbenzene (2.7 µg/kg), 4-methyl-2-pentanone (8.9 µg/kg), acetone (35 µg/kg), benzene (1.3 µg/kg), ethylbenzene (5.8 µg/kg), MTBE (19 µg/kg), methylene chloride (2.2 µg/kg), o-xylene (8.7 µg/kg), and toluene (20 µg/kg) were detected in boring 9C collected at the site.

SVOCs

Trace amounts of benzo(a)pyrene (58 µg/kg), benzo(b)flouranthene (140 µg/kg), benzo(g,h,i)perylene (62 µg/kg), chrysene (69 µg/kg), flouranthene (120 µg/kg), indeno(1,2,3-c,d)pyrene (52 µg/kg), phenanthrene (68 µg/kg), and pyrene (120 µg/kg) were detected in boring 9B at the 2- to 4-foot depth interval. Trace amounts of anthracene (130 µg/kg) was detected in boring 9C at the 8- to 10-foot depth interval. No other SVOCs were detected in this area.

5.1.2.2 Metals

Metals values obtained from the analysis of soil samples in this area were compared against background metals concentrations in California (Kearney, 1996). In boring 9C, copper (38.8 mg/kg) exceeded the average California background levels. No other metals concentrations detected exceeded these values.

5.1.3 Valve Pit/Oily Waste Sump at Units 7 and 8

One boring, boring 10, was installed in this area. Soil samples were collected at the 2- to 4-foot and 8- to 10-foot depth intervals.

5.2.3.1 Organics

TPH

Trace amounts of hydrocarbons in the C20-C25 range (12 mg/kg), C25-C30 range (20 mg/kg), C30-C35 range (22 mg/kg), and C35-C40 range (42 mg/kg) were detected in the soil sample from boring 10 at the 2- to 4-foot depth interval.

Trace amounts of hydrocarbons in the C15-C20 range (22 mg/kg), C20-C25 range (46 mg/kg), C25-C30 range (68 mg/kg), C30-C35 range (71 mg/kg), and C35-C40 range (42 mg/kg) were detected in the soil sample from boring 10 at the 8- to 10-foot depth interval. In a duplicate sample of the 2- to 4-foot depth interval trace amounts of hydrocarbons in the C25-C30 range (20 mg/kg), the C30-C35 range (21 mg/kg), and the C35-C40 range (36 mg/kg) were detected. TPH was not detected in other samples from this area.

VOCs

No VOCs were detected in soil samples collected from this area.

SVOCs

No SVOCs were detected in soil samples collected from this area.

5.1.3.2 Metals

Metals values obtained from the analysis of soil samples in this area were compared against background metals concentrations in California (Kearney, 1996). No other concentrations detected exceeded the California average values.

5.1.4 Powerblocks

Five boring were installed in this area. For all borings, soil samples were collected at the 2- to 4-foot and 8- to 10-foot depth intervals. Boring locations are designated 12a through 12e

5.1.4.1 Organics

TPH

Trace amounts of hydrocarbons in the C30-C35 range (7.1 mg/kg) and C35-C40 range (15 mg/kg) were detected in the soil sample from boring 12C at the 2- to 4-foot depth interval.

Trace amounts of hydrocarbons in the C20-25 range (11 mg/kg), C25-30 range (33 mg/kg), C30-C35 range (35 mg/kg), and C35-C40 range (36 mg/kg) were detected in the soil sample from boring 12C at the 8- t0 10-foot depth interval.

Trace amounts of hydrocarbons in the C25-C30 range (21 mg/kg), C30-C35 range (31 mg/kg), and C35-C40 range (21 mg/kg) were detected in the soil sample from boring 12D at the 2- to 4-foot depth interval. Trace amounts of hydrocarbons in the C15-C20 range (11 mg/kg), C20-25 range (17 mg/kg), C25-30 range (20 mg/kg), C30-C35 range (33 mg/kg), and C35-C40 range (45 mg/kg) were detected in the soil sample from boring 12D at the 8- to 10-foot depth interval. No other TPH compounds were detected in this area.

SVOCs

Dimethyl phthalate (93 µg/kg) was detected in boring 12E at the 8- to 10-foot depth interval. No other SVOCs were detected in soil samples collected from this area.

5.1.4.2 Metals

Metals values obtained from the analysis of soil samples in this area were compared against background metals concentrations in California (Kearney, 1996) No metals concentrations detected exceeded these values.

5.1.5 Primary Fuel Pumping Area

One boring (B14) was installed in this area. Soil samples were collected at the 2- to 4-foot and 8- to 10-foot depth intervals.

5.1.5.1 Organics

TPH

Trace amounts of hydrocarbons in the C15-C20 range (7 mg/kg), C20-25 range (17 mg/kg), C25-30 range (31 mg/kg), C30-C35 range (38 mg/kg), and C35-C40 range (29 mg/kg) were detected in the soil sample from boring 14 at the 2- to 4-foot depth interval. No other TPH compounds were detected in this area.

SVOCs

No SVOCs were detected in soil samples collected from this area.

5.1.5.2 Metals

Metals values obtained from the analysis of soil samples in this area were compared against background metals concentrations in California (Kearney, 1996). No metals concentrations detected exceeded these values.

5.1.6 Fuel Oil Pipeline

One boring (B15) was installed in this area. Soil samples were collected at the 2- to 4-foot and 8- to 10-foot depth intervals.

5.1.6.1 Organics

TPH

Trace amounts of hydrocarbons in the C20-C25 range (14 mg/kg), C25-C30 range (18 mg/kg), and C30-C35 range (15 mg/kg) were detected in the soil sample from boring 15 at the 2- to 4-foot depth interval.

Trace amounts of hydrocarbons in the C20-C25 range (14 mg/kg), C25-C30 range (33 mg/kg), C30-C35 range (26 mg/kg), and C35-C40 range (14 mg/kg) were detected in the soil sample from boring 15 at the 8- to 10-foot depth interval.

VOCs

No VOCs were detected in soil samples collected from this area.

SVOCs

Trace amounts of bis(2-ethylhexyl)-phthalate was detected at the 2- to 4-foot depth interval (130 µg/kg) and the 8- to 10-foot depth interval (89 µg/kg). No other SVOCs were detected in this area.

5.1.6.2 Metals

Metals values obtained from the analysis of soil samples in this area were compared against background metals concentrations in California (Kearney, 1996). No metals concentrations detected exceeded average California values.

5.1.7 Hazardous Waste Storage Area

One boring (B17) was installed in this area. Soil samples were collected at the 2- to 4-foot and 6- to 10-foot depth intervals.

5.1.7.1 Organics

TPH

Trace amounts of hydrocarbons in the C15-C20 range (55 mg/kg), C20-C25 range (67 mg/kg), C25-C30 range (120 mg/kg), C30-C35 range (140 mg/kg), and C35-C40 range (230 mg/kg) were detected in the soil sample from boring 17 at the 2- to 4-foot depth interval.

Trace amounts of hydrocarbons in the C20-C25 range (6.6 mg/kg), C25-C30 range (13 mg/kg), and C35-C40 range (22 mg/kg) were detected in the soil sample from boring 17 at the 8- to 10-foot depth interval.

VOCs

1,1,1-trichloroethane was detected in the 2- to 4-foot depth interval at a concentration of 0.49 mg/kg. No other VOCs were detected in soil samples from this area.

SVOCs

No SVOCs were detected in soil samples collected in this area

5.1.7.2 Metals

Metals values obtained from the analysis of soil samples in this area were compared against background metals concentrations in California (Kearney, 1996). Cadmium (0.37 mg/kg) slightly exceeded the average California concentration in soils, however the analytical value obtained was an estimated value due to the low concentration. No other metals concentrations detected exceeded the California average values.

5.1.8 Solvent Wash Station

Two borings (22a and 22b) were installed in this area. Soil samples were collected at the 2- to 4-foot and 8- to 10-foot depth interval from each of the borings.

5.1.8.1 Organics

TPH

TPH concentrations in the C25-30 range (26 mg/kg) and C30-35 range (34 mg/kg) were detected in boring 22b at the 2- to 4-foot depth interval. No other TPH compounds were detected in soil samples collected from this area.

VOCs

Tetrachloroethene (8.1 µg/kg) and trichloroethene (14 µg/kg) were detected in boring 22a at the 2- to 4-foot depth interval. At the 8- to 10-foot depth interval, these same two compounds were detected at 1.3 µg/kg and 1.7 µg/kg, respectively.

Tetrachloroethene (4.1 µg/kg) and trichloroethene (5.7 µg/kg) were also detected in boring 22b at the 8- to 10-foot depth interval. No other VOCs were detected in soil samples collected from this area.

SVOCs

No SVOCs were detected in soil samples collected from this area.

5.1.8.2 Metals

Metals values obtained from the analysis of soil samples in this area were compared against background metals concentrations in California (Kearney, 1996). No metals concentrations detected exceeded these values.

5.1.9 Baseline Data Point

One soil boring (B25) was installed in this area. Soil samples were collected at 2- to 4-foot and 8- to 10-foot depth intervals.

5.1.9.1 Organics

TPH

No TPH compounds were detected in soil samples collected from this area.

VOCs

No VOCs were detected in soil samples collected from this area.

SVOCs

No SVOCs were detected in soil samples collected from this area..

5.1.9.2 Metals

Metals values obtained from the analysis of soil samples in this area were compared against background metals concentrations in California (Kearney, 1996). Antimony (0.74 mg/kg) slightly exceeded the average California value for this metal, however the analytical value is estimated. No other metal concentrations detected exceeded the average California values.

5.2 GROUNDWATER ANALYTICAL RESULTS

A summary of groundwater analytical results is provided in this section by site area and chemical suite. Groundwater analytical results for TPH, VOCs, SVOCs, and metals are provided in Tables 5-2a through 5-2d, respectively. Copies of laboratory data sheets and chain-of-custody forms are provided in Appendix C. Comparison of analytical results with potential screening levels is provided in Section 6.0.

5.2.1 Former UST Area

Two groundwater samples at boring locations 3a and 3b were collected via the hydropunch method. Both samples were collected at an approximate depth of 20 feet bgs.

5.2.1.1 Organics

TPH

No TPH compounds were detected in groundwater samples collected from this area

VOCs

Trace concentrations of toluene were detected in groundwater collected from boring locations 3a and 3b at concentrations of 0.8 and 0.21 µg/L, respectively. Concentrations of m- and p-xylenes (0.5 µg/L) were also detected. No other VOCs were detected from groundwater samples collected from this area.

5.2.1.2 Metals

Trace concentrations of barium, molybdenum, nickel, and zinc were detected in groundwater samples collected from this area.

5.2.2 Oil/Gas Separator Area

Groundwater samples were collected at boring locations 9a ,9b, and 9c via the hydropunch method. Groundwater samples were collected at approximately 20 feet bgs.

5.2.2.1 Organics

TPH

Trace amounts of TPH in the C8-C9 range (0.21 mg/l) were detected in the groundwater sample collected from boring 9a. Trace amounts of TPH in the C7-C8 range (0.28 mg/l), C8-C9 range (1.2 mg/l), C9-C10 range (3.6 mg/l), and C10-C15 range (1.5 mg/l) were detected in the groundwater sample collected from boring 9b. Trace amounts of TPH in the C9-C10 hydrocarbon range (0.17 mg/l) were detected in groundwater collected from boring 9c.

VOCs

1,2,4-trimethylbenzene (1 µg/L), 1,3-dichlorobenzene (0.4 µg/L), isopropylbenzene (0.4 µg/L), n-propylbenzene (0.6 µg/L), naphthalene (4 µg/L), and toluene (0.2 µg/L) were detected in groundwater collected from boring 9a

1,1,2-trichloroethane (13 µg/L), 1,2,4-trimethylbenzene (28 µg/L), ethylbenzene (8 µg/L), isopropylbenzene (41 µg/L), isopropyltoluene (7 µg/L), m- and p-xylenes (7µg/L), n-propylbenzene (60 µg/L), naphthalene (51 µg/L), o-xylene (0.8 µg/L), sec-butylbenzene (6 µg/L), toluene (0.7 µg/L), 2-butanone (9 µg/L), 4-methyl-2-pentanone (50 µg/L), and trichloroethene (0.3 µg/L) were detected in groundwater collected from boring 9b.

1,1,2-trichloroethane (10 µg/L), 1,2,4-trimethylbenzene (34 µg/L), ethylbenzene (6 µg/L), isopropylbenzene (19 µg/L), isopropyltoluene (7 µg/L), xylenes (5 µg/L), n-propylbenzene (27 µg/L), naphthalene (28 µg/L), o-xylene (0.4 µg/L), sec-butylbenzene (5 µg/L), tetrachloroethene (0.2 µg/L), toluene (0.3 µg/L), and trichloroethene (0.3 µg/L) were detected in a duplicate sample of groundwater collected from boring 9b.

1,1,1-trichloroethane (0.17 µg/L), 1,1-dichloroethane (0.29 µg/L), benzene (0.32 µg/L), cis-1,2-dichloroethene (4.2 µg/L), ethylbenzene (0.73 µg/L), isopropylbenzene (0.55 µg/L), m- and p-xylenes (0.32 µg/L), tert-butylbenzene (0.17 µg/L), toluene (0.17 µg/L), and trichloroethene (0.98 µg/L) were detected in groundwater collected from boring 9c.

SVOCs

Di-n-butyl phthalate was detected in groundwater collected from borings 9a and 9b at a concentration of 0.78 and 0.95 µg/L, respectively. A duplicate sample from 9b yielded a value of 0.96 µg/L of this compound.

Naphthalene was detected in groundwater from boring 9b at a concentration of 41 µg/L, with a duplicate sample yielding a concentration of 26 µg/L.

5.2.2.2 Metals

Barium and molybdenum were detected in groundwater samples collected from this area.

5.2.3 Valve Pit/Oily Waste Sump at Units 7 and 8

One groundwater sample was collected from boring B10 via the Hydropunch method. The groundwater sample was collected from approximately 20 feet bgs.

5.2.3.1 Organics

TPH

No TPH compounds were detected in the groundwater sample collected from this area.

VOCs

1,1-dichloroethane (10 µg/L), 1,2-dichlorobenzene (1 µg/L), cis-1,2-Dichloroethene (0.9 µg/L), and trans-1,2-Dichloroethene (0.4 µg/L) were detected in the groundwater sample collected from this area.

SVOCs

Bis(2-ethylhexyl)phthalate was detected in groundwater at a concentration of 1.6 µg/L.

5.2.3.2 Metals

Arsenic, barium, molybdenum, nickel, vanadium, and zinc were detected in the groundwater sample collected from this area.

5.2.4 Powerblocks

Groundwater samples were collected from boring locations 12a through 12e via the hydropunch method. Groundwater samples were collected from approximately 20 feet below grade, with the exception of the sample from boring 12d, which was collected from approximately 17 feet below grade.

5.2.4.1 Organics

TPH

No TPH compounds were detected in groundwater samples collected from this area.

SVOCs

Bis(2-ethylhexyl) phthalate was detected in the groundwater sample collected from boring locations 12a (1.6 µg/L) and 12b (1 µg/).

5.2.4.2 Metals

Arsenic, barium, molybdenum, and vanadium were detected in some or all of the groundwater samples collected from this area.

5.2.5 Primary Fuel Oil Pumping Area

One groundwater sample was collected from boring B14 via the hydropunch method. The groundwater sample was collected from approximately 20 feet below grade.

5.2.5.1 Organics

TPH

No TPH compounds were detected in the groundwater sample from this area.

SVOCs

Bis(2-ethylhexyl)phthalate was detected at 1 µg/L in the water sample collected from this area.

5.2.5.2 Metals

Arsenic, barium, and vanadium were detected in groundwater collected from this area.

5.2.6 Fuel Oil Pipeline

One groundwater sample and one duplicate sample were collected from boring B15 via the hydropunch method. The groundwater sample was collected from approximately 20 feet below grade.

5.2.6.1 Organics

TPH

No TPH compounds were detected in the groundwater sample collected from this area.

VOCs

1,1-dichloroethane (0.6 µg/L), 1,2-dichlorobenzene (0.5 µg/L), 1,3-dichlorobenzene (0.2 µg/L), 1,4-dichlorobenzene (0.6 µg/L), and cis-1,2-dichloroethene (0.3 µg/L) were detected in the groundwater sample collected from boring 15.

1,1-dichloroethane (0.5 µg/L), 1,2-dichlorobenzene (0.6 µg/L), 1,3-dichlorobenzene (0.2 µg/L), 1,4-dichlorobenzene (0.1 µg/L), and cis-1,2-dichloroethene (0.3 µg/L) were detected in the duplicate groundwater sample collected from boring 15.

SVOCs

No SVOCs were detected in the groundwater sample from this area.

5.2.6.2 Metals

Barium, copper, molybdenum, nickel, and vanadium were detected in the groundwater sample collected from this area. The duplicate sample yielded concentrations of barium, molybdenum, nickel, and vanadium.

5.2.7 Hazardous Waste Storage Area

One groundwater sample was collected from boring B17 via the hydropunch method. The sample was collected from approximately 20 feet below grade.

5.2.7.1 Organics

TPH

No TPH compounds were detected in the groundwater sample collected from this area.

VOCs

1,1-dichloroethane (3.1 µg/L), 1,1-dichloroethene (0.11 µg/L), 1,2,4-trimethylbenzene (0.091 µg/L), benzene (0.3 µg/L), carbon disulfide (0.97 µg/L), and toluene (0.14 µg/L) were detected in the groundwater sample collected from this area.

SVOCs

No SVOCs were detected in the groundwater sample collected from this area.

5.2.7.2 Metals

Barium, molybdenum, silver, and vanadium were detected in groundwater.

5.2.8 Solvent Wash Station

Groundwater samples were collected from borings 22a and 22b via the hydropunch method. Samples were collected from approximately 20 feet below grade.

5.2.8.1 Organics

TPH

No TPH compounds were detected in groundwater samples collected from this area.

VOCs

1,1-dichloroethane (20 µg/L), 1,1-dichloroethene (0.3 µg/L), 1,2-dichlorobenzene (26 µg/L), 1,3-dichlorobenzene (2 µg/L), 1,4-dichlorobenzene (10 µg/L), cis-1,2-dichloroethene (0.3 µg/L), tetrachloroethene (0.3 µg/L), trichloroethene (2 µg/L), carbon disulfide (1 µg/L), chlorobenzene (3 µg/L), and vinyl chloride (1 µg/L) were detected in the groundwater sample collected from boring 22a.

1,1,1-trichloroethane (0.3 µg/L), 1,1-dichloroethane (2 µg/L), 1,1-dichloroethene (0.4 µg/L), 1,2,3-trichlorobenzene (0.4 µg/L), 1,2,4-trichlorobenzene (0.2 µg/L), 1,3-dichlorobenzene (0.3 µg/L), 1,4-dichlorobenzene (0.7 µg/L), cis-1,2-dichloroethene (4 µg/L), naphthalene (0.4 µg/L), trans-1,2-dichloroethene (0.4 µg/L), tetrachloroethene (2 µg/L), and trichloroethene (25 µg/L) were detected in the groundwater sample collected from boring 22b.

SVOCs

Bis(2-ethylhexyl) phthalate was detected in the groundwater sample collected from boring 22b at a concentration of 1.3 µg/L.

5.2.8.2 Metals

Arsenic, barium, copper, molybdenum, thallium, and vanadium were detected in the groundwater sample collected from boring 22a

Barium, copper, molybdenum, and vanadium were detected in the groundwater sample collected from boring 22b.

5.2.9 Baseline Data Point

One groundwater sample was collected in boring B25 via the hydropunch method. The groundwater sample was collected from approximately 20 feet below grade.

5.2.9.1 Organics

TPH

No TPH compounds were detected in groundwater samples collected from this area.

VOCs

1,1-dichloroethane (0.2 µg/L), 1,2,4-trimethylbenzene (0.2 µg/L), 1,3-dichlorobenzene (0.4 µg/L), cis-1,2-dichloroethene (0.2 µg/L), and toluene (0.2 µg/L) were detected in groundwater samples collected from this area.

SVOCs

Di-n-butyl phthalate (1.1 µg/L) and diethyl phthalate (0.63 µg/L) were detected in groundwater samples collected from this area.

5.2.9.2 Metals

Barium and molybdenum were detected in groundwater samples collected from this area.

Soil and groundwater analytical results are compared to potential regulatory soil and groundwater screening levels in order to evaluate if the concentration levels evidence contamination which may require remediation under current environmental laws.

6.1 DISCUSSION OF SOIL RESULTS

6.1.1 Petroleum-Impacted Soil

Petroleum-impacted sites are specifically exempted from the provisions and requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). For petroleum-impacted sites, applicable regulatory requirements are found in the state and federal UST requirements, the California Water Code, California Health and Safety Code, and the applicable Regional Water Quality Control Board Water Quality Control Plan.

In May 1996, the Los Angeles Regional Water Quality Control Board (LARWQCB) issued guidance on an interim approach for using soil screening levels to evaluate the need for remediation of petroleum-impacted soils (LARWQCB, 1996). The approach was developed to evaluate whether a site may require remedial action and what level of remediation may be required for site closure. The LARWQCB allows for site-specific risk analysis to determine the effect on groundwater and the potential health impacts for residuals in soil and groundwater on human health. The soil screening levels were developed primarily to determine if soil contamination poses a risk to groundwater. However, they generally are protective of human health from direct contact pathways (i.e. dermal exposure and soil ingestion).

The LARWQCB has developed two sets of soil screening levels: one for soil above drinking water (beneficial) aquifers and one for soil above non-drinking water (non-beneficial) aquifers. All groundwater is considered a drinking water resource unless exempted by LARWQCB based upon one of the criteria defined under State Water Resources Control Board (SWRCB) resolution 88-63: (i) total dissolved solids (TDS) greater than 3,000 mg/L; (ii) deliverability less than 22 gallons per day; or (iii) existing contamination that cannot be reasonably treated. TDS have been measured in both the surficial and Silverado aquifer system around the retention basins by SCE. Reported concentrations of TDS have consistently averaged above the TDS exemption (SCE, 1998). However, it is not known whether LARWQCB has made any formal determination that the groundwater beneath the site is non-beneficial. As a result, the potential LARWQCB petroleum-impacted soil screening levels for both non-beneficial use aquifers and

for beneficial aquifers with groundwater less than 20 feet bgs have been used in the following analysis and are summarized in Table 6-1.

The LARWQCB must make the determination on what would be the most appropriate soil screening levels for the site, based on the uses or potential uses of the groundwater underlying the site. In order for LARWQCB to make this determination, data would need to be supplied on existing salinity, deliverability, nearest water supply wells, etc.

For areas that may be under the jurisdiction of the DTSC, the DTSC considers potential impacts to human health by first following the Preliminary Endangerment Assessment (PEA) process. There are no published tables with PEA values for soil. However, calculated PEA values are usually very similar to EPA Region IX PRGs. DTSC PEA and EPA Region IX PRG values are calculated considering potential human exposures from soil ingestion, dermal contact, and inhalation of VOCs and particulates. The range of potential soil screening levels for organic compounds (EPA Region IX PRGs) for the site if the site is under the jurisdiction of the DTSC are shown in Table 6-2. Both residential use and industrial use scenarios are presented.

LARWQCB petroleum soil screening levels for non-beneficial and beneficial uses were not exceeded with respect to those samples obtained by Woodward-Clyde at RBGS.

The laboratory separation of carbon chain distribution used in this investigation and the LARWQCB soil screening level carbon chain distribution separation do not match exactly. For example, the LARWQCB soil screening category for light hydrocarbons is C4-C12, while the laboratory separated the carbon chain into C9-C10 and C10-C15.

LARWQCB soil screening levels for TPH were exceeded in the Phase II ESA (CH2M HILL, 1997) at the following locations:

- At fuel oil storage tanks 1, 2, 3, and 4, TPH concentrations exceeded LARWQCB beneficial use criteria. The area is outside the asset sale agreement property.
- At the oil/gas separator, TPH concentrations exceeded LARWQCB beneficial and non beneficial use criteria in soil samples that were collected from 11 and 13 feet bgs.
- At powerblock No. 7, TPH concentrations exceeded LARWQCB beneficial use criteria in a soil sample collected from the surface.
- At the fuel oil pumping station, TPH concentrations exceeded LARWQCB beneficial use criteria in a soil sample at 1 foot bgs.

- In the switchyard area, TPH concentrations exceeded LARWQCB beneficial use criteria in soil samples collected from 3 feet bgs. The area is outside the asset sale agreement.

- At the solvent wash station, TPH concentrations exceeded LARWQCB beneficial use criteria in soil samples collected from 1 foot bgs.

LARWQCB soil screening levels for benzene, ethylbenzene, toluene, and xylenes were not exceeded at the site for either non-beneficial and beneficial uses with respect to those samples obtained by Woodward-Clyde.

LARWQCB petroleum soil screening levels for beneficial uses appears to have been exceeded in the soil samples obtained by CH2M HILL (1998) during the soil boring baseline study in the following areas:

- The former UST area (area 3).
- The oil/gas separator area (area 9).
- The powerblocks (area 12).
- The fuel oil pipeline (area 15).
- The hazardous waste storage area (area 17).
- The Solvent Wash Station (area 22).

LARWQCB soil screening levels for benzene, ethylbenzene, toluene, and xylenes were exceeded in the Phase II ESA (CH2M HILL, 1997) at the following location:

- At the oil/gas separator, benzene LARWQCB non-beneficial and beneficial use criteria were exceeded in two soil samples (RBH54 collected from 13 to 13.5 feet bgs and RBH57 collected from 15 to 15.5 feet bgs). The LARWQCB beneficial use criteria for ethylbenzene, toluene, and xylenes were exceeded in the same soil sample.

EPA Region IX PRGs for soil for residential use was exceeded for benzo(a)pyrene at the former UST area (soil sample 3a at 2 to 4 feet bgs). No other EPA Region IX PRGs for soil were exceeded with respect to those samples obtained by Woodward-Clyde.

In the Phase II ESA (CH2M HILL, 1997), the EPA Region IX residential PRG for benzene was exceeded at the oil/gas separator in two soil samples (RBH54 collected from 13 to 13.5 feet bgs and RBH57 collected from 15 to 15.5 feet bgs).

In early April, SCE provided an Addendum to the Baseline Tank Study Report, Fuel Oil Tank 5, dated April 1998 and prepared by CH2M HILL to AES for review. The report cited a previous baseline document issued May 22, 1997. CH2M HILL concluded in the initial baseline study that the oil contamination identified at the site was likely caused by application of fuel oil to the gravel underlying the tank to protect it from corrosion. Groundwater at the south end of the RGS is very shallow, reportedly less than 12 feet bgs.

The Addendum to that initial report concluded that:

- TPH impacted soils above SCE screening levels are limited to the upper 1 to 5 feet directly beneath the tank.
- The TPH was likely placed to protect the tank from corrosion.
- Concentrations of TPH in groundwater are insignificant.

A review of the Addendum by WCC indicated that the maximum concentrations of TPH in the soil beneath the tank are as follows:

- C4 - C12 = 29,100 mg/kg
- C13 - C22 = 215,340 mg/kg
- C23 - C32 = 337,560 mg/kg

The concentrations above exceed WCC screening criteria. The data indicated that TPH contamination extended to greater than 10 feet below ground surface. CH2M HILL recommended no further action until tank to be removed or replaced. Analytical tests for CCR metals, VOCs, and SVOCs were not performed.

6.1.2 Metal-Impacted Soil

EPA Region IX PRGs for metals detected in soils are described in Appendix E. Because in certain instances background concentrations of metals in California may exceed the EPA Region IX PRGs, the DTSC requires metals detected in soils to be compared to a body of data representative of local conditions unaffected by site-related activities. Metals present at concentrations elevated with respect to these local conditions become chemicals of potential concern and are carried forward into a health risk assessment (DTSC PEA Guidance, 1997).

SECTIONSIX Discussion

Metal concentrations in soil were compared to background concentrations of metals and soils for California. Background metal concentrations have been determined in 50 benchmark soils selected from throughout the state by the Kearney Foundation of Soils Science (Kearney, 1996). The Kearny database was developed to help evaluate the severity of metal pollution problems in California soils, and has been accepted by DTSC as an appropriate database for establishing background metal concentrations. These average metal concentrations are shown in Table 6-3.

For this investigation, the following metals were elevated above the average metal concentrations in soil for California (Kearney, 1996) in one or more soil samples, but within the concentration range for California soils set forth in the Kearney database:

- The concentration of antimony was 1.3 mg/kg at boring 9c (oil/gas separator) collected from 2 to 4 feet bgs, and the antimony concentration was 0.74 mg/kg at boring 25(BL) collected from 2 to 4 feet bgs. The average concentration of antimony in California soils is 0.6 mg/kg.

- The concentration of cadmium was 0.37 mg/kg at boring 17 (hazardous waste storage area) collected from 2 to 4 feet bgs. The average concentration of cadmium in California soils is 0.36 mg/kg.

- The concentration of copper was 38.8 mg/kg at boring 9C (oil/gas separator) collected from 8 to 10 feet bgs. The average concentration of copper in California soils is 28.7 mg/kg.

- The concentration of lead was 29.4 mg/kg at boring 9b (oil gas separator) collected from 2 to 4 feet bgs and 95.2 mg/kg at boring 9c (oil gas separator) collected from 8 to 10 feet bgs. The average concentration of lead in California soils is 23.9 mg/kg.

- The concentration of antimony at boring 9c (oil/gas separator) collected from 8 to 10 feet bgs was 6.2 mg/kg, exceeding both the average (0.60 mg/kg) and range (0.15 to 1.95 mg/kg) of benchmark concentrations for antimony in California soils.

In the Phase II ESA (CH2M HILL, 1997), the following metals were elevated above average metal concentrations in soil for California (Kearney, 1996):

- At the hazardous material storage area, the antimony concentration was 37.1 mg/kg in soil sample RBH62 collected at 0.5 to 1.2 feet bgs. The average concentration of antimony in California soils is 0.6 mg/kg.

- At the hazardous material storage area, the copper concentration was 60.6 mg/kg in soil sample RBH62 collected at 5.4 to 6 feet bgs and 52.6 mg/kg in the sample

collected at 0.5 to 1.2 feet bgs. The average concentration of copper in California soils is 28.7 mg/kg.

- At the powerblocks, lead was detected in soil sample RBH19 at 5 feet bgs at a concentration of 57.9 mg/kg. Lead was detected at a concentration of 2,550 mg/kg in soil sample RBH62 collected at 5.4 to 6 feet bgs and at 130 mg/kg in soil sample collected at 0.5 to 1.2 feet bgs in the hazardous materials storage area. The average concentration of lead in California soils is 23.9 mg/kg.

- Mercury was detected at the powerblocks in soil sample RBH19 at 5 feet bgs at a concentration of 4.1 mg/kg. Mercury was detected at the hazardous materials storage area at a concentration of 2.3 mg/kg in soil sample RBH62 collected at 5.4 to 6 feet bgs. Mercury was detected at the solvent wash station at a concentration of 0.7 mg/kg in soil sample RBH52 collected at 0.6 to 1.1 feet bgs. The average concentration of mercury in California soils is 0.26 mg/kg.

- Molybdenum was detected at the hazardous materials storage area at a concentration of 5.8 mg/kg in soil sample RBH62 collected at 5.4 to 6 feet bgs. The average concentration of molybdenum in California soils is 1.3 mg/kg.

- Nickel was detected at the hazardous materials storage area at a concentration of 329 mg/kg in soil sample RBH62 collected at 5.4 to 6 feet bgs. The average concentration of nickel in California soils is 57 mg/kg.

- Selenium was detected at the powerblocks in soil sample RBH19 at 5 feet bgs at a concentration of 0.9 mg/kg. Selenium was detected at the hazardous materials storage area at a concentration of 0.97 mg/kg in soil sample RBH62 collected at 5.4 to 6 feet bgs. The average concentration of selenium in California soils is 0.058 mg/kg.

- Silver was detected at the powerblocks in soil sample RBH19 at 5 feet bgs at a concentration of 2.7 mg/kg. The average concentration of silver in California soils is 0.8 mg/kg.

- Vanadium was detected at the hazardous materials storage area at a concentration of 929 mg/kg in soil sample RBH62 collected at 5.4 to 6 feet bgs. The average concentration of selenium in California soils is 112 mg/kg.

- Zinc was detected at the hazardous materials storage area at a concentration of 156 mg/kg in soil sample RBH62 collected at 5.4 to 6 feet bgs. The average concentration of zinc in California soils is 149 mg/kg.

The SCE Soil Boring Baseline Study of the retention basins conducted in 1997 identified the following metals at concentrations above the average for California soils (Kearney, 1996):

- In the North Basin, eleven metals (antimony, arsenic, cadmium, copper, cobalt, lead, mercury, molybdenum, nickel, silver, and vanadium) were detected at concentrations exceeding the average for California soils.

- In the Boiler Chemical Cleaning Basin, nine metals (antimony, arsenic, copper, cobalt, lead, molybdenum, nickel, silver, vanadium) were detected at concentrations exceeding the average for California soils.

- In the South Basin, twelve metals (antimony, arsenic, beryllium, cadmium, copper, fluoride, lead, nickel, selenium, silver, vanadium, and zinc) were detected at concentrations exceeding the average for California soils.

The SCE Well Construction Report (Hamilton, 1997) detected the following metals that were elevated above average metal concentrations in soil for California (Kearney, 1996):

- In the North Basin, two metals (molybdenum and nickel) were detected above the average concentrations found in California soils.

- In the South Basin, five metals (antimony, molybdenum, nickel, selenium, and vanadium) were detected above the average concentrations found in California soils.

SCE forwarded to AES a copies of correspondence written by CH2M HILL dated February 26, 1998 concerning soil and groundwater conditions found during the refurbishment of a service water tank near Plant 1. CH2M HILL collected soil samples during excavation activities, and found total lead concentrations of up to 2600 mg/kg in soils, making these soils a hazardous waste under State of California regulations (Title 22 CCR). Additionally, based on a review of data provided with the correspondence the following metals were found to exceed the average and in many cases the range in California soils in one or more samples: antimony, arsenic, barium, cadmium, chromium, cobalt, copper, molybdenum, nickel, silver, and selenium. It is unclear from the letter whether active remediation of this area was undertaken.

6.2 DISCUSSION OF GROUNDWATER RESULTS

The primary screening criteria available for groundwater at the site are state and EPA primary maximum contaminant levels (MCLs), secondary MCLs, and action levels. MCLs are part of the drinking water standards adopted by both the EPA under the Safe Drinking Water Act and the Department of Health Services (DHS). MCLs are enforceable on water supply systems and at the tap and are applicable to ground and surface water resources when they are specifically referenced as water quality objectives in the pertinent Regional Water Quality Control Plans.

MCL values would apply to groundwater beneath this site based on the current Regional Water Quality Control Plan.

There are no MCLs for TPH, only for chemicals of concern that are constituents of petroleum hydrocarbons (i.e., benzene, toluene, ethylbenzene, and xylenes). State and EPA primary MCLs, secondary MCLs, action levels and DTSC Public Health Goals (PHGs) for the chemicals of concern detected in groundwater at the site are listed in Table 6-4.

The state and EPA levels may not be appropriate for the site if the groundwater is not being used for drinking water purposes. The LARWQCB would have to make the determination of what the appropriate level would be for the site. For chemicals without state or EPA MCLs, state action levels, and Federal Health Advisory Levels are shown, when available.

6.2.1 VOC- and SVOC-Impacted Groundwater

Concentrations of VOCs detected in groundwater (Tables 5-2b) were compared to primary state MCLs, primary EPA MCLs, MCL goals, secondary state MCLs, secondary EPA MCLs, state interim action levels, and federal health advisories (i.e., potential threshold concentrations) (Table 6-4). The following VOCs detected in the groundwater samples were elevated above one or more of the above-listed MCLs:

- The 1,1,2-trichloroethane concentration was 13 µg/L in the groundwater sample collected near the oil/gas separator and 10 µg/L in the duplicate groundwater sample. The state and federal MCL are 5 µg/L.
- The 1,1-DCA concentration was 10 µg/L in the groundwater sample collected near the valve pit/oily waste sump at powerblocks 7 and 8 (sample location 10). At the solvent wash station (sample location 22a), the 1,1-DCA concentration was 20 µg/L in the groundwater sample. The state MCL for 1,1-DCA is 5 µg/L.
- The naphthalene concentration was 51 µg/L in the groundwater sample collected near the oil/gas separator and 28 µg/L in the duplicate groundwater sample. The state health advisory is 20 µg/L.
- Trichloroethene in groundwater was detected at 25 µg/L at the solvent wash station (sample location 22b). The state and federal MCL is 5 µg/L.
- Vinyl chloride in groundwater was detected a 1 µg/L at the solvent wash station (sample location 22a). The state MCL for vinyl chloride is 0.5 µg/L and the federal MCL is 2.0 µg/L.

In the Phase II ESA (CH2M HILL, 1997), the following VOCs detected in the groundwater samples were elevated above one or more of the above-listed MCLs:

- Naphthalene was detected at a concentration of 167.6 µg/L in groundwater at the oil/gas separator area. The federal health advisory for naphthalene is 20 µg/L.
- Carbon tetrachloride was detected at a concentration of 13.6 µg/L in groundwater at the hazardous materials storage area. The state MCL is 0.5 µg/L and the federal MCL is 5 µg/L for carbon tetrachloride.
- 1,1-DCA was detected at a concentration of 22 µg/L in groundwater at the hazardous materials storage area. The state MCL for 1,1-DCA is 5 µg/L.
- Benzene was detected at a concentration of 12.7 µg/L in groundwater at the solvent wash station. The state MCL is 1 µg/L and the federal MCL is 5 µg/L for benzene.
- Trichloroethene was detected at a concentration of 36.7 µg/L in groundwater at the solvent wash station. The state and federal MCL are 5 µg/L for trichloroethene.

In the SCE Annual Groundwater Monitoring Report (Hamilton, 1998) for the retention basins, the following VOCs detected in the groundwater samples were elevated above one or more of the MCLs:

- In the North Basin, one VOC (benzene) was detected in the groundwater at concentrations in excess of the state and federal MCLs. One VOC (trichloroethene) was detected above the federal MCL goal.

In the South Basin, two VOCs (benzene and vinyl chloride) were detected in the groundwater at concentrations exceeding the state and federal MCLs. One VOC (1,1-dichloroethane) was detected in the groundwater at concentrations exceeding state MCLs.

No SVOCs were detected above potential "threshold" concentrations in groundwater sampled at RBGS.

6.2.2 Metal-Impacted Groundwater

Thallium was detected above the state and EPA MCL of 0.002 µg/L in the groundwater sample collected at the solvent wash station at a concentration of 0.052 µg/L.

In the Phase II ESA (CH2M HILL, 1997), the following metals in groundwater were reported at concentrations elevated above one or more of the above-listed MCLs.

- Mercury was detected at concentrations of 5 µg/L and 6 µg/L in groundwater at the powerblocks in samples RBH20 and RBH21. The state and federal MCL is 2 µg/L for mercury.
- Thallium was detected at concentration of 7 µg/L, 7 µg/L, and 8 µg/L in groundwater at the powerblocks in samples RBH20, RBH23, and RBH24, respectively. The state and federal MCL is 2 µg/L for thallium.
- The following seven metals were elevated above MCLs in groundwater sample RBH29 collected near powerblock units 7 and 8: barium, beryllium, cadmium, chromium, lead, mercury, and nickel.
- At the hazardous materials storage area, four metal (beryllium, cadmium, lead and mercury) were detected at concentrations in groundwater above MCLs.
- At the solvent wash station, three metals (lead, mercury, and thallium) were detected at concentration in groundwater above MCLs.

In the SCE Annual Groundwater Monitoring Report (Hamilton, 1998) for the retention basins, the following metals were detected at concentrations elevated above one or more of the MCLs:

- In the North Basin, two metals (arsenic and lead) were detected at concentrations in groundwater above state and federal MCLs. Three metals (aluminum, iron, and manganese) were detected at concentrations exceeding state and federal secondary MCLs.
- In the South Basin, two metals (aluminum and chromium) were detected at concentrations in groundwater above state MCLs and two metals (iron and manganese) were detected at concentrations above state and federal secondary MCLs.
- Fluoride was detected in the South Basin at concentrations in the groundwater up to 2.37 mg/l. The state MCL ranges from 1.4 mg/l to 2.4 mg/l. The specific MCL for fluoride is dependant on the annual average of maximum daily air temperatures experienced over a minimum of five years.
- Fluoride was detected in the North Basin at concentrations in the groundwater up to 1.49 mg/l.

6.2.3 Other Groundwater Contaminants

The SCE Annual Groundwater Monitoring Report (Hamilton, 1998) for the retention basins detected the following contaminants at concentrations elevated above one or more of the MCLs:

- In the North Basin, three contaminants (chloride, sulfate and TDS) were detected at concentrations in groundwater above the state and federal secondary MCLs. One parameter (E.C.) was detected above the state secondary MCL.
- In the South Basin, TDS, E.C. sulfate and chloride were detected at concentrations in groundwater above the state and federal secondary MCLs. One parameter (E.C.) was detected above the state secondary MCL.

SCE forwarded to AES a copy of correspondence written by SCE dated February 26, 1998 concerning soil and groundwater conditions found during the refurbishment of a service water tank near Plant 1. SCE collected water samples described as "groundwater drained from piling excavation soil cuttings." These water samples exceeded MCL criteria for arsenic, cadmium, chromium, and lead. These samples may indicate groundwater contamination above MCLs in this area.

In early April SCE provided and Addendum to the Baseline Tank Study Report, Fuel Oil Tank 5, dated April 1998 and prepared by CH2M HILL to AES for review. The report cited a previous baseline document issued May 22, 1997. CH2M HILL concluded in the initial baseline study that the oil contamination identified at the site was likely caused by application of fuel oil to the gravel underlying the tank to protect it from corrosion. Groundwater at the south end of the RGS is very shallow, reportedly less than 12 feet bgs.

The Addendum to that initial report concluded that:

- The TPH was likely placed to protect the tank from corrosion.
- Concentrations of TPH was likely placed to protect the tank from corrosion.

Table 6-5 summarizes the chemicals of concern in soil and groundwater identified in the Woodward-Clyde sampling effort that exceed the applicable criteria noted above.

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