APPENDIX O

Tetra Tech Site Assessment Report and Supplemental Data

TETRA TECH

December 4, 2007

Mr. Ken Ragland, P.G.
Port of Los Angeles
425 S. Palos Verdes Street
San Pedro, CA 90731

RE: Preliminary Review of Environmental and Geological Conditions in the Vicinity of the Proposed Pacific Energy Pipeline

Dear Mr. Ragland,

Tetra Tech, Inc. (Tetra Tech) has conducted a preliminary review of available documents regarding the environmental and geological conditions in the vicinity of the proposed Pacific Energy pipeline at the Port of Los Angeles (POLA). The objective of the review was to: 1) assess the presence of contaminants and their potential impacts to the proposed pipeline project, and 2) recommend appropriate actions to be taken in the areas of potential concern. The pipeline sections reviewed include: segments H – M, M – N, and N – T (Drawing Numbers 2917-Ex-101 and 2917-Ex-114); and sections C – B and B – A (Drawing Numbers 2917-Ex-012). The drawings are included in Attachment 1.

Shallow subsurface contamination (i.e., < 25 feet below ground surface (bgs)) exists throughout the industrial and commercial areas at POLA (Komex 2004a; Tetra Tech 2006; Tetra Tech 2007; and The Source Group 2007); however, there is limited environmental data for deeper soils and groundwater. Consequently, Tetra Tech prepared schematic cross sections beneath the proposed pipeline bore routes to assess whether contamination may have impacted the deeper soils and groundwater, and to assess whether pipeline borings may provide a conduit for the shallow subsurface contamination to the enter into the deeper subsurface (Figures 1 - 3).

1.0 Regional Geology

The proposed pipeline route is situated on the southern edge of the Coastal Plain Los Angeles County in the Peninsular Ranges geomorphic province of California. The Peninsular Ranges are characterized by steep, elongated ranges intervening valleys that trend northwestward. The Peninsular Ranges extend over 900 miles south from the Transverse Ranges (including the San Gabriel and San Bernardino Mountains) to the tip of Baja California. The Peninsular Ranges are bound to the east by the Salton Trough and extend to approximately 80 miles off the coast of Southern California (Oakeshott 1978).

The project is located on the southern portion of the Dominguez Gap area of the Downey Plain physiographic region. The Downey Plain extends from the Ballona Gap near Santa Monica across the central lowland of the Coastal Plain of Los Angeles County into the Coastal Plain of Orange County nearly to Santa Ana. It is bound on the north and east by the Santa Monica Mountains, the Elysian, Reppetto, Merced, and Puente Hills and their adjacent piedmont areas, and on the southwest by the Newport-Inglewood Uplift. The Downey Plain extends through the Newport-Inglewood Uplift to the Pacific Ocean at Dominguez Gap. The Dominguez Gap is an erosional feature through the Newport-Inglewood Uplift between Dominguez and Signal Hills created by the Los Angeles River. The Dominguez Gap physiographic area is approximately 2 miles wide from east to west and extends the Downey Plain south of the Newport-Inglewood Uplift to the Pacific Ocean at Long Beach and San Pedro (CADWR 1961).

The project area is underlain by Quaternary and Tertiary age sediments of both marine and terrestrial origin above basement bed rock. The Quaternary deposits are mainly of marine and non-marine origin, composed of fluvial sediments (alluvium) extending to approximately 30 to 50 feet bgs originally derived from the Los Angeles River (CADWR 1961). The underlying Pleistocene age sediments are up to 3,000 feet thick and were deposited within marine and non-marine depositional environments.

The major geological structural features in the vicinity of the project area include the steeply southwest dipping, northwest trending Palos Verdes Fault Zone. The Palos Verdes Fault Zone, the Newport-Inglewood Structural Zone, the Lomita – Wilmington Syncline, and the Wilmington Anticline. The Palos Verdes fault zone is located approximately 0.5 to 1 mile southwest of the Site. The Newport-Inglewood Structural Zone is located approximately 5 miles to the northeast of the Site. The Lomita – Wilmington Syncline is located beneath the proposed pipeline route (CADWR 1961).

2.0 Regional Hydrogeology

The proposed pipeline route is located in the southern portion of the West Coast (groundwater) Basin. The West Coast Basin extends southwesterly from the Newport-Inglewood uplift (including the Baldwin Hills, Rosecrans Hills, Dominguez Hill, Signal Hill, and Bixby Ranch Hill), to Santa Monica Bay, to the drainage divide on the Palos Verdes Hills, and to San Pedro Bay. It extends from the Ballona Escarpment (near Santa Monica) on the northwest to the Los Angeles County line on the southeast. It is approximately 24 miles long and 7.5 miles wide, encompassing an area of approximately 160 square miles (CADWR 1961).

Fresh water bearing sediments of the West Coast Basin extend from the ground surface to depths of over 1,500 feet bgs. The fresh water bearing formations of the West Cost Basin are, in descending order:

- Recent alluvial materials derived from fluvial and eolian processes; and
- The alluvial Pleistocene age Lakewood and San Pedro formations.

The Recent alluvial materials contain a semi-perched aquifer, the Gaspur Aquifer, and portions of the Bellflower Aquiclude. The Lakewood Formation contains portions of the Bellflower Aquiclude, the confined Gardena Aquifer, and the confined Gage Aquifer (CADWR 1961).

3.0 Project Area Geology and Hydrogeology

3.1 Geologic and Hydrostratigraphic Units

3.1.1 General Description

The schematic cross section lines identified on Figure 1 and shown in Figures 2 and 3 were prepared based on data presented in Appendix A of CADWR Bulletin No. 104, *Planned Utilization of the Ground Water Basins of the Coastal Plain of Los Angeles County*. They summarize general features of the project area geology and hydrogeology along the proposed pipeline bore routes in Sections H – M and N – T. As shown on Figures 2 and 3, the hydrostratigraphic units and corresponding sedimentary formations of the West Coast Basin that may be penetrated by the proposed pipeline bore routes in Sections H – M and N – T in the project area are, in descending order:

- A shallow, unconfined semi-perched aquifer in Recent alluvium exposed at the ground surface;
- The Bellflower Aquiclude of the upper Pleistocene Lakewood Formation; and
- The confined Gage aquifer of the upper Pleistocene Lakewood Formation.

The San Pedro Formation and Lynwood and Silverado aquifers are present in the project area at elevations below those that would be penetrated by the proposed pipeline bore routes in Sections H – M and N – T. The Gaspur and Gardena Aquifers are not present in the project area (CADWR 1961).

In the project area, the semi-perched Recent age aquifer extends from the ground surface to approximately 30-50 feet bgs; the Bellflower Aquiclude occurs from approximately 30-50 feet bgs to 120-140 feet bgs; the Gage Aquifer occurs from approximately 120-150 feet bgs to 200-220 feet bgs; the Lynwood Aquifer occurs from approximately 250-400 feet bgs to 400-550 feet bgs; and the Silverado Aquifer occurs from approximately 600-800 feet bgs to 900-1,100 feet bgs (CADWR 1961).

3.2 Occurrence of Groundwater

3.2.1 Semi-perched Aquifer

The first encountered groundwater in the project area is the unconfined groundwater of the semi-perched aquifer (Figures 2 and 3; CADWR 1961). It is estimated to extend from the ground surface to approximately 30 to 50 feet bgs in the project area. The proposed pipeline bore routes will completely penetrate through the semi-perched aquifer. The semi-perched aquifer is generally composed of Recent age alluvium composed sand and gravel with minor amounts of silt and clay derived from stream deposition, estuary deposits, and beach sand. The hydraulic conductivity of the semi-perched aquifer is reported to be relatively low at 0.9 feet per day (Riedel 1990). Due to the proximity of the East Basin Channel, the depth to groundwater of the semi-perched aquifer in the project area is dependent on the local tide. Groundwater has been generally reported between 3.5 and 10 feet bgs on Mormon Island, and it is likely that similar conditions are present throughout the proposed pipeline route. Likewise, the direction of groundwater flow in the project area is tidally influenced, with gradient reversals occurring with the changing tide.

The project area contains natural land features that have been expanded at some locations, such as Mormon Island, by the placement of fill deposits including dredge tailings derived from Recent alluvium and construction debris. On Mormon Island, debris, such as electrical tape tar, wood, concrete and asphalt, have been are known to occur within upper section of the fill material. The dredged fill soils that extend to approximate 30 feet bgs consist primarily of gray, very fine- to fine-grained sand and silts with relatively low hydraulic conductivity (9.0×10^{-1} ft/day) and transmissivity (4.08 – 13.38 ft^2/day). The maximum thickness of fill underlying Mormon Island is estimated to be between 35 to 45 feet (Riedel 1990). Recent alluvial deposits or the sediments of the Pleistocene Bellflower Aquiclude, are encountered beneath the dredged fill materials. It is likely that other areas containing similar fill materials in the shallow subsurface are present along the proposed pipeline route.

3.2.2 Bellflower Aquiclude

The Bellflower Aquiclude of the Lakewood Formation lies directly underneath the semi-perched aquifer (Figures 2 and 3). It is estimated to be approximately 100 to 120 feet thick in the project area. The cross section shown on Figure 2 indicates that the proposed pipeline bore route will completely penetrate through the Bellflower Aquiclude in Section H – M. The cross section shown on Figure 3 indicates that the proposed pipeline bore route will partially penetrate through the Bellflower Aquiclude in Section N – T. The Bellflower Aquiclude is a heterogeneous mixture of fine grained continental, marine, and wind blown sediments composed of clay, silt, sandy silt to silty sand, clayey sand to sandy clay, and gravelly clays that generally inhibit groundwater movement between the semi-perched aquifer and Gage Aquifer. The composition of the sediments generally restricts movement of groundwater, allowing groundwater to percolate slowly through them. However, local areas with moderate permeability that allow significant groundwater movement are present. The vertical movement of groundwater movement through the Bellflower Aquiclude is dependent on the hydrostatic pressure of the underlying aquifer, and may be either up or down (CADWR 1961).

3.2.3 Gage Aquifer

The Gage Aquifer of the Lakewood Formation directly underlies the Bellflower Aquiclude. It is estimated to be approximately 80 to 100 feet thick in the project area. The cross section shown on Figure 2 indicates that the proposed pipeline bore route will penetrate into the upper portion of the Gage Aquifer in Section H – M. The cross section shown on Figure 3 indicates that the proposed pipeline bore route will not penetrate into the Gage Aquifer in Section N – T. The Gage Aquifer is in the lowest portion of the Lakewood Formation. In the project area, it is composed of fine to medium sand with variable amounts of gravel, sandy silt, and clay of marine and continental origin with moderate to low permeability, and is confined by the Bellflower Aquiclude (CADWR 1961).

4.0 Soil and Groundwater Contamination

The project area has been used for industrial purposes, including petroleum production, storage, and marine terminal operations since the early 1900s (Riedel 1990). Consequently, the soil and groundwater of the semi-perched aquifer of the project area are impacted with petroleum hydrocarbons, volatile organic compounds (VOCs), polynuclear aromatic hydrocarbons (PAHs), and metals. The Mormon Island area is known to be impacted with petroleum hydrocarbons released from historic petroleum production, storage, and marine terminal operations. Other areas where the soil and groundwater of the semi-perched aquifer are known to be impacted with petroleum hydrocarbons in the project area exist along Harry Bridges Street and Alameda Street. It is therefore likely that areas impacted with petroleum hydrocarbon contamination will be encountered in the shallow soil and groundwater of the semi-perched aquifer during pipeline construction.

4.1 Pipeline Section H – M

The proposed pipeline section H – M would be installed in a north-south alignment, originating in the central portion of Mormon Island (Drawing Number 2917-Ex-101). Mormon Island is a man-made land peninsula created from fill and dredged material within the Port of Los Angeles. Historic and present industrial and commercial operations at Mormon Island include:

- Shell Oil Marine Terminal, located at Berths 167-169, has been used for liquid bulk storage and shipping;
- Former GATX Los Angeles Marine Terminal Tank, located at Berths 171-173 formerly used for crude oil bulk storage;
- U.S. Borax, located northwest at 300 Falcon Street, has been used for borate product storage, refining, and shipping;
- Ultramar/Valero Oil, located at 961 La Paloma Avenue, has been used for liquid bulk storage and shipping;
- Rio Doce Pasha Marine Terminal, located at 802 S. Fries Avenue, Berths 174-176, has been utilized as an omni-mixed terminal; and
- Port of Los Angeles Construction and Maintenance Yard, Berths 159-161, located on the northwest portion of Mormon Island.

A variety of petroleum hydrocarbons including crude oil and several refined products such as gasoline, diesel fuel, bunker fuel, and gas oil have been stored in aboveground storage tanks (ASTs) at numerous tank farms. The petroleum hydrocarbons have been transferred via pipeline, truck, barge, and shipped to and from facilities at Mormon Island (Tetra Tech 2006). Subsurface contamination in both soil and groundwater, including the presence of free petroleum product, is known to exist throughout Mormon Island (Tetra Tech 2006 and Tetra Tech 2007a).

4.1.1 Former GATX Los Angeles Marine Terminal Tank (Berths 171-173)

The former GATX Los Angeles Marine Terminal (Berths 171-173) is located immediately south of the proposed entrance point for the pipeline section H – M (Drawing Number 2917-Ex-101). Tetra Tech has conducted quarterly groundwater monitoring and free product recovery at the former GATX facility since the first quarter 2006. The most recent results, Third Quarter 2007 Groundwater Monitoring Report, indicated that light non-aqueous phase liquid (LNAPL) is present in onsite monitoring wells (Tetra Tech 2007a). Groundwater samples were collected from 29 monitoring wells and analyzed for total petroleum hydrocarbons (TPH) carbon chain (C_7-C_{36}) by EPA Method 8015M and for VOCs, including fuel oxygenates, by EPA Method

8260B. At the time of sampling, depth-to-groundwater ranged from 3.95 feet to 9.38 feet below top of casing (TOC); groundwater elevations ranged from 0.93 feet to 4.39 feet above MLLW; and due to the proximity to the East Basin Channel, groundwater is tidally influenced. The laboratory data indicated that the majority of the groundwater beneath the former Tank Farms No. 1 and No. 2 contains a layer of sheen or contains total TPH concentrations greater than 5,000 micrograms per liter (µg/L). Total TPH concentrations in groundwater beneath former Tank Farm No. 3 were less than 3,000 µg/L, with the exception of free product that was observed in a monitoring well located in Fries Avenue. TPH-diesel range petroleum hydrocarbons are the dominant fingerprint of the total TPH detected in most of the groundwater samples. Additionally, twenty (20) VOCs, primarily aromatic VOCs and fuel oxygenates were detected at varying concentrations in the shallow groundwater samples.

4.2 Pipeline Section M – N

The proposed pipeline section M – N is located north of Mormon Island (Drawing Number 2917-Ex-101). Trans Pacific (TRAPAC) Terminals facility is located at Berths 134 through 147, west of pipeline section M – N. Tetra Tech conducted a Phase I Environmental Site Assessment (ESA) of Harry Bridges Boulevard, TRAPAC Terminals, and Pier A Street Rail Yard (Tetra Tech 2007b), which included data from The Source Group, Inc.'s Draft Site Characterization Report (The Source Group 2007). Based on the review of various environmental reports, the following was noted:

- Groundwater at Berth 142 is impacted with dense non-aqueous phase liquid (DNAPL), TPH (total TPH ranging from 540 μg/L to 610,000 μg/L), and PAHs (ranging from 18 μg/L to 29,000 μg/L for naphthalene).

- Elevated concentrations of organic compounds in soil were found at Berth 144, before the wharf reconstruction in 1996, at a depth of 6 feet to 10 feet bgs.

- Berth 147 was also impacted by elevated concentrations of copper, lead, and nickel in soil, greater than 10 times the Soluble Threshold Limits Concentrations (STLC), at a depth of 2 feet to 4 feet bgs.

- Free product (i.e., LNAPL) and elevated levels of gasoline range organics (>10,000 μg/L) plumes exist north and south of Harry Bridges Boulevard.

- Soil contamination at the Pier A Street Rail Yard occurred at several specific areas such as around the aboveground storage tank, roundhouse, and pipeline right-of way areas. VOCs, PAHs, and metals concentrations were above the U.S. EPA's industrial Preliminary Remediation Goals (PRGs). Additionally, soil TPH ranged from 48 mg/kg to 110,000 mg/kg.

4.3 Pipeline Section N – T

4.3.1 Former Koppers Facility

The former Koppers facility was located within POLA on the northeastern corner of the intersection of South Avalon Boulevard and East Water Street, northwest of Berths 195-199 and northeast of Berths of 185-187. A portion of the proposed pipeline, section N – T (Drawing Number 2917-Ex-114), would traverse beneath the former Koppers facility (at a depth > 80 feet bgs). Consequently, Tetra Tech reviewed three documents prepared by Komex to evaluate whether operations at the former Koppers facility have impacted the subsurface environment. The reviewed document included: the Phase I ESA (Komex 2003), the Preliminary Soil and Groundwater Characterization Report (Komex 2004a), and the Feasibility Study (Komex 2005). Based on these investigations at the former Koppers facility, the shallow subsurface soil (i.e., ≤ 15 feet bgs) and shallow groundwater have been impacted with metals, volatile organic compounds, semi-volatile organic compounds, and total petroleum hydrocarbons (as diesel fuel).

According to Komex, historic land usage included oil tank farms, the presence oil wells, ASTs, and oil pipelines. The majority of the property area is currently operated by Distribution and Auto Services (DAS) and is covered with a parking lot. Four small buildings are located at the western portion of the property; the northeastern portion of the property is undeveloped. Railroad tracks are present on the western border of the Site and in the vicinity.

The site was occupied American Lumber and Treating, a wood-treating facility, from the 1920s through approximately 1954, when Koppers took over operations of the Site. Onsite activities included treatment of wood (telephone poles, dock pilings, lumber, and railroad ties). A variety of wood preservatives were used including creosote, creosote mixed with diesel fuel, "Wolman Salts" (a mixture of sodium fluoride and dinitrophenol with sodium or potassium dichromate), copper chromate, copper chromated arsenate (CCA), and pentachlorophenol (PCP) in oil. Unknown quantities of hazardous wastes containing arsenic, selenium, antimony, zinc, cadmium, copper, chromium, fungicides, halogenated compounds, and, dioxins were reported to have been disposed of in onsite wastewater ponds and other areas. In 1972, Koppers ceased operations and demolished their structures before turning over control of the site to POLA.

Reportedly, when wood treating operations ceased onsite, unknown quantities of sediments and residues which had accumulated in the former wastewater ponds were removed. Subsequently, the site was covered with approximately eight feet of fill by POLA, prior to its current development and operation by DAS.

According to Komex, in 1981, the California Department of Health Services (DHS) considered the Site a hazardous waste property. In 1984, the California Environmental Protection Agency, Department of Toxic Substances Control (DTSC) added the Site to the State Superfund List.

The elevation of the former Koppers facility is approximately 10-15 feet above mean sea level. Shallow soils primarily consist of clayey silt, sandy silt, silty sand, and sand to a depth of about 80 feet bgs. Shallow subsurface sediments consist of recent alluvium and artificial fill. No surface water bodies exist onsite. Shallow groundwater is encountered at 8-14 feet bgs. The shallow groundwater flow direction is toward the northwest, according to Komex.

Between January 21 and 27, 2004, 37 boreholes were advanced at the Site targeting the five potential areas of concern (Komex 2004a). The boreholes were advanced to first groundwater throughout the site and offsite. The analytical results indicated the following:

- TPHd concentrations detected in soil ranged from non-detect to 40,000 milligrams per kilogram (mg/kg)
- TPHd concentrations detected in groundwater ranged from 130 ug/L to 290,000 µg/L
- The highest concentrations of metals in soil include: chromium (36 mg/kg - 5,700 mg/kg), arsenic (13 mg/kg - 2,900 mg/kg), and copper (24 mg/kg - 9,000 mg/kg)

Additionally, PAHs, including Benzo(a)pyrene and naphthalene, and VOCs were detected in shallow subsurface soil and groundwater samples throughout the site. The highest VOC levels were found at the former treatment plant area, the former creosote and fuel area farm, and the former wastewater pond area. PCP concentrations detected in groundwater at concentrations greater than 100 µg/L.

Polychlorinated biphenyls (PCBs) were not detected in soil or groundwater at the site. Dioxin was found in three groundwater samples, but at concentrations below the MCL of 30 picograms per liter.

Based on the investigations conducted by Komex, the shallow subsurface environment (soil and groundwater) at the former Koppers facility has been impacted with various organic and inorganic contaminants. It is important to note that the full lateral and vertical extent of soil and groundwater contamination has not been delineated.

4.3.2 Former Auto Warehousing Company Facility

The Former Auto Warehousing Company Facility is located within the Port of Los Angeles at the southern terminus of McFarland Avenue, near the intersection of Alameda Street. The property is also known as Berth 200A and is located approximately 50 feet north of the East Basin of the Los Angeles Harbor. A portion of the proposed pipeline, section N – T (Drawing Number 2917-Ex-114), would traverse beneath the Former Auto Warehousing Company Facility (at a depth > 80 feet bgs). Tetra Tech reviewed the Phase II ESA prepared by Komex (Komex 2004b) to evaluate the potential for deep subsurface contamination.

The facility was a former automobile-processing center, which was operated by Auto Warehousing Company from 1993-2003. The majority of the site consists of asphalt and concrete-paved parking lots, a 33,000 square foot service garage and office building, a spray painting area, a car wash rack and associated wastewater clarifier. From about 1925 until the late 1950s or early 1960s, the site was part of a lumber mill. At least two oil wells were formerly located onsite.

On March 25 and 26, 2004, Komex advanced 10 boreholes at the site. Samples were collected at 1 foot, 10 feet, and 15 feet bgs. Once groundwater was encountered, temporary wells were installed and groundwater was sampled.

Based on lithologic data obtained from the soil boreholes, the shallow soils consist primarily of light olive brown to dark gray sandy silt and silty sand with shells, with lesser amounts of silt, sand, and clayey silt to a depth of 16 feet bgs. Gray to black staining was observed in nine of 10 soil boreholes at depths ranging from 7.5 feet to 16 feet bgs. Groundwater was encountered between 8.5 feet and 13.5 feet bgs.

Analytical results indicated the following:

- TPH gasoline and VOCs were not detected above laboratory reporting limits for soil samples selected for analysis.

- Metals were detected above laboratory reporting limits for all of the soil samples selected for analysis. The results of the analysis indicate that the metal concentrations are below the RWQCB soil Environmental Screening Levels (ESLs) for commercial/industrial land use, with the exception of arsenic. Arsenic was detected at a concentration of 6.1 mg/kg slightly above the ESL (6.1 mg/kg) in a soil sample collected at 1 foot bgs. However, arsenic occurs naturally in soils throughout southern California and this concentration is typical of background conditions.

- TPH gasoline was not detected above laboratory reporting limits for the groundwater samples selected for analysis.

- VOCs were detected in low concentrations in groundwater: benzene was detected at 2.2 µg/L, naphthalene at 1.6 µg/L, n-butylbenzene at 0.5 µg/L, and methylbenzene was detected at 0.5 µg/L. The concentrations of benzene and naphthalene are below the RWQCB groundwater ESLs for non-beneficial use groundwater at commercial sites (46 µg/L and 24 µg/L, respectively); the RWQCB has not published ESLs for butylbenzene and methylbenzene.

Based on the findings of the Komex Phase II ESA, it appears that historical operations have not significantly impacted the shallow subsurface environment at the Former Auto Warehousing Company Facility.

4.4 Pipeline Section C – B

4.4.1 Los Angeles Export Terminal (LAXT)

LAXT is located on Terminal Island, adjacent to Pier 300. The proposed pipeline route of segment C – B (Drawing Numbers 2917-Ex-012) would originate at the LAXT facility and would be installed in trenches. In 1998, Tetra Tech conducted an environmental baseline study to assess conditions at the LAXT facility (Tetra Tech 1998). Analytical results of surficial soil samples indicated:

- Relatively low TPH concentrations ranging from 165 mg/kg to 738 mg/kg in composite soil samples
- Metal concentrations were consistent with regional background concentrations
- PAHs were detected at relatively low concentrations; however, dibenz(a,h)anthracene was detected above the industrial PRGs
- VOCs were not detected in soil samples
- PCBs (Aroclor 1248) was detected in one composite soil sample at a concentration (0.18 mg/kg), which is below the industrial PRG

4.4.2 Pacific Energy Future Crude Oil Terminals

Pacific Energy Future Crude Oil Terminals is located on Terminal Island, east of LAXT. The proposed route of pipeline section C – B (Drawing Numbers 2917-Ex-012) would be installed in a trench beneath Site 3 of Pacific Energy Future Crude Oil Terminals. In 2006, Tetra Tech performed a Baseline Environmental Assessment for the proposed Pacific Energy Crude Oil Terminal (Tetra Tech 2006b). The investigation included collecting shallow (i.e., ≤ 5 feet bgs) soil sampling. Analytical results for soil indicated the following:

- TPH results were all below the LA-RWQCB maximum soil screening criteria above non-drinking water aquifers
- VOC results were all below the industrial PRGs

- PAH results were compared to the industrial PRGs. One sample contained dibenz(a,h)anthracene at a concentration that exceeds the PRG
- PCB results were non-detect (<50 µg/kg) or were below the industrial PRG of 740 µg/kg for Aroclor-1260
- Metal results were below the industrial PRGs

The TPH-impacted soil may be left in place based on the 1996 LA-RWQCB Interim Site Assessment Cleanup Guidebook given that the site groundwater is non-potable. However, if the soil is excavated, the soil should be reanalyzed for TPH. If the soil contains TPH above 1,000 mg/kg, then the soil may require treatment prior to reuse or off-site disposal.

4.4.3 Pier 400

The proposed route of pipeline sections C – B and B – A (Drawing Number 2917-Ex-012) would be installed in trenches beneath Navy Way and Pier 400. The subsurface soils at Pier 400 consist of hydraulic fill overlying natural alluvial soils. Most of the hydraulic fill consists of silty sands. Groundwater is tidally influenced and is typically encountered at 5 feet MLLW, approximately 12 feet bgs (Diaz Yourman 2006).

4.4.4 Exxon/Mobil Southeast Terminal

Tetra Tech did not have access to and, therefore, did not review environmental data for the Exxon/Mobil Southeast Terminal or the immediate vicinity. This area includes the following proposed pipeline sections: C – D, D – E, E – F, C – G, C – I, and I – E, and C – J (Drawing Number 2917-Ex-013).

4.4.5 Valero Refinery

Tetra Tech did not have access to and, therefore, did not review environmental data for the Valero Refinery or the immediate vicinity. This area includes the following proposed pipeline sections: T – U, U – V, U – W, and T – X (Drawing Number 2917-Ex-014).

5.0 Impact Analysis

During the pipeline construction the following activities may be performed:

- Soil excavation and pipeline construction in the surface soils, shallow subsurface soils, and groundwater of the semi-perched aquifer;
- Grading of shallow subsurface soils;
- Dewatering of the shallow subsurface soils and groundwater of the semi-perched aquifer for pipeline construction; and
- Drilling and pipeline construction in surface soils, shallow subsurface soils, and groundwater of the semi-perched aquifer, and the deeper Bellflower Aquiclude and Gage Aquifer.

If contaminated soil and/or groundwater are encountered during pipeline construction, the potential impacts to construction workers, the general public, and the environment should be mitigated. However, routine transportation and disposal of contaminated and/or hazardous materials generated from the proposed project should not pose a significant concern to the public.

Further, based on the geological conditions at the project area, there is a low probability that contamination from the shallow subsurface has migrated through the Bellflower Aquiclude into the Gage aquifer. There is a potential, however, for contaminated groundwater in the semi-perched aquifer to be introduced into deeper hydrostratigraphic zones during the proposed pipeline boring activities.

6.0 Mitigation Measures

Tetra Tech conducted a preliminary review of the available documents regarding the environmental and geological conditions in the vicinity of the proposed Pacific Energy pipeline. The data indicates that a variety of inorganic (i.e., metals) and organic constituents (petroleum hydrocarbons, PAHs, and chlorinated compounds) may have existed in the shallow subsurface soil and groundwater of the proposed pipeline route at a wide-range of concentrations. In addition to the dissolved constituents, shallow groundwater contains LNAPL. Furthermore, contamination in the vicinity of the proposed pipeline route has not been fully delineated laterally or vertically. Consequently, the environmental conditions in the deep zone (i.e., >25 feet bgs) are not well documented or understood. Prior to and during construction activities, Tetra Tech recommends the following mitigation measures:

1. A Phase I Environmental Assessment should be performed for the proposed pipeline route to identify areas where known and potential environmental hazards are present that could pose impacts to the proposed project.

2. If warranted, a Phase II Environmental Assessment should be performed, to further define the nature and extent of the known and potential environmental hazards in the proposed pipeline route identified in the Phase I Environmental Assessment. The Phase II Environmental Assessment should be performed under appropriate regulatory agency oversight if constituents are identified at concentrations that exceed regulatory guidelines, and may include: advancing soil borings or performing cone penetration tests (CPT) in areas where shallow contamination is known to exist, near the proposed pipeline route, which may impact deeper soils and groundwater. Soil and groundwater samples may be collected and analyzed to identify the extent and magnitude of contamination.

3. A construction monitoring and protection plan should be developed based on the results of the Phase II Environmental Assessment to provide protection to construction workers and the general public from potentially contaminated and hazardous materials that may be encountered, excavated, dewatered, transported and disposed of during the project. The plan should be prepared in accordance with all relevant federal, state, and local regulations. Further, the soil and water wastes generated during additional investigation activities and during the pipeline installation need to be characterized to determine the hazardous status of the wastes and to evaluate disposal options.

4. If dewatering is required for pipeline construction, additional characterization of the groundwater will be necessary. Groundwater characterization would likely include groundwater well installation for sampling and constituent analysis, and pumping tests to evaluate the groundwater extraction rate and volume. The groundwater samples would be analyzed for total petroleum hydrocarbons, volatile organic compounds, semivolatile organic compounds, polycyclic

aromatic hydrocarbons, pesticides, polychlorinated biphenyls, Title 22 metals, or other parameters as required by the National Pollutant Discharge Elimination System (NPDES). If constituents are identified in groundwater at concentrations above regulatory guidelines, a treatment and discharge/disposal plan and NPDES permit will likely be required for groundwater extracted for construction dewatering.

5. Additional assessment of the hydrologic conditions of the semi-perched aquifer, Bellflower Aquiclude, and Gage Aquifer should be performed in areas where contaminated groundwater in the semi-perched aquifer could be introduced into deeper hydrostratigraphic zones along the pipeline bore routes. Groundwater characterization would include groundwater well installation for sampling and constituent analysis, pumping tests to evaluate aquifer characteristics, including storage, transmissivity, and hydraulic conductivity. Groundwater samples would be analyzed for total petroleum hydrocarbon, volatile organic compounds, semivolatile organic compounds, polycyclic aromatic hydrocarbons, pesticides, polychlorinated biphenyls, and Title 22 metals. Groundwater samples would also be analyzed for physical groundwater characteristics including pH, conductivity, metals, general mineral content, and other parameters. At least one set of cluster wells should be completed to evaluate the vertical gradient and potential for vertical flow between the semi-perched aquifer, Bellflower Aquiclude, and Gage Aquifer.

6. A plan should be developed and implemented for specialized drilling and pipeline construction practices to prevent the introduction of contaminated groundwater from the semi-perched aquifer into deeper hydrostratigraphic zones along the pipeline bore routes. The plan should be developed based on the results of an assessment of the hydrologic conditions of the semi-perched aquifer, Bellflower Aquiclude, and Gage Aquifer in the areas where contaminated groundwater in the semi-perched aquifer could be introduced into deeper hydrostratigraphic zones along the pipeline bore routes by drilling activities and/or along the pipeline boring. The plan may include using a conductor casing during the pipeline bore drilling through the semi-perched aquifer into the underlying Bellflower Aquiclude.

Please contact me at (626) 470-2427 or Dr. David Liu at (626) 470-2441 with any questions or comments.

Sincerely,
TETRA TECH

Robert Kurkjian, PhD

Enclosures: Attachment 1, Pipeline Drawings
Figure 1, Proposed Bore Route
Figure 2, Schematic Cross Section of Bore Route Along Section H-M
Figure 3, Schematic Cross Section of Bore Route Along Section N-T

References

California Department of Water Resources (CA DWR). 1961. Planned Utilization of the Ground Water Basins of the Coastal Plain of Los Angeles County, Appendix A – Ground Water Geology: CDWR, Bulletin 104.

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FIGURES

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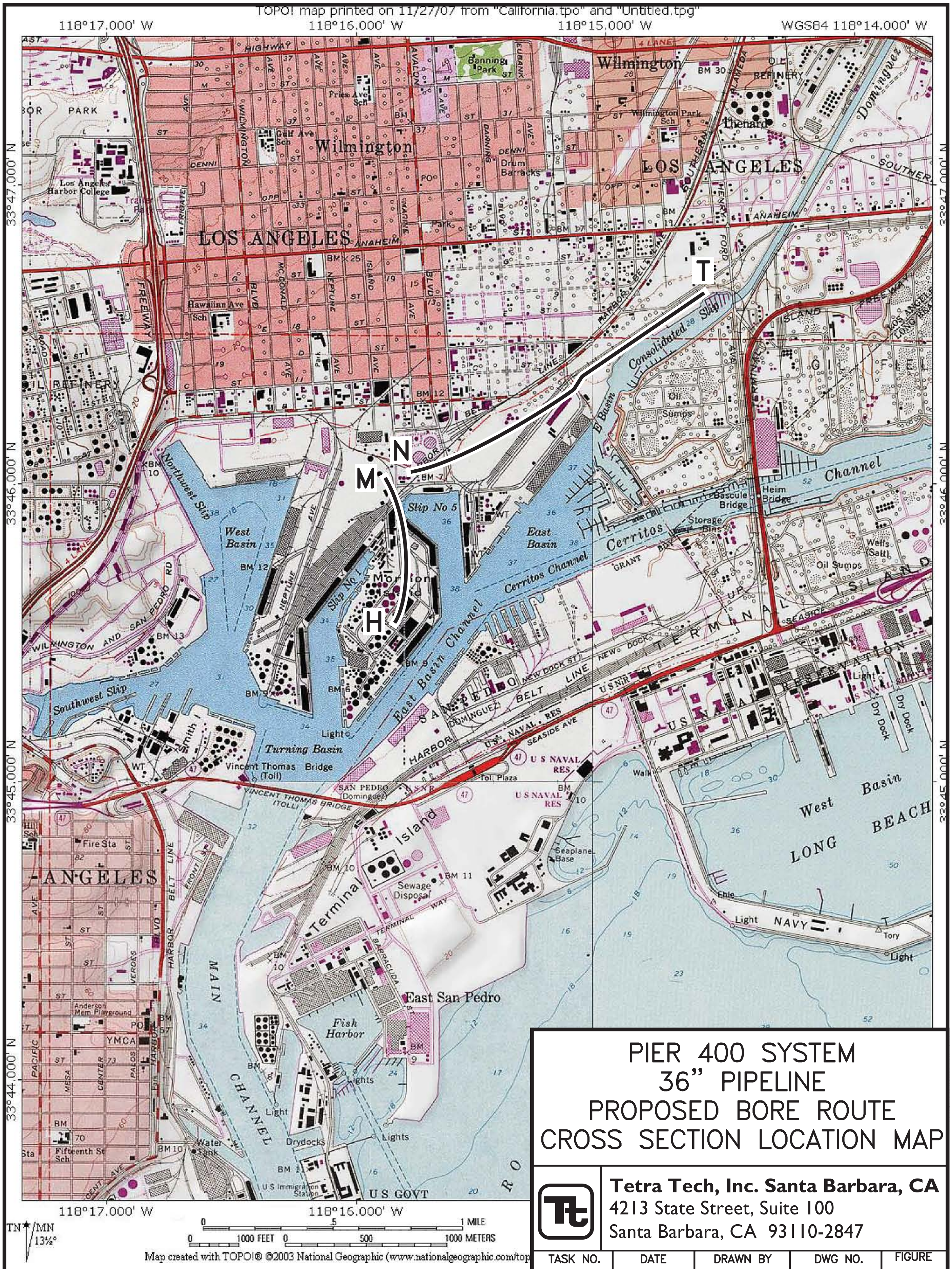

PIER 400 SYSTEM
36" PIPELINE
PROPOSED BORE ROUTE
CROSS SECTION LOCATION MAP

Tetra Tech, Inc. Santa Barbara, CA
4213 State Street, Suite 100
Santa Barbara, CA 93110-2847

TASK NO.	DATE	DRAWN BY	DWG NO.	FIGURE
17284-01	11/28/07	PRICHARD	6589	1

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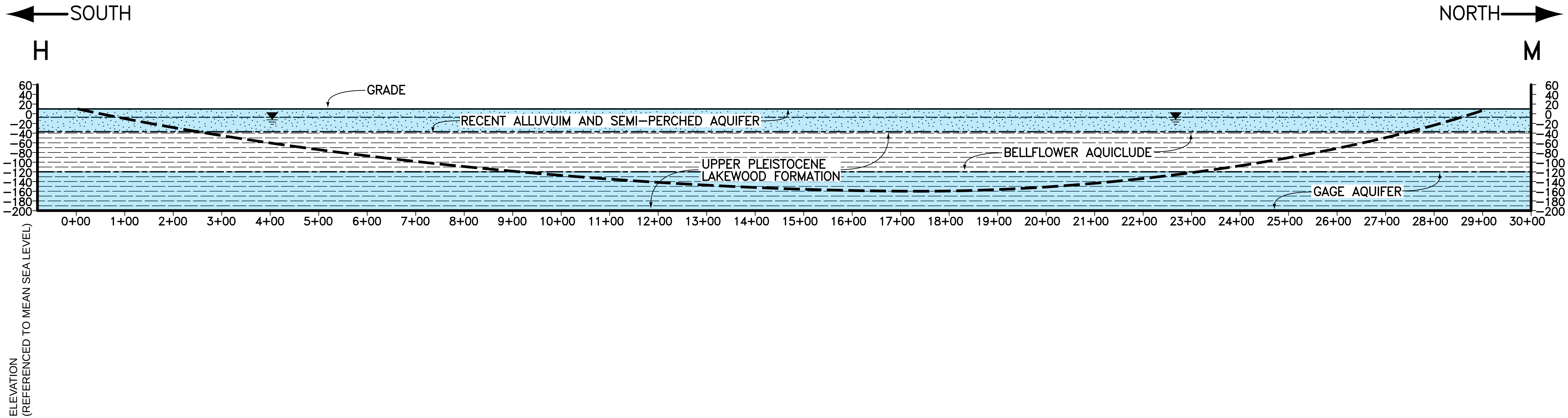

LEGEND

- PROPOSED 36" PIPELINE
- APPROXIMATE HYDROSTRATIGRAPHIC BOUNDARY
- APPROXIMATE TOP OF FIRST ENCOUNTERED GROUNDWATER

0 100' 200' 300'
SCALE

PIER 400 SYSTEM 36" PIPELINE
SCHEMATIC CROSS SECTION OF
BORE ROUTE ALONG SECTION H-M

TETRA TECH, INC.
4213 State Street, Suite 100
Santa Barbara, CA 93110-2847

TC NO.	DATE	DRAWN BY	DWG NO.	FIGURE
17284–01	11/27/07	PRICHARD	6585	2

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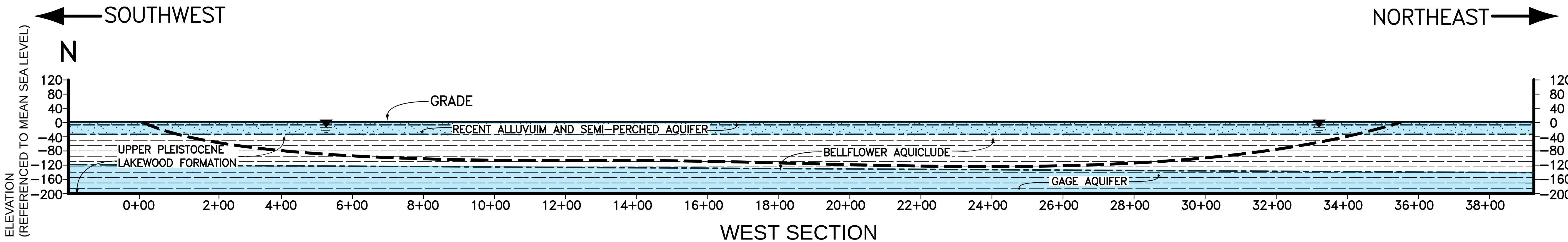
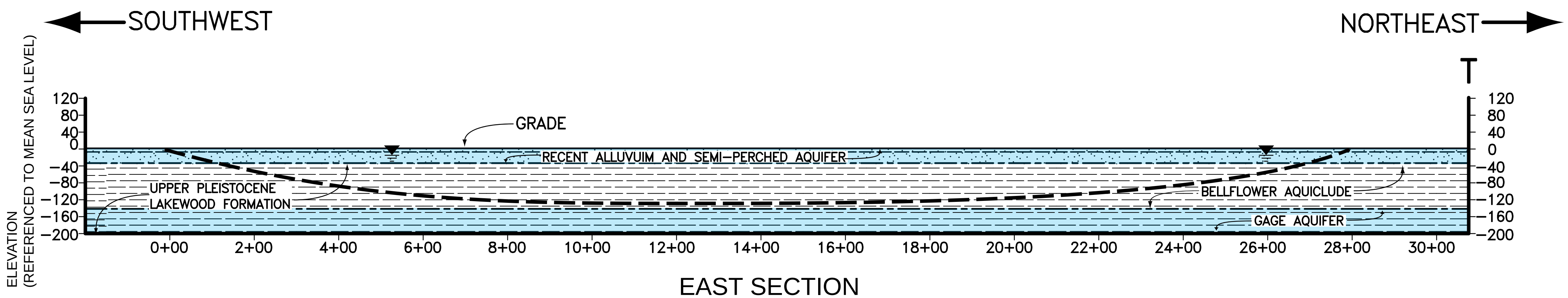


WEST SECTION



EAST SECTION

LEGEND

- PROPOSED 36" PIPELINE
- APPROXIMATE HYDROSTRATIGRAPHIC BOUNDARY
- APPROXIMATE TOP OF FIRST ENCOUNTERED GROUNDWATER

0 150' 300' 450'
SCALE

PIER 400 SYSTEM 36" PIPELINE
SCHEMATIC CROSS SECTION OF
BORE ROUTE ALONG SECTION N-T

TETRA TECH, INC.
4213 State Street, Suite 100
Santa Barbara, CA 93110-2847

TC NO.	DATE	DRAWN BY	DWG NO.	FIGURE
17284−01	11/28/07	PRICHARD	6584	3

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ENVIRONMENTAL
ENGINEERING & CONTRACTING, INC.
CA CONTR. LIC. #A-743267
150 EL CAMINO REAL, SUITE #120, TUSTIN, CALIFORNIA 92780
PHONE (714) 573-4441 FAX (714) 573-2876

REPORT
SUBSURFACE ENVIRONMENTAL INVESTIGATION

at

Ultramar Refinery
2402 E. Anaheim Street
Wilmington, California

and

Air Products Hydrogen Plant
700 North Henry Ford Avenue
Wilmington, California

CRWQCB Cleanup and Abatement Order Number 98-003
Site File Number 93-36
EEC Job No. S185-14

July 27, 1999

Prepared for

Ultramar Inc.
2402 E. Anaheim Street
Wilmington, California

by

James Leist
Project Manager

Mark Zeko
Registered Geologist # 6278
Certified Hydrogeologist # 310

CERTIFIED HYDROGEOLOGIST
MARK T. ZEKO
No. 310
STATE OF CALIFORNIA

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ENVIRONMENTAL
ENGINEERING & CONTRACTING, INC.
CA CONTR. LIC. #A-743267
150 EL CAMINO REAL, SUITE #120, TUSTIN, CALIFORNIA 92780
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1.0 INTRODUCTION

Ultramar Inc. (Ultramar) retained Environmental Engineering & Contracting, Inc. (EEC) to conduct a subsurface environmental investigation at the Ultramar Refinery and the Air Products Hydrogen Plant (Figure 1). The work was conducted in response to Ultramar's Cleanup and Abatement Order (CAO), Number 98-003 (File Number 93-36), issued by the California Regional Water Quality Board CRWQCB) on January 21, 1998.

1.1 Purpose

The purpose of the subsurface investigation was to evaluate groundwater conditions at various locations within the Ultramar Refinery (Refinery) and the Air Products Hydrogen Plant (Hydrogen Plant) sites. The spatial relationship of the two sites is shown on Figure 2. The proposed locations were identified in a comprehensive Evaluation Report summarizing available subsurface investigations that have been performed to date at the Refinery and the adjacent Hydrogen Plant facilities (EEC, 1998). A workplan for the investigation was approved by the CRWQCB in a letter dated February 5, 1999. The investigation focused on obtaining soil and water samples from the project areas to evaluate whether hydrocarbons were present in the subsurface. To accomplish the project objectives, a total of seven groundwater monitoring wells were installed in the study area: four monitoring wells were installed at the Refinery, and three wells were installed at the Hydrogen Plant. The location of the groundwater monitoring wells are shown on Figure 3 and 4.

1.2 Document Organization

This report includes a discussion on the following:

- Site Description
- Regional and Site Geology and Hydrogeology
- Soil and Groundwater Investigation Activities
- Groundwater Monitoring Well Construction
- Groundwater Gradient and Flow Direction
- Soil and Groundwater Sampling Methods

- Soil and Groundwater Analytical Results
- Investigation Results

2.0 BACKGROUND

The Refinery, Hydrogen Plant, and surrounding areas are zoned for heavy industrial uses. Currently, land use in the vicinity of the Refinery and Hydrogen Plant includes power generation, oil production and refineries, coke calcining, and other heavy industrial facilities. Other industries include salvage yards, automobile and boat repairs facilities, container storage terminals, and small businesses.

Both the Refinery and Hydrogen Plant are located in the Wilmington Oil Field, and have been subjected to intense oil field activities beginning in the late 1930s. Oil field activities associated with the subject sites include exploratory oil drilling and subsequent production well operations, aboveground storage tanks (ASTs), pipelines, and sump disposal sites for oil field wastes and other waste products.

2.1 Refinery

At least 20 oil production wells have been placed within the Refinery site since the late 1930s. Aerial photographs indicate that large areas of the Refinery have at one time or another contained sumps and other surface impoundments most likely related to oil production activities. It is suspected that the sumps contained hydrocarbon products associated with oil exploration.

In addition to oil exploration, the area south of the Terminal Island (TI) freeway (known as the TCL/Ultramar parcel) was intensely used for land disposal activities. Documented disposal practices occurred from approximately October 1948 to at least February 1951. Although permit requirements were for the deposit of soil, concrete, brick, tile, drilling mud, and similar materials, samples collected in 1981 indicated that previous use may have been inconsistent with previous permit agreements.

In August 1988, the Department of Toxic Substances Control (DTSC) ordered the owner, Union Pacific Resources Company (UPRC), to investigate the extent of contamination at the site, and to develop a Remedial Action Plan (RAP) with DTSC regulatory oversight. This agreement is known as the TCL Consent Order. In the same year, a 34-acre portion of the parcel was sold by UPRC to the Beacon Oil Company (now Ultramar Inc.), and is often referred to as the TCL/Ultramar parcel.

In 1985 the CRWQCB issued Order Number 85-25, requiring UPRC to perform site assessment investigations at the Champlin Petroleum Company refinery (later purchased by Ultramar Inc., and renamed Ultramar Refinery). In response to Order Number 85-25, various subsurface investigations have been performed at the site. Since Ultramar's ownership of the property, additional site investigations were conducted on a voluntary compliance basis.

Investigations at the Refinery have been conducted by Earth Technology Corporation, (Earth Technology), Engineering Enterprises Inc. (EEI), Environmental Resolutions, Inc. (ERI), ICF Kaiser Engineers, Inc. (ICF Kaiser), Environ Corporation (Environ), and EEC. Subsurface investigations have included the installation of temporary and permanent monitoring wells, drilling soil borings, utilizing a rapid optical screening tool (ROST), exploratory trenching, groundwater monitoring, overexcavation of impacted soil, confirmation soil sampling, and free product analysis. Detailed discussions of investigations performed at the Refinery are included in EEC report Evaluation Report - Summary of Subsurface Environmental Investigations at Ultramar Refinery and Air Products Hydrogen Plant, Wilmington, California, dated October 26, 1998.

2.1.1 Monitoring Well Installations

Since September 1985, the Refinery has installed a total of 26 monitoring wells with the majority being located north of the TI freeway. Monitoring wells have been installed by several consultants: Earth Technology Corporation (Earth Technology), Engineering Enterprises, Inc. (EEI), and ERI. Groundwater monitoring well locations are shown on Figure 3.

2.1.2 Clean Fuels Project Investigations and Regulatory Compliance

The Clean Fuels Project (CFP) was a state- and federally-mandated program requiring the manufacture of cleaner-burning reformulated gasoline and diesel fuel. From April 1993 through December 1995, Ultramar was involved in a fast-track construction and expansion program to meet the mandated deadlines.

Previous guidelines for the excavation, segregation, disposal, reuse, and site-specific cleanup levels of hydrocarbon- and lead-impacted soil are beyond the scope of this report, but a history is detailed in EEC's report, "Evaluation Report - Summary of Subsurface Environmental Investigations at the Ultramar Refinery and Air Products Hydrogen Plant," dated October 26, 1998. However, a table of Ultramar's current WDR soil reuse/cleanup levels from the CRWQCB is included in Appendix A, Table 1. This table summarizes the contents of the CRWQCB's letter dated August 15, 1996.

2.2 Hydrogen Site

Like the Ultramar Refinery, the Hydrogen Plant Site has had a long history of oil exploration and production activities. Unlike the Refinery, large surface impoundments have not been observed in aerial photographs.

Review of aerial photographs, interviews with former employees, and review of historical documents revealed that prior to the late 1920s, little to no activity occurred at the Hydrogen Plant Site. By the late 1930s to early 1950s, several buildings occupied the site. Oil production and storage facilities, as well as various sumps and pits, occupied the site. According to California Division of Oil and Gas (CDOG) Wildcat Maps, seven oil production wells were located at the site, as were at least 20 ASTs.

Prior to acquisition by Ultramar, various investigations conducted at the Hydrogen Plant Site confirmed the presence of buried drums, tank bottoms, and miscellaneous debris. The investigations presented a comprehensive evaluation of subsurface conditions with respect to hydrocarbons and metals in the subsurface. After excavation of soil identified as exceeding interim waste discharge requirements (WDR) guidelines was complete, a rapid remediation of the site was conducted by overexcavation of the impacted soil. However, free product was observed on the groundwater surface at several locations. Attempts were made to remove free product while the excavations were open. Observations made prior to backfill indicate that remnants of free product may remain at the site.

Various subsurface investigations have been performed at the site by Remedial Action Corporation, ERI, and Tetra Tech. Investigations have included temporary monitoring well installation, exploratory trenching, soil borings and sample collection, overexcavation of impacted soil, confirmation soil sampling, groundwater sampling, and free product analysis. Detailed discussions of investigations performed at the Hydrogen Plant Site are included in a report by EEC entitled Evaluation Report - Summary of Subsurface Environmental Investigations at Ultramar Refinery and Air Products Hydrogen Plant, Wilmington, California, dated October 26, 1998.

3.0 GEOLOGY AND HYDROGEOLOGY

3.1 Regional Geology

The Refinery and Hydrogen Plant sites lie within the Peninsular Ranges Geomorphic Province. The Peninsular Range is dominated by northwest-southeast trending blocks separated by similar trending strike-slip faults. The Los Angeles Basin lies within the Peninsular Range Province. The Los Angeles Basin is approximately 50 miles long and 20 miles wide. The Basin contains approximately 14,000 feet of marine and continental rocks of Miocene to early Pleistocene age. These rocks are overlain by unconsolidated and semi-consolidated Quaternary marine and continental sediments.

The Los Angeles Basin contains four structural divisions: The southwestern block; the northwestern block; the northeastern block; and the central block. Both sites are located within the southwestern block. The southwestern block of the Los Angeles Basin is bounded on the east by the Newport-Inglewood fault zone, to the north by the Santa Monica fault zone and to the south and west by the Pacific Ocean. The structural trend of the Newport-Inglewood fault zone, a combination of folds and faults, is expressed as a chain of low, en echelon anticlinal hills. The anticlinal structures of the rocks in this portion of the basin have formed important traps for petroleum and natural gas, including the Wilmington Oil Field.

Two well documented major active fault zones are located in the vicinity of the site: 1) the Palos Verdes Fault Zone; and 2) the Newport-Inglewood Fault Zone. The Palos Verdes Fault Zone is located approximately 3.5 miles west-southwest of the site. Vertical displacement along this fault is estimated to be as great as 6,500 feet (Ziony et al., 1974). Based on offshore data, it has been estimated that two to five moderate earthquakes during late Holocene time resulted in surface rupture along this fault zone (Fischer et al., 1987). The Newport-Inglewood Fault Zone is located approximately 3.5 miles northeast of the site. Displacement along this fault has been estimated to be as great as 5,000 feet of right-lateral offset, and 4,000 feet of vertical offset. A magnitude 6.3 earthquake occurred on this fault in 1933 (Norris and Web, 1990).

3.2 Site Geology

The Refinery and Hydrogen Plant are located along the southwestern margin of the Los Angeles Basin, within the Dominguez Gap, the alluvial floodplain of the Los Angeles River. The Dominguez Channel approximates the western boundary of the Refinery site, and the eastern boundary of the Hydrogen Plant site. The Dominguez Channel enters the East Basin Channel of the Los Angeles Harbor approximately 600 feet west of the site. The Dominguez Gap is a stream-cut channel eroded and backfilled by ancestral river deposits. Surficial sediments beneath this area consist of fill material, alluvial sand, silt, and clay of Recent age. These sediments obtain a thickness of approximately 150 feet beneath the site.

The upper 5 to 20 feet of sediments beneath the Refinery site, and possibly the Hydrogen Plant site, consist of hydraulic fill material (consisting predominately of dredge sand, silt, and clay) placed over the Los Angeles/Long Beach Harbors during the 1920s. This material has poor engineering properties and is susceptible to settlement and liquefaction.

The Refinery and Hydrogen Plant are located in the Wilmington Oil Field. The Wilmington field is the most productive field in California, and the second most productive field in the United States (Norris and Webb, 1990). The Wilmington field encompasses approximately 13,500 acres, trending 11 miles in a northwest-southeast direction and 3 miles east-west, extending southeast from the Wilmington District of Los Angeles, through the Long Beach Harbor, and beyond the offshore limits of the City of Long Beach.

The Wilmington Oil Field is a broad, asymmetrical anticline which is broken by a series of transverse normal faults. Faulting has created seven major oil producing zones which are late Miocene to early Pliocene in age. The majority of oil producing zones are found at a depth of approximately 2,500 to 6,000 feet below ground surface (bgs). At least 22 oil production wells were located at the Refinery at one time. According to CDOG Wildcat Maps (1991), seven oil production wells were located at the Hydrogen Plant Site.

Approximately 10 to 14 feet of land subsidence has occurred at the sites and surrounding vicinity due to oil withdrawal and the subsequent pore volume collapse in the oil reservoir formations (Allen, 1973). To control further subsidence, a water injection program was implemented in the 1930s. This reinjection process continues today and it is also used as a means of increasing oil recovery from existing production wells.

3.3 Regional Hydrogeology

Unnamed semi-perched aquifers have been described by Poland (1959) in the upper 20 to 50 feet of the Recent sediments. The groundwater is locally encountered at a depth of six to ten feet below grade in the vicinity of the site. Water from these semi-perched aquifers is generally of poor quality. Chloride concentrations are as high as 2,200 parts per million (ppm) and concentrations of total dissolved solids (TDS) range from 1,000 to 12,900 ppm (Poland 1959). The high salinity and low permeability of the shallow deposits have discouraged extensive development of this groundwater.

The principal aquifer in the Recent alluvium is the Gaspur Aquifer which extends from a depth of 90 feet below sea level (bsl) to 140 feet bsl beneath the site. A confining layer (Bellflower Aquiclude) separates shallow sediments and artificial fill found beneath the site from the Gaspur Aquifer. The Bellflower Aquiclude is estimated to be approximately 70 feet thick beneath the site.

The Recent alluvium is underlain by sands, silts and clays of the Lakewood Formation, which is approximately 50 feet thick beneath the site. The principal aquifer of the Lakewood Formation is the Gage Aquifer. The Gage Aquifer extends from approximately 150 feet bsl to 200 feet bsl beneath the site. The Lakewood Formation is underlain by sands with gravel, silt, and clay of the Lower Pleistocene San Pedro Formation, which is approximately 900 feet thick beneath the site. The principal aquifers in the San Pedro Formation are the Lynwood and Silverado aquifers. The Lynwood Aquifer extends from a depth of approximately 200 feet bsl to 300 feet bsl beneath the site. The Silverado Aquifer extends from a depth of approximately 600 feet bsl to 900 feet bsl (California, Dept. of Water Resources, 1961).

3.4 Site Hydrogeology

Beneath the Refinery and the Hydrogen Plant, first encountered groundwater is contained in the hydraulic fill that is present over most of the site vicinities. The groundwater may also be found in the unnamed perched aquifers as described above. Groundwater levels are controlled by a toe drain and pumping system which ranges from depths of 5 to 10 feet below ground surface. Due to the nature of the hydraulic fill, this water bearing zone yields limited water to nearby wells. It is also laterally and vertically heterogenous across the site vicinity. Dewatering of the fill is necessary since a significant portion of the port region is below sea level (Environ, 1995). Groundwater within the fill contains TDS concentrations above acceptable drinking water standards.

The Bellflower Aquiclude underlies the hydraulic fill material at a depth of approximately 10 to 20 feet below grade. The Bellflower Aquiclude, approximately 70 feet thick in the site vicinity, separates the hydraulic fill from the principal aquifer (the Gaspur Aquifer). The Gaspur Aquifer extends from a depth of 90 feet bsl to 140 feet bsl beneath the site. Extensive seawater intrusion has occurred in the Gaspur Aquifer thereby causing poor water quality. As of April 1993, chloride concentrations in the Gaspur Aquifer in the site vicinity range between 10,000 and 15,000 ppm (LACDPW, 1993). Groundwater is considered to be drinking water quality when chloride concentrations are less than 250 ppm.

In an effort to stop further seawater intrusion, the Los Angeles County Department of Public Works (LACDPW) constructed the Dominguez Gap Barrier Project. The Dominguez Gap Barrier Project is designed to protect the groundwater supplies of that portion of the West Coast Groundwater Basin located adjacent to San Pedro Bay from seawater intrusion. However, by the time that the barriers were installed, sea water had already progressed further inland than the point where the injection wells were placed. The barrier system consists of 41 water injection wells to create a fresh water pressure ridge to halt seawater intrusion and observation wells to monitor groundwater levels and quality. During the period of April 1992 to April 1993, 5,259 acre-feet (1.714×10^9 gallons) of water were injected into the Gaspur and underlying aquifers. The site is located on the coastal (saltwater) side of the Dominguez Gap Barrier Project; improvement in water quality is not expected.

Prior to 1977, oil field brine resulting from crude oil production was reinjected into the Gaspur Aquifer, as permitted by the CRWQCB. This reinjection was allowed because the Gaspur was recognized to be unusable for domestic, industrial or agricultural purposes (Environ, 1995).

4.0 INVESTIGATIONAL ACTIVITIES

4.1 Goals and Objectives

The purpose of this investigation was to evaluate subsurface conditions in the vicinity of areas previously determined to exhibit elevated hydrocarbon concentrations at both the Refinery and Hydrogen Plant. The investigation focused on obtaining soil and water quality data as it pertained to petroleum hydrocarbons. To accomplish the project objectives, EEC conducted a field investigation consisting of the following: 1) obtained groundwater monitoring well permits; 2) updated a site health and safety plan; 3) marked the proposed boring locations and contacted Underground Services Alert (USA); 4) drilled a total of seven soil borings; 5) collected soil samples from each boring; 6) installed groundwater monitoring wells in each boring; 7) surveyed wellhead elevations of all new and existing groundwater monitoring wells; 8) measured depth to groundwater in new and existing monitoring wells and determined gradient and flow direction; 9) developed the new wells and collected water samples; and
10) submitted soil and water samples to a California State Certified Laboratory for analysis.

4.2 Pre-Boring Activities

In preparation for the drilling activities at the two sites, EEC obtained permits for the installation of each monitoring well, updated a site health and safety plan, contacted USA, retained a geophysical locating service to verify the absence of underground utilities at each proposed borehole location, and researched available Refinery maps in the areas of the proposed investigation.

4.2.1 Well Permits

EEC obtained a permit for each site to conduct the installation of the groundwater monitoring wells. The permits were obtained from the Los Angeles County Department of Health Services (LACDHS). The wells were constructed in compliance with the standards established by the California Department of Water Resources Bulletins 74-81 and 74-90, and California Code of Regulations, Chapter 16, section 2649. A copy of the well permits are included in Appendix A.

4.2.2 Site Health and Safety Plan

EEC conducted field work at the site in accordance with the protocols established in EEC's Site Health and Safety Plan S185-7.SSP. The site health and safety plan addresses the potential health hazards that might be encountered at the worksite and describes the basic safety procedures that EEC personnel and our subcontractors followed during drilling activities at the site. A copy of the plan was available onsite during drilling, development, and groundwater sampling activities.

4.3 Field Activities

Field activities included notifying USA, subcontracting a geophysical locating company, researching available maps for the presence of underground utilities, performing the drilling activities, collecting soil samples, installing and developing monitoring wells, performing groundwater monitoring and sampling, managing soil and groundwater wastes, surveying all new and existing groundwater monitoring wells, and determining groundwater flow direction and gradient.

4.3.1 USA Notification and Subsurface Clearance

In compliance with California Government Code Sections 4216-4216.9, EEC notified USA of our intent to perform subsurface work at least 48 hours prior to commencing field activities. USA is a regional notification center that notifies owners and operators of subsurface utilities (water, gas, electric, sewer, oil lines, etc.) of a contractor's intent to perform subsurface work. EEC marked the proposed boring locations with white spray paint so that the locations could be identified by USA members, and so that any conflicts with the proposed locations could be identified, and well locations adjusted, if necessary.

Dig Alert ticket numbers were issued by USA for work at the two sites. Ticket number 454669 was issued for work conducted at the Refinery; ticket number 372947 was issued for work conducted at the Hydrogen Plant.

As a supplement to the USA clearance, EEC retained a geophysical locating subcontracter (Maverick, of Simi Valley, California) to screen potential drilling location for utilities or other shallow subsurface features. Maverick utilized a Geophysical Survey Systems, Inc. (GSSI) ground penetrating radar (GPR) SIR-3, a 3M Dynatel 2220L Cable Locator, and Schonstedt Instrument Company MAC-51B Magnetic and Cable Locator to detect buried utilities. No underground utilities were detected by USA or Maverick at the boring locations.

In addition to the above, EEC researched available Refinery plot plans and as-built maps to assist in identifying subsurface utilities.

4.3.2 Soil Borings

Between May 3 and June 16, 1999, a total of seven groundwater monitoring wells were installed at the two sites: three wells were installed at the Hydrogen Plant site (Figure 4), and four wells were installed at the Refinery (Figure 3). Borings for the well installations were drilled using a Cental Mine Equipment (CME) 75 Limited Access Rig (LAR) equipped with 10-inch diameter, continuous flight, hollow-stem augers.

The upper 5 feet of each boring was hand-augered to verify the absence of underground utilities at the boring locations. In addition, each borehole at the Refinery was widened to at least 10 inches prior to the commencement of drilling, to avoid conflicts with previously unidentified underground utilities. As a result of this borehole clearing, boring MW30 was relocated approximately 10 feet northwest of the proposed location due to the identification of a subsurface utility line encountered during hand-augering. No other underground utilities were encountered during drilling activities.

Prior to each day of drilling, the drill rig was inspected to verify that it was free from hydraulic or oil leaks. Augers and other downhole equipment were steam-cleaned before drilling each boring to minimize the possibility of cross-contamination between boreholes. Drilling and well construction were performed under the observation of an EEC scientist and under the technical direction of an EEC State of California Registered Geologist. Additional information on drilling and sampling protocol is included in Appendix B.

Borings and monitoring wells drilled and installed at the Hydrogen Plant were designated MW1 through MW3; borings and monitoring wells drilled and installed at the Refinery were designated MW27 through MW30. Boreholes at the Hydrogen Plant were drilled to 30 feet bgs. Two boreholes (MW27 and MW28) at the Refinery were drilled to 30 feet bgs depths. Boring MW29 was drilled to 31.5 feet bgs, and boring MW30 was drilled to 25 feet bgs. The locations of the wells are shown on Figures 3 and 4. Boring logs are included in Appendix C.

4.3.3 Soil Sampling

Soil samples were generally collected at 5-foot intervals during drilling. First encountered groundwater was not always apparent during drilling activities. Earth materials encountered in the borings were described and logged by an EEC scientist using the Unified Soil Classification System (Appendix C). The scientist also evaluated a sample of soil from each depth interval with a photo-ionization detector (PID) to evaluate relative hydrocarbon vapor concentrations. PID readings for each depth interval are shown on the Borings Logs (Appendix C).

Soil samples from the borings were collected by advancing the boring to a point immediately above the sampling depth and then driving a California-modified, split-spoon sampler (2.5-inch inside-diameter), containing three 6-inch long brass sample sleeves, into the soil through the hollow center of the auger. The sampler was driven 18 inches into the soil with a standard 140-pound hammer repeatedly dropped from a height of 30 inches. The number of blows to drive the sampler each 6-inch increment was counted and recorded to evaluate the relative consistency of the soil. The split-spoon sampler was cleaned with Alconox (a laboratory grade detergent) and triple-rinsed with potable and deionized water between each sampling interval.

The soil sample in the lower of the three sleeves was retrieved from the sampler and sealed with Teflon tape and plastic caps, then labeled and placed in iced storage for transportation to BC Laboratories of Bakersfield, California for analysis. BC Laboratories is a California State-certified laboratory for the analyses requested. A Chain-of-Custody Record was initiated by the sampler and accompanied the samples to the laboratory. Copies of the Chain-of-Custody Record are included in Appendix D.

4.3.4 Monitoring Well Installation

All seven monitoring wells were constructed with 4-inch diameter, polyvinyl chloride (PVC) schedule 40 casing. Screened casing, with 0.010-inch slots extended approximately 20 feet below the static groundwater level. Due to the shallow groundwater at both sites, screened casing extended approximately 2 feet above the static groundwater level. Blank PVC casing was set from the top of the screened casing to a few inches below the ground surface.

All casing joints were flush threaded and no glues, chemical cements, or solvents were used in well construction. All PVC casing was steam cleaned prior to installation to avoid the possibility of introducing contaminants into the soil and groundwater. The annular space of each well was backfilled with No. 2/12 Monterey sand from total depth to approximately 2 feet above the top of the screened casing. After installation of the sand, the well was surged to settle the sandpack. After the sandpack had settled, additional sand was added in the annular space to again bring the sand 2 feet above the top of the screened casing. This was done as many times as necessary to settle the sandpack. A bentonite plug, approximately 3 feet thick, was placed above the sand as a seal against cement entering the sand pack. The sand and bentonite were tremmied into the annular space through the hollow stem augers as the augers were withdrawn from each boring. Graphic representations of well construction details are shown in Appendix E.

The top of each casing was covered with a locking cap and the bottom with a threaded end plug. The wells were protected with traffic grade steel wellhead covers elevated slightly above the surrounding grade and set in place with concrete. Each wellhead cover has a watertight and expanding seal to protect the well against surface-water infiltration. This well cover also discourages vandalism and reduces the possibility of accidental disturbance of the monitoring wells.

4.3.5 Well Development

All seven wells were initially developed during installation (see the previous section). On June 24, 1999, all seven wells were developed by removing water from the well utilizing a vacuum truck. Development is the process of removing stagnant water in the well, removal of fine-grained sediment that had entered the well screen during construction, and establishes a steady flow of groundwater into the well. The wells were developed by surging the well with a 3 ½ -inch stainless steel bailer, and then the water was removed from the well with a vacuum truck. Water removal continued until pH, temperature, conductivity, and turbidity of the removed water had stabilized. Stabilization occurs when pH, temperature, and conductivity are within 0.1 pH units, 1 degree Fahrenheit, and 10%, respectively, of previous readings. With the exception of Hydrogen Plant monitoring well MW2 (which ran dry after 2.2 well volumes were removed), each well was purged of at least three well volumes of water.

4.3.6 Groundwater Monitoring and Sampling

All seven new monitoring wells were gauged on June 23, 1999. Depths to static groundwater below the tops of the well casings were measured to the nearest 0.01 foot with a Heron oil-water interface probe. After measuring depth to water, EEC checked the groundwater in each well (new and existing) for the presence of free product, a sheen, or emulsion, by lowering a disposable plastic bailer into each well and retrieving a sample at the air-water interface. With the exception of the Refinery's MW29, no new wells contained free product, hydrocarbon sheen, or emulsion. Monitoring well MW29 contained viscous, dark-colored free product resembling crude oil. Due to the difficulty of removing viscous free product from field measuring devices, and the inherent inaccuracy of quantifying viscous floating product thicknesses, no product thickness could be accurately determined.

After checking each well for the presence of a sheen, all wells were purged using an Ultramar-contracted vacuum truck supplied by Ecology Control Industries (ECI) of Torrance, California. Each monitoring well was outfitted with a dedicated stinger assembly (constructed of threaded PVC pipe) to reduce the possibility of cross-contamination between wells. Following all purging activities, purge water was treated utilizing the Refinery's wastewater treatment system. Following the purging, water samples were collected by lowering a new disposable bailer into the water and retrieving a sample. The bailer was lowered into the water no more than the length of the bailer. A new bailer was used for each well to reduce the possibility of cross-contamination.

Water in the bailers was transferred to laboratory-cleaned glass containers containing the appropriate preservative. After filling the containers, and confirming that no air bubbles were visible inside the containers, the samples were immediately sealed with Teflon lids, labeled, and placed in iced storage at 4°C for transport to BC Laboratories. A Chain of Custody Record was initiated by the sampler and accompanied the samples to the laboratory. A copy of the Chain of Custody Record is included in Appendix D.

4.3.7 Management of Soil Cuttings and Groundwater

Soil cuttings and decontamination water generated during drilling was placed in Department of Transportation-approved 55-gallon drums. At the time of this writing, the drums remain secured at each site, pending proper disposal. Drums containing decontamination water were emptied with the ECI vacuum truck on June 24, 1999. As mentioned above, this water was treated in the Refinery's wastewater treatment system. A total of six 55-gallon drums of decontamination water, and 22 drums of soil were generated during this investigation. All drums were properly labeled with information including the date of accumulation, the contents, and an EEC contact phone number.

4.3.8 Survey of Groundwater Monitoring Wells

All new and existing groundwater monitoring wells at both sites were surveyed by a licensed surveyor, and referenced to a City of Los Angeles benchmark. On July 15, 1999, Dulin and Boynton of Signal Hill, California surveyed the tops of each well's casing in reference to a benchmark located near the intersection of Anaheim Street and Henry Ford Avenue. This benchmark (BM #24-04493) has a reference elevation (in 1985) of 4.278 feet above mean sea level (msl). Therefore, all monitoring wells were referenced to this benchmark and casing elevations for each well are expressed in feet above msl. Wellhead elevations were measured to the nearest 0.01 foot.

4.3.9 Groundwater Elevations, Flow Directions, and Gradients

Following the new survey of casing elevations, groundwater depths measured on June 23, 1999 were subtracted from casing elevations to determine groundwater elevations at each well. Using the groundwater elevations, a contour map of each site was prepared to determine the groundwater gradient and flow direction beneath each site. The Refinery's groundwater flow direction on June 24, 1999 was to the south-southeast with a gradient of 0.005. This groundwater flow direction and gradient is consistent with direction and gradient determined over at least the last several years. Refinery groundwater elevation data is included on Table 1, and Figure 5 indicates groundwater flow direction and gradient.

The Hydrogen Plant groundwater flow direction on June 24, 1999 was to the northwest with a gradient of 0.006. This groundwater flow direction and gradient are consistent with the direction and gradient determined during a subsurface investigation conducted by Environmental Resolutions, Inc (ERI) in February 1994. Hydrogen Plant groundwater elevation data is included on Table 2, and Figure 6 indicates groundwater flow direction and gradient.

Since groundwater flow direction at each of the sites is *away* from the Dominguez Channel (which bisects both sites), the Dominguez Channel is considered an influent stream in this area of Wilmington. An influent stream is characterized by a loss of water as it flows past a given area.

4.4 Laboratory Analyses

Both soil samples and water samples were collected from the boreholes and monitoring wells at each site during this investigation. All samples were submitted to BC Laboratories, of Bakersfield, California. BC Laboratories is a State of California certified laboratory for the requested analysis.

4.4.1 Soil Analyses

A total of eleven unsaturated soil samples were submitted for laboratory analysis. Depending on the depth to groundwater in each borehole, at least one, but occasionally two, soil samples from each boring were selected for laboratory analyses.

4.4.1.1 Hydrogen Plant

A total of six unsaturated soil samples originating from the Hydrogen Plant investigation were submitted for analysis. These samples were collected at either 5 feet or 6.5 feet bgs, and at 10 feet bgs. All soil samples were analyzed for total petroleum hydrocarbons as gasoline (TPHg) and total petroleum hydrocarbons as diesel (TPHd) by Environmental Protection Agency (EPA) Method 8015, the aromatic hydrocarbons benzene, toluene, ethylbenzene, total xylene isomers (BTEX), and methyl tertiary butyl ether (MTBE) by EPA Method 8020. Additionally, California Code of Regulations (CCR), Title 22, Section 66261 metals were analyzed by EPA Methods SW-6010 and SW-7471 on one soil sample from each boring having the highest diesel concentration. In the event that diesel concentrations from soil samples collected from each borehole were reported at non-detectable concentrations, the shallowest soil sample was analyzed for CCR metals.

4.4.1.2 Refinery

A total of five unsaturated soil samples originating from the Refinery investigation were submitted for analysis. All these samples were collected at either 5 feet or 6 feet bgs, and at 10 feet bgs. All soil samples were analyzed for TPHg and TPHd by EPA Method 8015, and BTEX and MTBE by EPA Method 8020. Additionally, CCR metals were analyzed by EPA Methods SW-6010 and SW-7471 on one soil sample from each boring. If two soil samples were analyzed from a boring, the soil sample having the highest diesel concentration was analyzed for CCR metals. One soil sample having the highest diesel concentration was additionally analyzed for volatile organic compounds (VOCs) and semi-VOCs by EPA Methods 8260 and 8270, respectively.

4.4.2 Groundwater Analyses

Groundwater samples collected from the wells at both sites were analyzed for TPHg and TPHd by EPA Method 8015, BTEX and MTBE by EPA Method 8020. MTBE concentrations were confirmed by Gas Chromatography/Mass Spectrometry (GC/MS).

5.0 SITE STRATIGRAPHY

5.1 Hydrogen Plant

Soil samples collected during this investigation indicate that the stratigraphy beneath the site consists predominately of silt, sandy silt, and clayey silt, with minor quantities of sand. The cross section line for the borings drilled during this investigation are shown on Figure 4. Boring MW1 consisted of silty sand to approximately 7 feet bgs. Below the silty sand, silt, and sandy silts were encountered to 30 feet bgs. Boring MW2 consisted of fine-grained sand to approximately 4 feet bgs. Silty sand was encountered below 4 feet bgs to a depth of approximately 7 feet bgs. Silty and silty sand was encountered below this depth to approximately 17.5 feet bgs and continued to 22.5 feet bgs, where a return of silt and sandy silt was encountered to 30 feet bgs. The north to south stratigraphy beneath the Hydrogen Plant site is shown on Figure 7.

Boring MW2 consisted of fine-grained sand and silty sand to a depth of approximately 7.5 feet bgs. Below this depth, silt was encountered to a depth of approximately 17.5 feet bgs. Below the silt layer was clayey silt approximately 10 feet thick. Below 22.5 feet, silt was again encountered to a total boring depth of 30 feet bgs. Soil encountered in MW3 consisted of fill material to a depth of approximately 8.5 feet bgs. Below this depth consisted of silt to a depth of approximately 12.5 feet bgs. Below 12.5 feet bgs, a layer of silty sand was encountered and extended to a depth of 17.5 feet bgs. A clayey silt layer was encountered below this depth to a depth of 27.5 feet bgs, to the total depth of the soil boring (30 feet bgs). The west to east stratigraphy beneath the Hydrogen Plant site is shown in Figure 8.

5.2 Refinery

Soil samples collected during this investigation indicate that the stratigraphy beneath the site consists predominately of silty sand, sandy silt, and clayey silt, with minor quantities of sand. Boring MW27 consisted of silt and sandy silt to a depth of approximately 8 feet bgs. Below this, clayey silt was encountered to a depth of approximately 22.5 feet bgs. A 5-foot thick silt layer was encountered below the silt to a depth of approximately 27.5 feet bgs. The final 2.5 feet consisted of clayey silt. Boring MW29 was drilled through approximately 10 feet of base, fill material. Below this depth, silty sand and silt were encountered to approximately 19 feet bgs. Below 19 feet bgs, clayey silt was encountered to a depth of 31.5 feet bgs. Boring MW28 consisted of fine-grained sand from grade to approximately 7.5 feet bgs. Below this depth, silt and sandy silts were encountered to 30 feet bgs. The west to east stratigraphy beneath the Refinery site is shown on Figure 9.

According to an ERI subsurface report, boring MW26 consisted of silty sand to a depth of approximately 12.5 feet bgs. Below this depth, silty clay was encountered to a depth of approximately 17.5 feet bgs. Silty sand was encountered below 17.5 feet bgs to the total depth of the boring (30.5 feet bgs). Boring MW29 consisted of base fill to a depth of approximately 8.5 feet bgs. Below this depth, silty sand and silt was encountered to a depth of approximately 19 feet bgs. Clayey silt was encountered below this depth to a depth of 31 feet bgs. Boring MW30 consisted of silty sand and silt from grade to approximately 7 feet bgs. Below 7 feet bgs, and extending to 12.5 feet bgs, silty clay was encountered. Sandy silt laid below this and extended to approximately 17.5 feet bgs. Below 17.5 feet bgs, a 6.5 foot layer of clayey silt was encountered to 24 feet bgs. A silty sand layer was observed in the final 1 foot of drilling. The south to north stratigraphy beneath the Refinery site is shown on Figure 10.

6.0 CHARACTERIZATION RESULTS

6.1 Hydrogen Plant Soil Results

Soil characterization was evaluated through field observations, field PID measurements, and interpretation of laboratory analyses. The results of the site investigation in regards to soil are discussed below.

6.1.1 Field Observations

Field observations include visual evidence of hydrocarbon staining, olfactory evidence of hydrocarbons, and elevated PID readings (exceeding 50 ppm). No visual or olfactory evidence of hydrocarbons was encountered during the Hydrogen Plant investigation. PID readings never exceeded 0 ppm. Field observations and PID readings are included on the Boring Logs (Appendix C).

6.1.2 Laboratory Results

Laboratory results of soil samples submitted for analyses are summarized on Table 3. With the exception of the soil sample collected from boring MW1 at a depth of 5 feet bgs, all TPHg, TPHd, BTEX, and MTBE concentrations were reported at non-detectable hydrocarbon concentrations. A TPHd concentration of 160 milligrams per kilograms (ppm) was reported in soil sample MW1-5'. However, TPHg, BTEX, and MTBE concentrations in this soil sample were reported at non-detectable concentrations.

With the exception of soil sample MW1-5', all soil samples collected from borings at the Hydrogen Plant were reported at CCR metal concentrations less than 10 times each metal's soluble threshold limit concentration (STLC). Soil sample MW1-5' yielded lead and barium concentrations of 84 ppm and 1,100 ppm, respectively. STLC concentrations were reported at 5.4 ppm and 7.0 ppm, respectively.

6.2 Refinery Soil Results

Soil characterization was evaluated through field observations, field PID measurements, and interpretation of laboratory analyses. The results of the site investigation in regards to soil are discussed below.

6.2.1 Field Observations

Field observations include visual evidence of hydrocarbon staining, olfactory evidence of hydrocarbons, and elevated PID readings (exceeding 50 ppm). With the exception of soil boring MW28, all Refinery soil borings yielded field indications of hydrocarbon impact. Soil boring MW27 yielded field indications of hydrocarbon impact from surface grade to approximately 7.5 feet bgs. Dark hydrocarbon staining, olfactory evidence of light and heavy hydrocarbons, and PID readings exceeding 2,000 ppm were encountered in this boring. Soil boring MW29 yielded heavy hydrocarbon odors in soil samples collected beginning at 10 feet and decreasing to trace evidence of impact at 30 feet bgs. PID readings were consistently in excess of 125 ppm. Additionally, once groundwater was encountered, a distinct hydrocarbon sheen was observed on the groundwater. Soil boring MW30 yielded field indications of hydrocarbon impact from surface grade to approximately 25 feet bgs. Hydrocarbon staining, olfactory evidence of heavy hydrocarbons, and a maximum PID reading of 1,381 ppm were encountered in this boring. Field observations and PID readings are included on the Boring Logs (Appendix C).

6.2.2 Laboratory Results

TPHg, TPHd, and benzene concentrations in soil samples collected from MW27 were reported at concentrations of 5,900 ppm, 360 ppm, and 33 ppm, respectively. Other detectable constituents included toluene, ethylbenzene, and xylenes. Detectable concentrations of toluene, xylenes, and TPHd were reported at concentrations of 0.016 ppm, 0.011 ppm, and 20 ppm, respectively in boring MW28. All other constituents were reported at non-detectable concentrations. Soil samples collected from boring MW29 yielded a TPHg concentration of 4.9 ppm, a TPHd concentration of 300 ppm, and a benzene concentration of 0.097 ppm. Toluene, ethylbenzene, and xylenes were also detected. TPHg, TPHd, and benzene concentrations in soil samples collected from MW30 were reported at concentrations of 81 ppm, 5,800 ppm, and 0.045 ppm, respectively. Toluene, ethylbenzene, and xylenes were also detected. Laboratory results of soil samples submitted for analyses are summarized entirely on Table 4.

6.3 Hydrogen Plant Groundwater Results

Laboratory results of water samples collected from the wells at the Hydrogen Plant are shown on Table 2. The water sample collected from MW1 yielded non-detectable hydrocarbon concentrations for all constituents analyzed (TPHg, TPHd, BTEX, and MTBE). A duplicate sample collected from this well (coded as HMW101 on the Chain of Custody) yielded similar results. Analytical results obtained from a water sample collected from MW2 yielded detectable TPHg (at 59 micrograms per liter), TPHd (at 1,800 micrograms per liter), and benzene (at 0.54 micrograms per liter) concentrations. All other hydrocarbon constituents were non-detected. With the exception of TPHd (at 2,500 micrograms per liter), all other petroleum hydrocarbon constituents were reported at non-detectable concentrations in the water sample collected from MW3. A trip blank sample was reported at non-detectable concentrations for all constituents analyzed.

6.4 Refinery Groundwater Results

Laboratory results of water samples collected from Refinery monitoring wells during this investigation are shown on Table 5 (a complete listing of all Refinery groundwater analytical results is included on Table 1). The water sample collected from well MW27 was reported at the following concentrations: TPHg at a concentration of 110,000 micrograms per liter (ppb); TPHd at a concentration of 4,600 ppb; and benzene at a concentration of 18,000 ppb. Other detectable constituents included toluene (at 25,000 ppb), ethylbenzene (at 2,900 ppb), and xylenes (at 18,000 ppb). A duplicate sample collected from this well (coded as MW102 on the Chain of Custody) yielded similar results. The water sample collected from well MW28 yielded TPHg concentrations at 67 ppb, TPHd at 840 ppb, and xylenes concentrations at 0.76 ppb. No water sample was collected from well MW29 due to the presence of free product exceeding trace quantities. The water sample collected from well MW30 yielded detectable hydrocarbon concentrations for TPHg, TPHd, BTEX, and MTBE. TPHg, TPHd, and MTBE was reported at 280 ppb, 5,600 ppb, and 17 ppb, respectively. BTEX was reported at 11 ppb, 0.57 ppb, 3.3 ppb, and 4.7 ppb, respectively. A trip blank sample was reported at non-detectable concentrations for all constituents analyzed.

7.0 CONCLUSIONS

7.1 Hydrogen Plant

Based on the results of this subsurface investigation conducted at the Hydrogen Plant, EEC concludes the following:

- Groundwater stabilized in the monitoring wells at approximately 8.5 feet bgs;
- Groundwater flow direction is to the northwest, with a gradient of 0.006. Groundwater flow direction and gradient are consistent with flow direction and gradient encountered during a pre-CFP construction investigation conducted in February 1994 by another consultant. The Dominguez Channel appears to supply groundwater to this area of Wilmington (i.e., is an influent stream);
- Analytical results, the lack of visual evidence of hydrocarbons, the lack of hydrocarbon odors, and PID readings not exceeding zero ppm, suggest that low to no hydrocarbon impact exists in the subsurface in the vicinity of the wells installed during this investigation;
- Analytical results indicate that hydrocarbon-impacted groundwater is present in the vicinity of well MW2 and MW3. A maximum TPHd concentration of 2,500 ppb (MW3), and a maximum TPHg concentration of 59 ppb (MW2), were encountered between two of the site's groundwater monitoring wells; and
- The lack of detectable concentrations of hydrocarbons in the downgradient monitoring well (MW1) indicate that hydrocarbon-impacted groundwater is not migrating offsite.

7.2 Refinery

Based on the results of this subsurface investigation conducted at the Refinery, EEC concludes the following:

- Groundwater stabilized in the monitoring wells at depths ranging from 5.7 feet (well MW27) to 10.4 feet bgs (well MW28);

- Groundwater flow direction is to the south-southeast, with a gradient of 0.005. Groundwater flow direction and gradient are consistent with flow direction and gradient encountered during the last several years of groundwater monitoring at the Refinery. The Dominguez Channel appears to supply groundwater to this area of Wilmington (i.e., is an influent stream);

- Analytical results, visual evidence of hydrocarbon staining and hydrocarbon odors, and elevated PID readings indicate that hydrocarbon-impacted soil is present in the vicinity of soil borings MW27, MW29, and MW30. Hydrocarbon sheen was observed on groundwater during the drilling of boring MW29. Only trace quantities of diesel-range hydrocarbons exist in the vicinity of soil boring MW28;

- Groundwater beneath the site has been impacted by petroleum hydrocarbons. The most significant impact was encountered in monitoring wells MW27 and MW29:

    - Monitoring well MW27 was placed in the vicinity of former boring B-17 (west of the Maintenance Shop). During CFP construction activities, floating product was observed on the groundwater surface in this area. TPHg concentrations in well MW27 were reported at a concentration of 110,000 ppb; TPHd was reported at a concentration of 4,600 ppb; and benzene was reported at a concentration of 18,000 ppb. Other detectable constituents included toluene (at 25,000 ppb), ethylbenzene (at 2,900 ppb), and xylenes (at 18,000 ppb);

    - Monitoring well MW29 was placed in the vicinity of the former Safety Basin. This well was placed on the northeast corner of the Amine Unit, where hydrocarbon concentrations exceeding Ultramar's interim WDR limits was encountered at this location during CFP construction activities. Monitoring well MW29 contained viscous, dark-colored free product resembling crude oil. No water sample was collected due to the presence of floating product. Because of the difficulty of removing viscous free product from field measuring devices, and the inherent inaccuracy of quantifying viscous floating product thicknesses, no product thickness could be accurately determined; and

- Analytical results of soil and groundwater samples indicate only one occurrence of detectable MTBE concentrations. The water sample collected from the Refinery's well MW30 yielded a MTBE concentration of 17 ppb.

8.0 REFERENCES

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-------. 1994b. Subsurface Environmental Investigation at Port of Los Angeles Parcel, 700 and 710 North Henry Ford Avenue, Wilmington, California. August 16.

-------. 1995. Well Installation Report, Ultramar Refinery, Wilmington, California. December 15.

Remedial Action Corporation. 1994a. Report "Phase I Environmental Site Assessment, M-I Drilling Fluids Facility, 710 North Henry Ford Avenue, Wilmington, California". April 5.

-------. 1994b. Report - Phase II Environmental Site Investigation, Former Harbor-Pac International and M-I Drilling Fluids Facilities, Port of Los Angels, Wilmington, California. June 10.

9.0 LIMITATIONS

The discussion and recommendations presented in this report are based on a compilation of observations and data gathered during EEC's assessment. It is possible that variations in the soil conditions may exist beyond the locations explored during this assessment, and that future activity could alter the condition of soil as described in this report.

The services provided by EEC have been conducted in a manner consistent with generally accepted standards of environmental geological practice in California at the time this assessment was performed. This assessment was conducted solely for the purpose of evaluating environmental conditions of the soil with respect to hydrocarbon and metal concentrations at the subject site. No other warranty, expressed or implied, is made.

EEC ENVIRONMENTAL ENGINEERING & CONTRACTING, INC.

1=2005'

Map Source: U.S.G.S. 7.5-minute topographic quadrangle map Long Beach, Calif. 1964 photorevised 1981

SITE LOCATION MAP
ULTRAMAR REFINERY AND AIR PRODUCTS HYDROGEN PLANT WILMINGTON, CALIFORNIA

File:	Date:	PM:	R.G./P.E.	PROJECT NO.	FIGURE
S1850201	10/26/98	JAL	MTZ	S185-14	1

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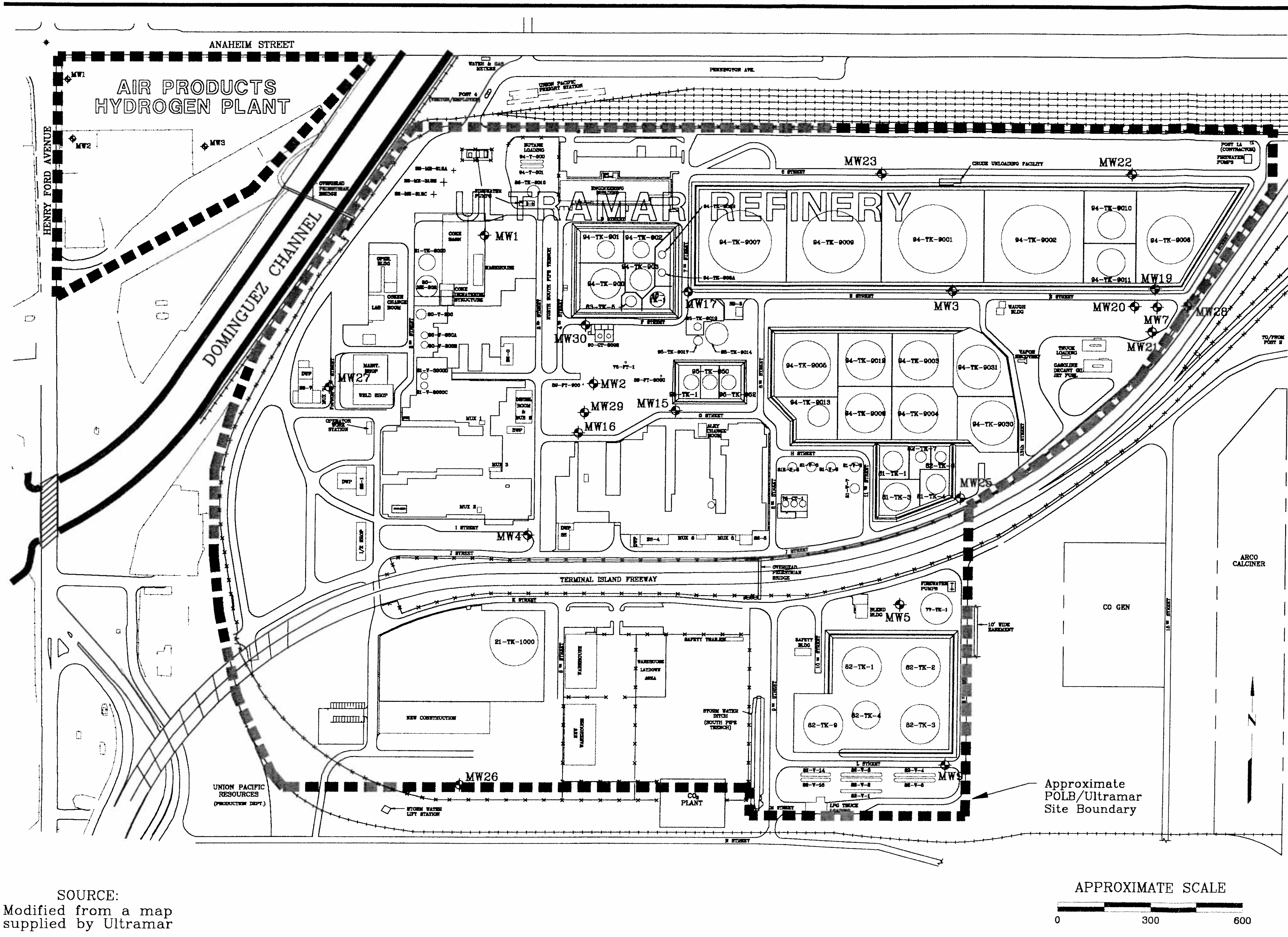

EXPLANATION

- MW26 — Existing Groundwater Monitoring Well
- Aboveground Storage Tank
- Building
- Containment Dike

GENERALIZED SITE PLAN

Ultramar Refinery
2402 E. Anaheim Street
Wilmington, California

Scale: 1"=300'	Size: BSIZE (11X17)
Date: October 26, 1998	File: S1850011
Project Number: S185-11	
Approved By	Figure 2

ENVIRONMENTAL ENGINEERING & CONTRACTING, INC.

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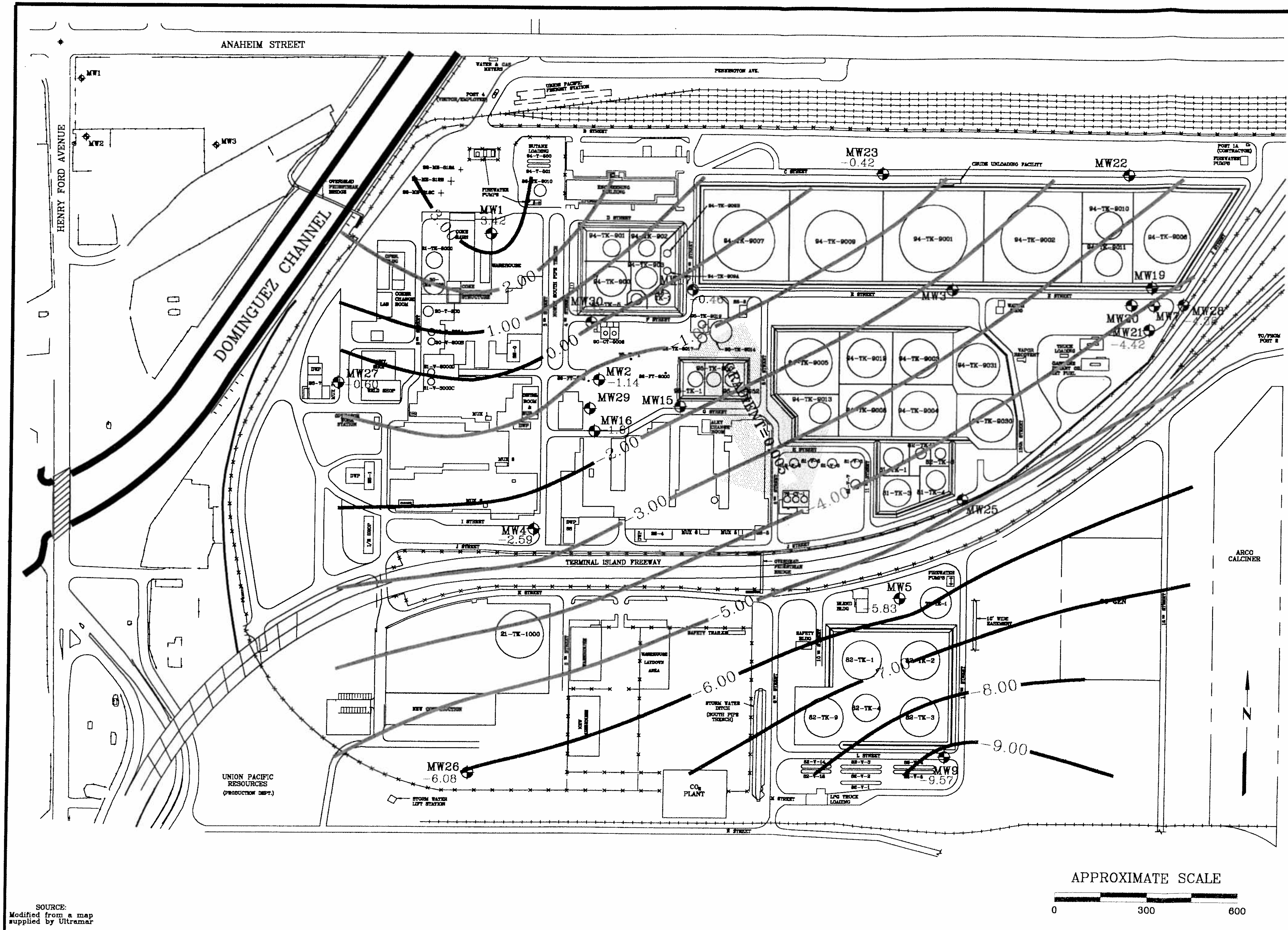

EXPLANATION

- MW30 -0.15 — Groundwater Monitoring Well and Relative Groundwater Elevation (in reference to mean sea level, expressed in feet)
- Line of Equal Groundwater Elevation
- Aboveground Storage Tank
- Building
- Containment Dike

GROUNDWATER FLOW DIRECTION MAP JUNE 23, 1999

Ultramar Refinery
2402 E. Anaheim Street
Wilmington, California

Scale: 1"=300'	Size: BSIZE (11X17)
Date: January 12, 1999	File: S185quarterly
Project Number: S185-7	

ENVIRONMENTAL ENGINEERING & CONTRACTING, INC.

Approved By	Figure 5

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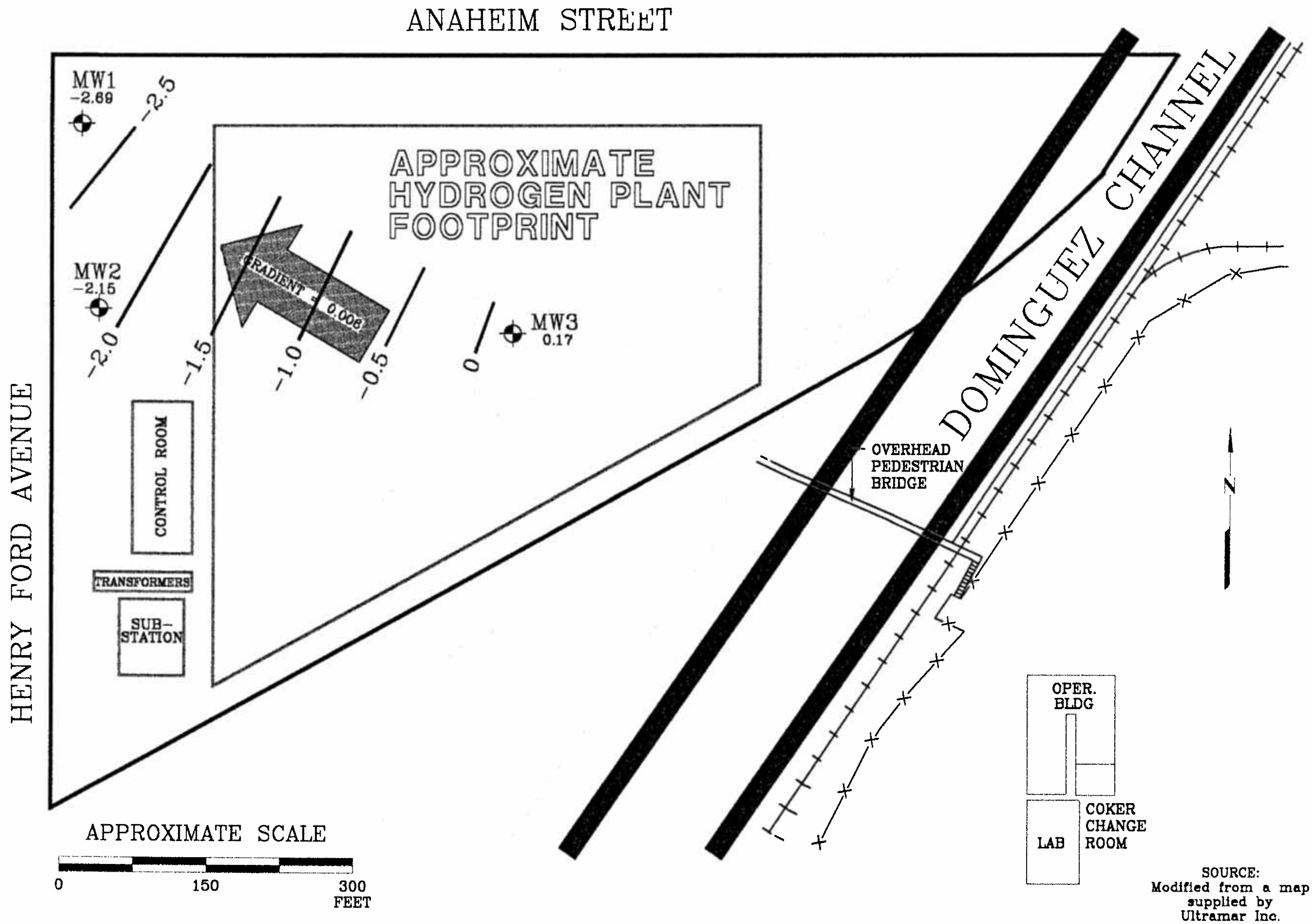


ENVIRONMENTAL ENGINEERING & CONTRACTING, INC.

File:	PM:	PE/RG:
S185H2SITE	JAL	MTZ

Legend

MW3 0.17 — Groundwater Monitoring Well and Relative Groundwater Elevation

Line of Equal Groundwater Elevation

GROUNDWATER FLOW DIRECTION
JUNE 23, 1999

Air Products Hydrogen Plant
700 N. Henry Ford Avenue
Wilmington, California

Project Number: S185-14

Date: July 26, 1999

Figure 6

SLIC # 0570 (PC)
+ SLIC # 0005

ENVIRONMENTAL
ENGINEERING & CONTRACTING, INC.
501 Parkcenter Drive, Santa Ana, CA 92705
Phone (714) 667-2300 Fax (714) 667-2310

REPORT
SECOND QUARTER 2003
GROUNDWATER MONITORING AND SAMPLING

at

Wilmington Refinery
2402 East Anaheim Street
Wilmington, California
And
Hydrogen Air Products Facility
700 North Henry Ford Avenue
Wilmington, California

Prepared for

Ms. Virginia Bleich
Valero Wilmington Refinery
2402 East Anaheim Street
Wilmington, California 90744

EEC Job S185-19

July 15, 2003

CERTIFIED HYDROGEOLOGIST
MARK T. ZEKO
No. 310
STATE OF CALIFORNIA

By

Tom Titus
Senior Staff Geologist

Mark Zeko, R.G., C. HG.
Senior Hydrogeologist
Vice-President

ENVIRONMENTAL
ENGINEERING & CONTRACTING, INC.
501 Parkcenter Drive, Santa Ana, CA 92705
Phone (714) 667-2300 Fax (714) 667-2310

REPORT
SECOND QUARTER 2003
GROUNDWATER MONITORING AND SAMPLING

At
Wilmington Refinery
2402 East Anaheim Street
Wilmington, California
And
Hydrogen Air Products Facility
700 North Henry Ford Avenue
Wilmington, California

1.0 INTRODUCTION

This report presents the results of the Second Quarter 2003 groundwater monitoring and sampling for the Ultramar Inc., a Valero Energy Corporation Company (Valero), Wilmington Refinery (Refinery) and Air Products Facility (Hydrogen Facility) in Wilmington, California, as shown on Figure 1. Groundwater monitoring and sampling for this quarter were performed on June 25, 2003.

Twenty-four of the 25 monitoring wells located at the Refinery and Hydrogen Facility were monitored this quarter. Monitoring well RMW24 was not monitored because it was inaccessible. Groundwater samples were collected from six wells at the Refinery and three wells at the Hydrogen Facility. Monitoring wells RMW01, RMW03, RMW04, RMW05, RMW07, RMW09, RMW15, RMW19, RMW20, RMW21, RMW22, RMW24, RMW25, RMW27, RMW29, and RMW30 were not sampled due to inaccessibility, free-phase hydrocarbon product (free product), and/or the sampling plan. A total of 11 Refinery wells contained trace or measurable free product.

2.0 BACKGROUND

The Refinery and Hydrogen Facility are located in areas previously used for oil well drilling and production operations. Oil production activities began in the late 1930s and ceased in 1970 when the Refinery was constructed. Since 1985, Ultramar has installed a total of 33 monitoring wells to evaluate groundwater quality and hydrogeologic conditions at the Refinery and Hydrogen Facility. The current quarterly groundwater monitoring program is being conducted in response to a request from the State of California Regional Water Quality Control Board (RWQCB).

3.0 FIELD METHODOLOGY

On June 25, 2003, Environmental Engineering & Contracting, Inc. (EEC) gauged each monitoring well for the presence of free product using an oil/water interface probe and/or a disposable bailer. If a monitoring well did not indicate the presence of free product using an interface probe, a clear disposable bailer was used to collect a grab sample from the well to inspect the sample for the presence of a hydrocarbon sheen or measurable free product.

Additionally, for wells that did not contain free product, static depth to groundwater measurements were obtained using an interface probe. The depth to groundwater coupled with the measuring point elevation were used to calculate the groundwater elevation at each well, the direction of groundwater flow, and groundwater gradient at the Refinery and Hydrogen Facility.

On June 25, 2003, nine of the 25 wells were sampled. Each well was purged prior to sampling using a vacuum truck. During purging operations, field test parameters consisting of temperature, pH, conductivity, turbidity, and water volume purged were measured to evaluate completeness of purging to ensure that a representative groundwater sample was collected. The well purging records are presented in Appendix A. A groundwater sample was collected after field test parameters had stabilized and a minimum of three casing volumes of water were removed from the well. All groundwater samples were collected using a new disposable bailer.

Following sample collection, each water sample was labeled and placed in a chilled ice chest pending transport to the project laboratory. All samples were submitted under proper chain-of-custody documentation to Calscience Analytical Laboratories in Garden Grove, California. All of the samples were analyzed for total petroleum hydrocarbons as diesel (TPHd) and as gasoline (TPHg) by EPA Method 8015 Modified and for benzene, toluene, ethylbenzene, and xylenes (BTEX) and methyl-tert-butyl-ether (MTBE) by EPA Method 8021B.

4.0 RESULTS

A summary of the quarterly groundwater results are presented in Table 1. The quarterly groundwater results are posted along with previous data on Figure 2. A summary of the groundwater elevation data and groundwater water flow direction is presented in Table 2 and on Figure 3, respectively. Plots showing the trends of the concentrations detected in each well are presented in Appendix B. A summary of the historical groundwater elevation and analytical data is presented in Appendices C and D, respectively. Laboratory data sheets and chain-of-custody documentation are provided in Appendix E. A discussion of the results is presented below.

4.1 TPH Groundwater Analytical Results

Results for TPHd ranged from not detected (3 wells) to 7,200 micrograms per liter (ug/L) (HMW02) (Table 1 and Figure 2). Results for TPHg ranged from not detected (7 wells) to 300 ug/L (RMW02).

4.2 BTEX Groundwater Analytical Results

Results for toluene ranged from not detected (8 wells) to 4.6 ug/L (RMW02). Results for ethylbenzene ranged from not detected (8 wells) to 0.34 ug/L (RMW02). Benzene, xylenes, and MTBE were not detected in any of the wells.

4.3 Free Product Removal

During the current reporting period, approximately 0.53 and 0.79 gallons of free product were recovered with the passive skimmers from RMW15 and RMW27, respectively. As of June 25, 2003, a total of 2.38 and 8.47 gallons of product have been recovered from monitoring wells RMW15 and RMW27, respectively.

4.4 Free Product Assessment

Measurable free-phase hydrocarbon or hydrocarbon sheen was detected in RMW01, RMW03, RMW07, RMW09, RMW15, RMW19, RMW20, RMW25, RMW27, RMW29, and RMW30 at the Refinery. Free product was not detected at the Hydrogen Facility.

4.5 Groundwater Flow Direction and Gradient

A potentiometric surface map was developed utilizing groundwater level data obtained on June 25, 2003 and is provided on Figure 3. The direction of groundwater flow at the Refinery is to the southeast at a gradient of 0.004 and at the Hydrogen Facility to the southwest at a gradient of 0.001. The direction of groundwater flow during the previous quarter at the Hydrogen Facility was to the northeast at a gradient of 0.003. This change of groundwater flow direction appears to be a result of groundwater recharge activities associated with the Dominguez Gap Barrier Project. The Dominguez Channel is a groundwater divide resulting in opposing groundwater flow directions at the Refinery and Hydrogen Facility.

4.6 Quality Assurance/Quality Control

A duplicate groundwater sample was collected from RMW17. The analytical results obtained from the duplicate sample are consistent with the results from the sample collected from RMW17. Laboratory quality assurance (QA) and quality control (QC) parameters were within the acceptable ranges.

5.0 CONCLUSION

Based upon the Second Quarter 2003 groundwater monitoring and sampling events, EEC concludes the results of the current sampling event are generally consistent with previous sampling events.

Table 2
Summary of Second Quarter 2003 Groundwater Level Data
Wilmington Refinery and Hydrogen Air Products Facility
Wilmington, California
June 25, 2003

Date	Groundwater Depth (feet bgs)	Groundwater Elevation (feet msl)
HMW01		
6/25/2003	4.75	1.35
HMW02		
6/25/2003	5.4	1.1
HMW03		
6/25/2003	6.3	1.25
RMW01		
6/25/2003	NM	NM
RMW02		
6/25/2003	5.49	-0.15
RMW03		
6/25/2003	NM	NM
RMW04		
6/25/2003	7.15	-2.5
RMW05		
6/25/2003	8.97	-4.73
RMW07		
6/25/2003	NM	NM
RMW09		
6/25/2003	NM	NM
RMW15		
6/25/2003	NM	NM
RMW16		
6/25/2003	6.28	-0.79
RMW17		
6/25/2003	8.8	0.34
RMW19		
6/25/2003	NM	NM
RMW20		
6/25/2003	NM	NM
RMW21		
6/25/2003	10.22	-3.59

Explanation:

bgs = below ground surface

msl = mean sea level

NM = not measured

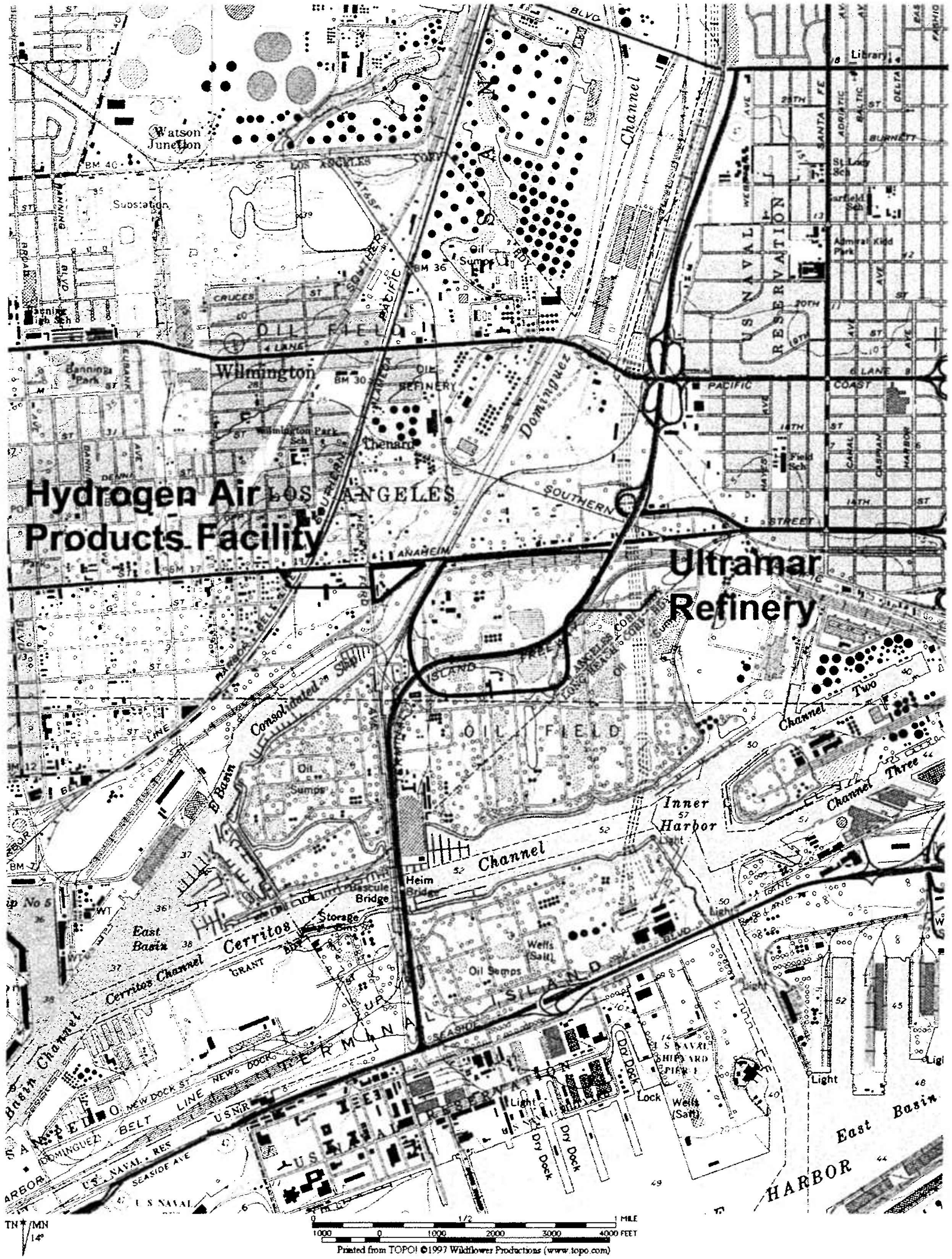
Date	Groundwater Depth (feet bgs)	Groundwater Elevation (feet msl)
RMW22		
6/25/2003	NM	NM
RMW23		
6/25/2003	6.53	0.3
RMW25		
6/25/2003	NM	NM
RMW26		
6/25/2003	5.78	-4.78
RMW27		
6/25/2003	NM	NM
RMW28		
6/25/2003	9.28	-3.25
RMW29		
6/25/2003	NM	NM
RMW30		
6/25/2003	NM	NM

Explanation:

bgs = below ground surface

msl = mean sea level

NM = not measured



ENVIRONMENTAL ENGINEERING & CONTRACTING, INC.	Map Source: U.S.G.S. 7.5-minute topographic quadrangle map Long Beach, Calif. 1964 photorevised 1981		Site Location Map Ultramar Refinery and Air Products Hydrogen Facility Wilmington, California	
File: S1850201	Date: 7/10/03	PM: TT	PE/RG MZ	Project Number: S185-19	Figure 1

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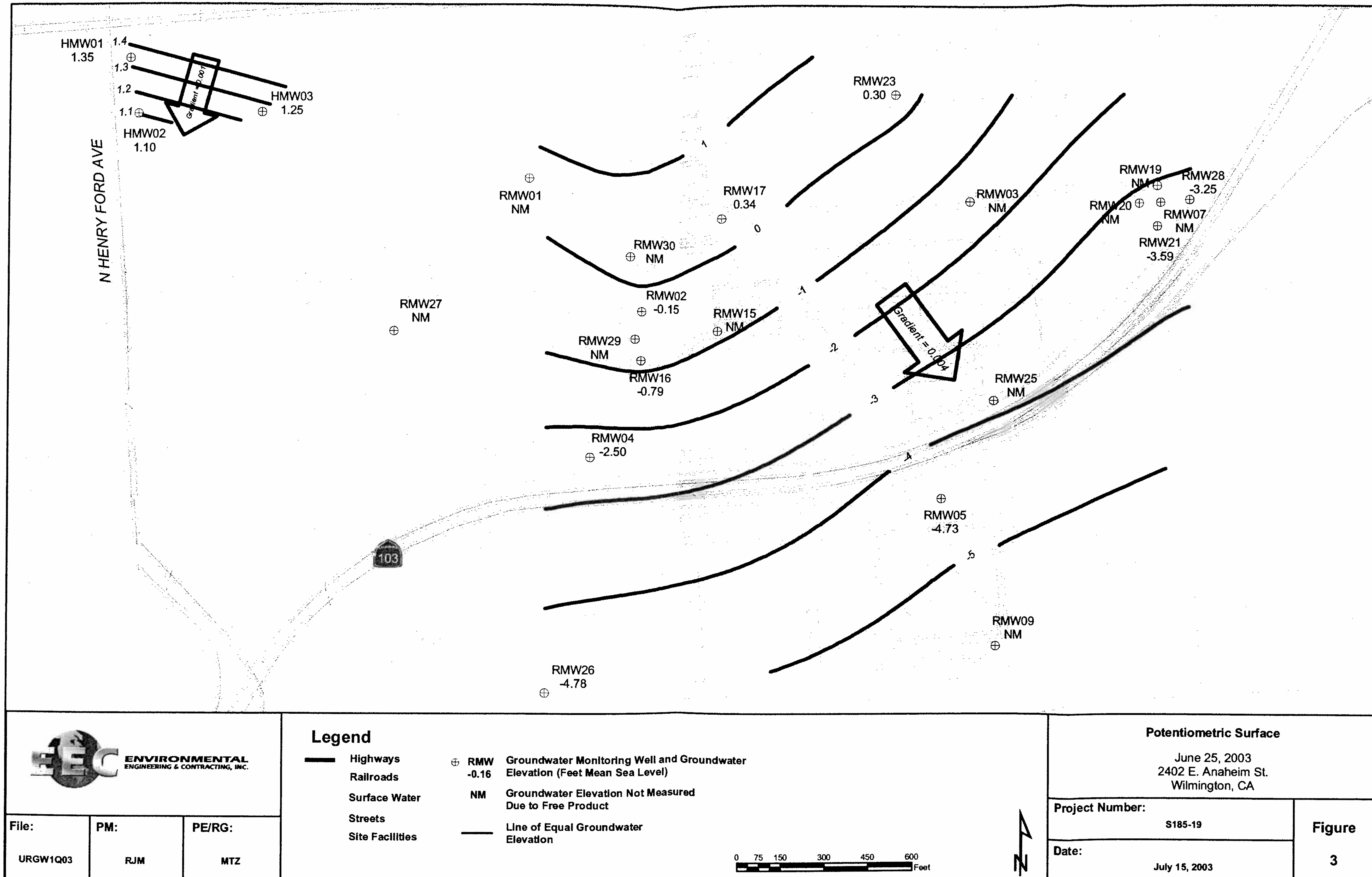

File:	PM:	PE/RG:
URGW1Q03	RJM	MTZ

Potentiometric Surface

June 25, 2003
2402 E. Anaheim St.
Wilmington, CA

Project Number:	Figure
S185-19	3
Date: July 15, 2003	

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ENGINEERING & CONTRACTING, INC.

www.eecworld.com
CONTR. LIC. #AHAZ-743267
515 N. CABRILLO PARK DRIVE, SUITE #120
SANTA ANA, CALIFORNIA 92701
PHONE (714) 667-2300 FAX (714) 667-2310

REPORT
FIRST QUARTER 2002
GROUNDWATER MONITORING AND SAMPLING

at

ULTRAMAR REFINERY
2402 East Anaheim Street
Wilmington, California

and

AIR PRODUCTS HYDROGEN FACILITY
700 North Henry Ford Avenue
Wilmington, California
(CRWQCB File Number 93-36)

Prepared for:

Ultramar Inc.
Wilmington, California

EEC Job S185-19
April 12, 2002

CERTIFIED HYDROGEOLOGIST
MARK T. ZEKO
No. 310
STATE OF CALIFORNIA

By:

Tom Titus
Senior Staff Geologist

Mark Zeko
Registered Geologist #6278
Registered Hydrogeologist #310

ENVIRONMENTAL
ENGINEERING & CONTRACTING, INC.

www.eecworld.com
CONTR. LIC. #AHAZ-743267
515 N. CABRILLO PARK DRIVE, SUITE #120
SANTA ANA, CALIFORNIA 92701
PHONE (714) 667-2300 FAX (714) 667-2310

FIRST QUARTER 2002
GROUNDWATER MONITORING AND SAMPLING

Ultramar Refinery
and
Air Products Hydrogen Facility
Wilmington, California

1.0 INTRODUCTION

This report presents the First Quarter 2002 groundwater monitoring and sampling results for the Ultramar Refinery (Refinery) and Air Products Facility (Hydrogen Facility) in Wilmington, California (Figure 1). There are 23 active groundwater monitoring wells in the groundwater monitoring program: 20 monitoring wells at the Refinery and three at the Hydrogen Facility as presented in Figures 2 and 3, respectively.

All of the wells were monitored this quarter. The wells were monitored on February 11, 2002. The wells not containing a sheen or free product were subsequently sampled February 12, 2002.

2.0 BACKGROUND

The Refinery and Hydrogen Facility are located in areas previously used for oil field type activities including oil well drilling and production operations. These activities began in the late 1930s and ended in 1970 when the Refinery was constructed. Structures located at the site prior to the construction of the Refinery included above ground storage tanks, pipelines, and sumps.

Since 1995, Ultramar has installed 26 monitoring wells to evaluate groundwater conditions in the area of the Refinery and Hydrogen Facility. The current quarterly groundwater monitoring programs is being conducted in response to a request from the State of California Regional Water Quality Control Board (RWQCB).

3.0 METHODS

Environmental Engineering & Contracting, Inc. (EEC) checked all of the monitoring wells at the Refinery and Hydrogen Facility for free product using an oil/water interface probe and/or a disposable bailer. In the wells where an oil/water interface could not be detected by the probe, EEC collected a sample with a disposable bailer and assessed it for a sheen and/or free product. The oil/water interface is difficult to determine in many wells which contain a viscous crude oil product due to probe interference.

Upon the assessment of free product in the wells, EEC measured the depth to static groundwater in all of the wells not containing free product at the Refinery and all of the Hydrogen Facility monitoring wells using the oil/water interface probe. EEC used the static groundwater measurements to calculate the groundwater elevations, flow gradients, and flow directions at the Refinery and Hydrogen Facility.

EEC purged and sampled the monitoring wells not containing free product. The wells were purged using a vacuum truck. EEC monitored the temperature, pH, conductivity, turbidity, and volume of water removed from the wells during the purging process. After three casing volumes were removed from the well and the groundwater parameters had stabilized, EEC collected a water sample using a disposable bailer.

The water samples were placed in a cooler chilled with ice and submitted to Calscience Analytical Laboratories under strict chain-of-custody protocol. The samples were analyzed for one or more of the following constituents: total petroleum hydrocarbons as diesel (TPHd) and as gasoline (TPHg) by EPA Method 8015 and benzene, toluene, ethylbenzene, and xylenes (BTEX) and methyl-tertiary-butyl-ether (MTBE) by EPA Method 8021B.

4.0 REFINERY RESULTS

The groundwater measurements and calculations are presented in Table 1. A summary of the laboratory data is presented in Table 2. The laboratory report is presented in Appendix A.

4.1 Groundwater Remediation

Passive skimmer product recovery units were installed in MW15 and MW27 at the refinery on July 8, 2000. The units are designed to remove light hydrocarbon products from the two monitoring wells. As of February 11, 2002, approximately 0.346 and 4.056 gallons of product have been removed from MW15 and MW27, respectively.

4.2 Free Product Assessment

A sheen or free product was detected in MW1, MW3, MW7, MW9, MW15, MW19, MW20, MW25, MW26, MW27, MW29, and MW30. Free product was detected in all of these wells last quarter.

4.3 Groundwater Flow Direction and Gradient

The groundwater flow gradient and direction is 0.003 to the southeast (Figure 2). The flow gradient and direction is similar to last quarter.

4.4 Laboratory Analysis

Water samples were collected from MW2, MW4, MW5, MW16, MW17, MW21, MW23, and MW28. Water samples were also collected from MW26 even though trace amounts of free product were detected. Water samples were not collected from the other wells due to the presence of free product. A summary of the laboratory results was presented in Table 2. The laboratory report was presented in Appendix A. A brief summary and comparison of the laboratory results to last quarter is presented below:

4.4.1 MW2

The concentrations of MTBE increased from 330 ug/L to 430 ug/L and m-p-xylenes from 7.6 ug/L to 7.7 ug/L from last quarter. TPHg decreased from 450 ug/L to 430 ug/L and benzene from 0.33 ug/L to non-detect (ND). TPHd remained at 3,200 ug/L. Toluene, Ethylbenzene, and o-xylenes remained ND.

4.4.2 MW4

Monitoring well MW4 was not sampled last quarter. The concentration of TPHd decreased from 9,200 ug/L from the third quarter 2001 to 4,700 ug/L this quarter. No other analyses were performed this quarter in accordance with the sampling schedule.

4.4.3 MW5

Monitoring well MW5 was not sampled last quarter. The concentration of TPHd decreased from 11,000 ug/L from the third quarter 2001 to 1,300 ug/L this quarter. No other analyses were performed this quarter in accordance with the sampling schedule.

4.4.4 MW16

The concentrations of TPHd decreased from 6,400 ug/L to 1,500 ug/L, TPHg from 200 ug/L to ND, and MTBE from 150 ug/L to ND from last quarter. No other analyses were performed this quarter in accordance with the sampling schedule.

4.4.5 MW17

The concentrations of TPHd increased from 3,300 ug/L to 3,800 ug/L from last quarter. TPHg, benzene, toluene, ethylbenzene, m,p-Xylenes, and o-Xylenes remained ND. No other analyses were performed this quarter in accordance with the sampling schedule.

4.4.6 MW21

Monitoring well MW21 was not sampled last quarter. The concentration of TPHd decreased from 4,900 ug/L from the third quarter 2001 to 2,700 ug/L this quarter. No other analyses were performed this quarter in accordance with the sampling schedule.

4.4.7 MW23

The concentrations of TPHd increased from ND to 2,100 ug/L, ethylbenzene from ND to 0.36 ug/L, and m,p-Xylenes from ND to 0.45 ug/L from last quarter. The concentrations of all other constituents analyzed remained ND. No other analyses were performed this quarter in accordance with the sampling schedule.

4.4.8 MW26

Monitoring well MW26 was not sampled last quarter because free product was detected in the well. A very minor amount of free product was detected in the well this quarter. Due to the minor amount of detect free product, the well was sampled. All of the sampled constituents were ND.

4.4.9 MW28

The concentrations of TPHd decreased from 1,100 ug/L to ND from last quarter. All other constituents remained ND.

4.4.6 QA/QC

The quality assurance (QA) parameters were within the acceptable ranges, therefore quality control (QC) for the project has been met.

5.0 HYDROGEN FACILITY RESULTS

The groundwater measurements and calculations are presented in Table 3. A summary of the laboratory data is presented in Table 4. The laboratory report is presented in Appendix A.

5.1 Free Product Assessment

A sheen or free product was not detected in any of the Hydrogen Facility monitoring wells. No sheen or free product was detected in any of the wells last quarter or in any of the previous nine quarters.

5.2 Groundwater Flow Direction and Gradient

The groundwater flow gradient and direction is 0.004 to the northwest (Figure 3). The flow gradient and direction is similar to last quarter.

5.3 Laboratory Analysis

Water samples were collected from MW1, MW2, and MW3. A summary of the laboratory results was presented in Table 4. The laboratory report was presented in Appendix A. A brief summary and comparison of the laboratory results to last quarter is presented below:

5.3.1 MW1

All other constituent concentrations remained ND from last quarter.

5.3.2 MW2

The concentrations of TPHd decreased from 2,600 ug/L to ND, toluene from 0.77 ug/L to ND, and m-p-xylenes from 0.64 ug/L to 0.50 ug/L from last quarter. All other constituent concentrations remained ND.

5.3.3 MW3

The concentrations of m,p-xylenes increased from 0.48 ug/L to 0.56 ug/L from last quarter. The concentrations of TPHd decreased from 3,900 ug/L to ND, benzene from 0.41 ug/L to ND, and toluene from 0.76 ug/L to ND from last quarter. All other constituent concentrations remained ND.

5.3.4 QA/QC

The quality assurance (QA) parameters were within the acceptable ranges, therefore quality control (QC) for the project has been met.

6.0 SUMMARY OF RESULTS

This section contains a summary of the Fourth Quarter 2001 monitoring and sampling event.

6.1 Refinery

A summary of the Refinery results is listed below:

1. All 20 groundwater monitoring wells were monitored this quarter;
2. A sheen or free product was detected in 12 groundwater monitoring wells;
3. The groundwater flow gradient and direction is 0.003 to the southeast;
4. Nine groundwater monitoring wells were sampled;
5. The hydrocarbon concentrations detected in the groundwater this quarter are similar to those from the previous quarter;
6. Approximately 0.346 and 4.056 gallons of free product have been removed from MW15 and MW27; and
7. The wells containing free product appear to be limited to the following areas:
    a. Near the intersection of E and J Streets;
    b. Southeast of tank 81-TK-4;
    c. Southwest of tank 95-TK-1;
    d. East of 4th Street between F and G Streets; and
    e. East of Substation 7.

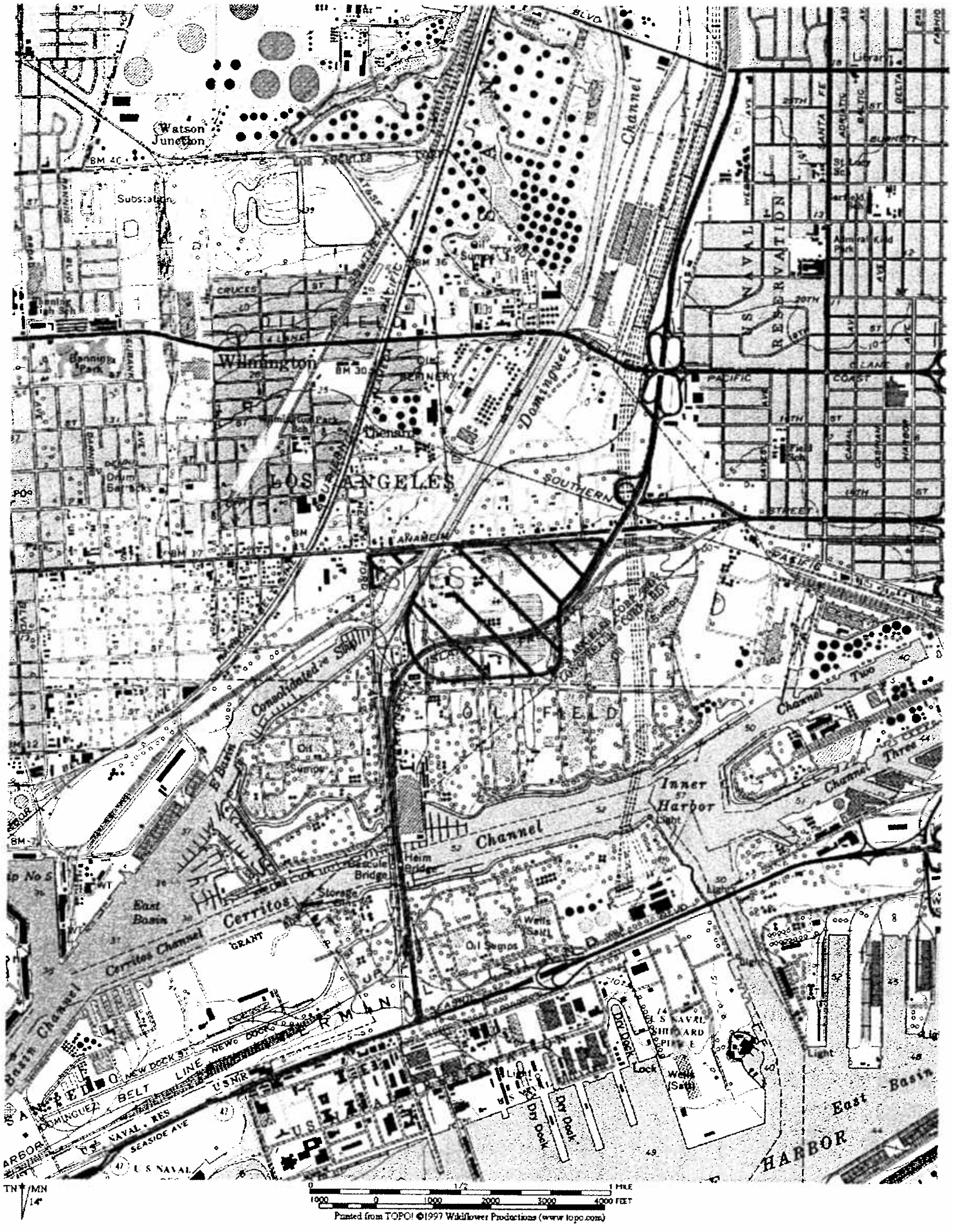
6.2 Hydrogen Facility

A summary of the Hydrogen Facility results is listed below:

1. All three groundwater monitoring wells were monitored this quarter;
2. Free product was not detected in any of the groundwater monitoring wells;
3. The groundwater flow gradient and direction is 0.006 to the northwest;
4. The hydrocarbon concentrations detected in the groundwater this quarter are similar to those from the previous quarter; and
5. MTBE was not-detect in MW1, MW2 and MW3.

7.0 REFERENCES

Los Angeles Regional Water Quality Control Board, 1998, Monitoring and Sampling Schedule, Ultramar Refinery, Wilmington, California, May 8.



ENVIRONMENTAL ENGINEERING & CONTRACTING, INC.

1=2005'

Map Source: U.S.G.S. 7.5-minute topographic quadrangle map Long Beach, Calif. 1964 photorevised 1981

SITE LOCATION

ULTRAMAR REFINERY
2402 E. Anaheim Street
Wilmington, California

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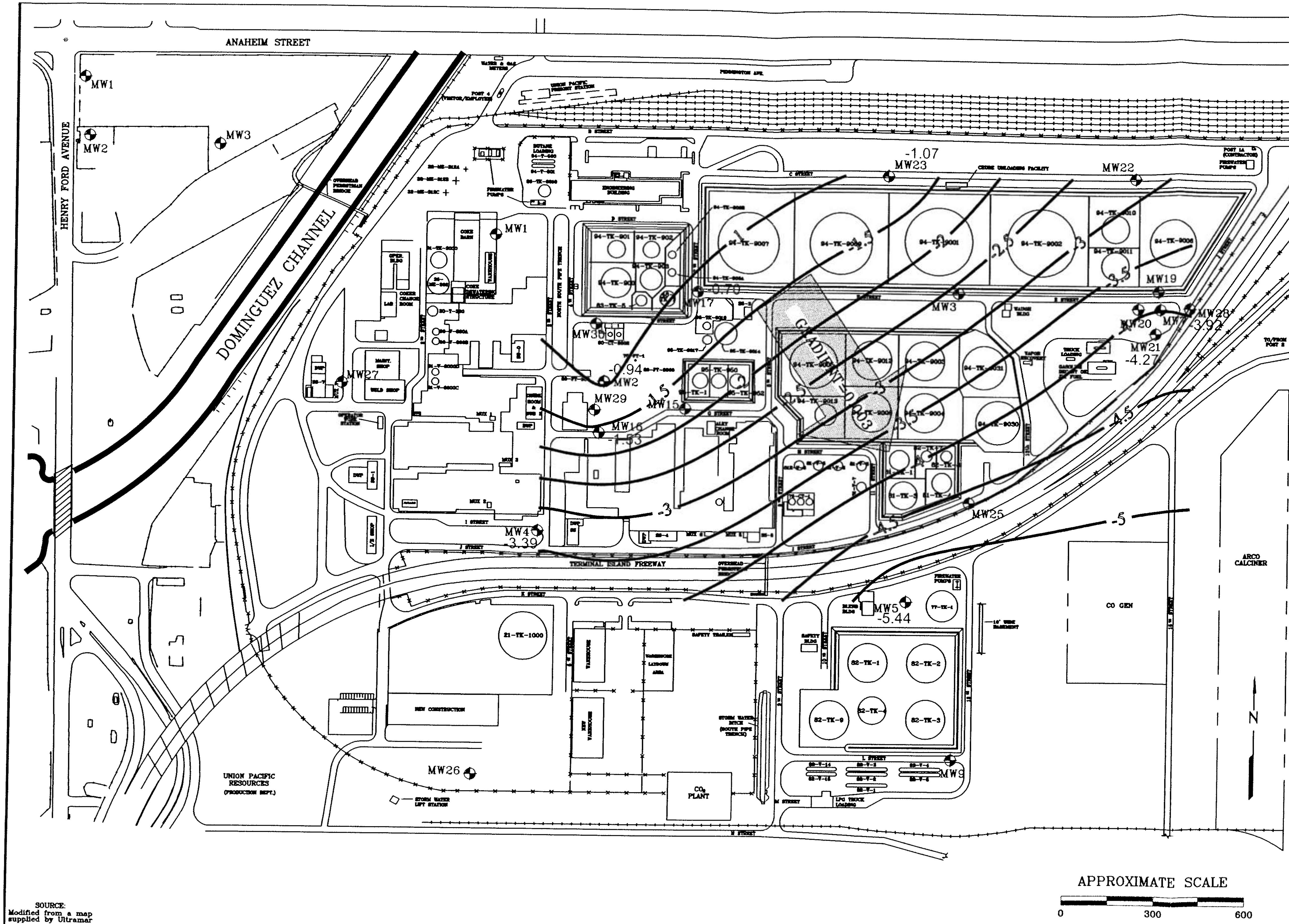
S1850201(R14)	4/1/02	TT	MTZ	S185-19	1



EXPLANATION

-1.07 MW23 — Groundwater Monitoring Well and Relative Groundwater Elevation (in reference to mean sea level, expressed in feet)

Line of Equal Groundwater Elevation

Aboveground Storage Tank

Building

Containment Dike

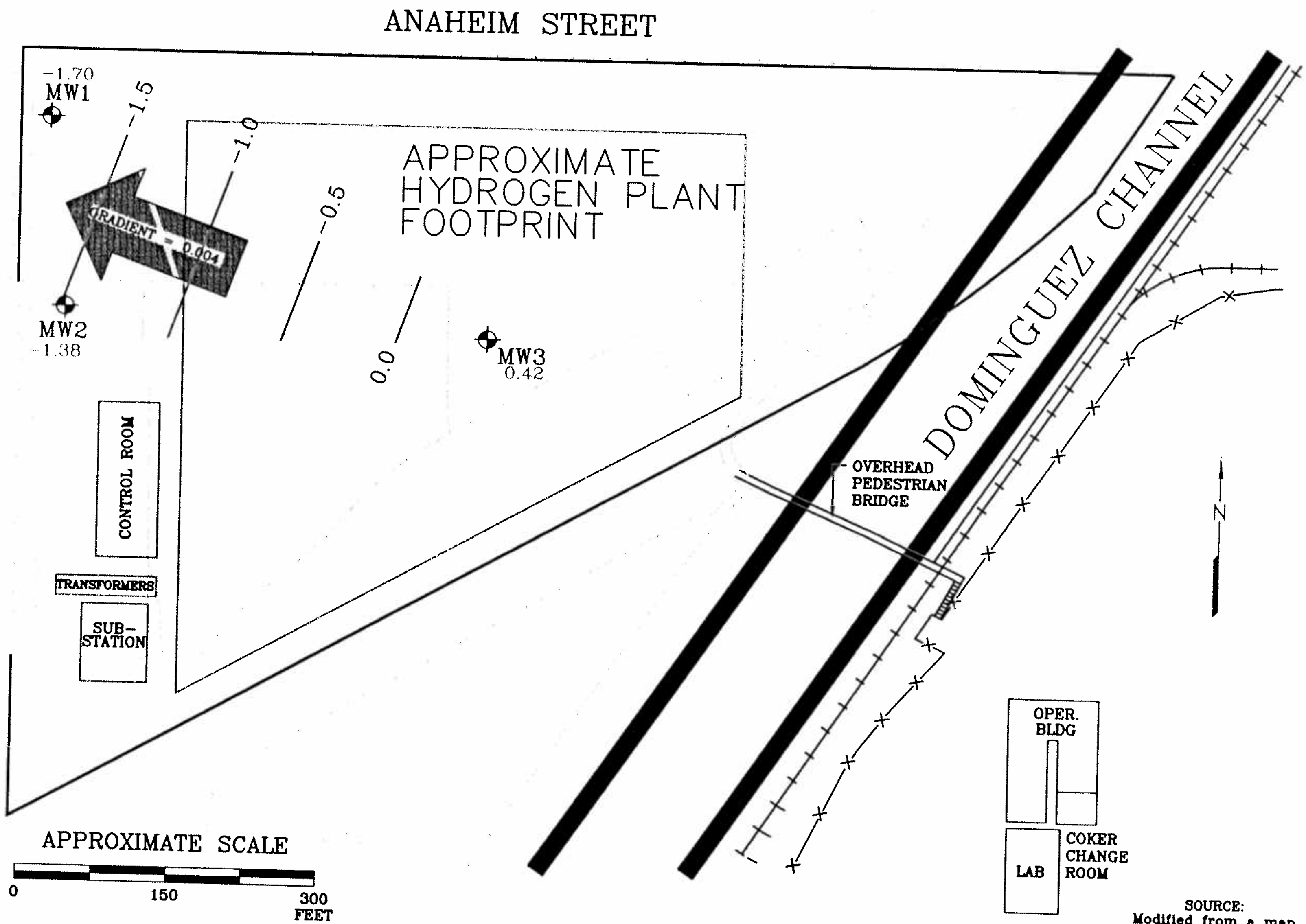
GROUNDWATER FLOW DIRECTION February 12, 2002

Ultramar Refinery
2402 E. Anaheim Street
Wilmington, California

Scale: 1"=300'	Size: BSIZE (11X17)
Date: April 1, 2002	File: S185quarterly Figure 2 1q02
Project Number: S185-19	

ENVIRONMENTAL ENGINEERING & CONTRACTING, INC.

Approved By:	Figure: 2



ENVIRONMENTAL ENGINEERING & CONTRACTING, INC.

File:	PM:	PE/RG:
Fig 3 1q02	TT	MTZ

Legend:

MW3 0.42 — Groundwater Monitoring Well and Relative Groundwater Elevation

Line of Equal Groundwater Elevation

GROUNDWATER FLOW DIRECTION
February 12, 2002
AIR PRODUCTS HYDROGEN FACILITY
700 N. Henry Ford Avenue
Wilmington, California

Project Number:	Figure:
S185-19	3
Date: April 1, 2002	

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