REPORT ON PHASE III
ADDITIONAL SITE CHARACTERIZATION
June 2011
FORMER CHEMOIL REFINERY
SLIC No. 453A
SIGNAL HILL, CALIFORNIA

VOLUME I

Prepared for:

Signal Hill Holding Company
c/o Mr. Harrison Chang
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Stephen M. Testa　　Date
President, CEG No. 1613

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June 30, 2011

California Regional Water Quality Control Board –
Los Angeles Region
420 West Fourth Street, Suite 200
Los Angeles, CA 90013

Attention: Ms. Ann Lin

Subject: Report on Phase III
Additional Site Characterization
June 2011
Former Chemoil Refinery, Signal Hill, California
SLIC No. 453A
Project No. 94-11-1008.74

Dear Ms. Lin:

On behalf of Signal Hill Holding Corporation, presented herewith is Testa Environmental Corporation's (TEC) Report on Phase III Additional Site Characterization for the Signal Hill Holding Company (SHHC) former Chemoil refinery site, located in the city of Signal Hill, California. The information discussed herewith reflects the request of the California Regional Water Quality Control Board – Los Angeles Region (CRWQCB-LAR) for quarterly gauging and groundwater quality monitoring and the need for further subsurface site characterization. Such activity has been performed since 1985.

In addition, the need for additional subsurface site characterization was discussed in July 2008. Results of such discussions resulted in the implementation of additional work which was divided into three Phases. This report contained herewith is comprehensive in nature and includes a summary of results previously generated during Phases I and II, and results generated during conduct of Phase III related activities. Included is discussion site description and history, purpose and scope, field and laboratory methodology for field and analytical work, subsurface hydrogeologic conditions, soil and groundwater quality, and conclusions. In addition, the site conceptual model has been updated to reflect all subsurface data generated to date.

Attachments include all pertinent agency correspondence, soil boring logs and well construction details, tabulation of soil boring data, soil quality and soil gas data, groundwater gauging data and annotated hydrographs showing fluctuations of water levels with time, groundwater quality data and graphs showing fluctuations with time, and associated laboratory reports. Graphic illustrations showing location of all sampling points, soil borings and probes and monitoring wells, and subsurface hydrogeologic conditions and distribution of hydrocarbons in the subsurface, are also provided.

Should you have any questions, or require further clarification pertaining to the contents of this report, please do not hesitate to contact us.

Very truly yours,

TESTA ENVIRONMENTAL CORPORATION

Stephen M. Testa
President, CEG No. 1613

cc. Mr. Harrison Chang, Signal Hill Holding Company
Mr. Rick McAukey, MPO Walnut Partners, LLP,
Mr. Tom Graf, Jorden and Graf

REPORT ON PHASE III ADDITIONAL SITE CHARACTERIZATION
JUNE 2011
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1.0 EXECUTIVE SUMMARY

Subsurface environmental-related activities have been performed at the Signal Hill Holding Corporation (SHHC) former refinery site located in Signal Hill, California, since 1985, with a hiatus from monitoring between July 1999 and October 2001. On behalf of SHHC, Testa Environmental Corporation (TEC) re-initiated quarterly groundwater quality monitoring at the former Chemoil refinery site in 2001. In addition, TEC has performed additional subsurface site characterization related-activities in late 2008 and 2009. The information discussed herewith reflects the request of the California Regional Water Quality Control Board – Los Angeles Region (CRWQCB-LAR) for further site characterization as set forth in their letters dated March 24, May 20 and June 10, 2009.

The report contained herewith is comprehensive in nature and includes a summary of results previously generated during Phases I and II, and results generated during conduct of Phase III related activities. Activities performed as part of Phase I and Phase II additional site characterization included continuation of quarterly groundwater gauging and quality monitoring, abandonment of three former light non-aqueous phase liquid (LNAPL) hydrocarbon recovery wells and one former monitoring well, installation of six soil borings which were completed as groundwater monitoring wells, including four of such wells being situated off-site, testing of 52 soil samples retrieved from the six new wells, and conduct of a soil gas survey. As part of Phase III, the soil gas survey was extended off-site south of the site, and three additional off-site groundwater monitoring wells were installed. In addition, the Human Health Risk Assessment and Site SCM have been updated to reflect all subsurface data generated to date.

The site is underlain by deposits of unconsolidated, stratified, laterally discontinuous sequences of fine-grained soil with an intervening fine-to coarse-grained sand layer, which exists at depths from about 13 feet to 45 feet below ground surface (bgs). Groundwater beneath the site is not a source or potential source for drinking water. As of March 2011, overall groundwater occurred at elevations of 5.31 and 6.52 feet relative to mean sea level, respectively (depths ranging from 12.60, to 15.70 and 41.50 bgs, respectively), as measured in wells MW-8, and MW-1 and MW-3, respectively. Depth to groundwater ranged from 10.80 to 41.50 feet bgs, as measured in wells MW-19 and MW-3, respectively. Beneath the Eastern Parcel, groundwater was encountered at elevations of 5.39 and 5.50 feet (i.e., depths of 24.60 to 26.10 feet) as measured in wells MW-2 and MW-10, respectively. Groundwater flow beneath the site was generally toward the south-southeast, slight mounding beneath the southwest portion of the Western Parcel. Hydraulic gradient is on the order of 0.003 to 0.006 ft/ft.

In regards to overall soil quality, additional characterization activities associated with Phases I, II and III, were consistent with past site operations and reported results. Notably, significant portions of the soil column beneath the Western Parcel are impacted by residual hydrocarbons. Such impact extends from the existing ground surface vertically downward to the water table, notably, beneath the southern portion of the Western Parcel. The northern portion of the Western Parcel is least impacted by the subsurface presence of residual hydrocarbons. In addition, a small localized area in the northwestern corner of the Eastern Parcel was also delineated. Soil quality data generated during Phase II and III related activities noted the presence of residual hydrocarbons in the vicinity of the piezometric table south of the site as reported in wells MW-12 and MW-17, situated west of the Western Parcel, and wells MW-15, MW-16, MW-17 and MW-19, situated south-southwest of the Western Parcel.

During the March 2011 groundwater sampling event, dissolved GRO was reported in 10 out of 16 wells, and ranged from non-detect to 0.35 to 19 mg/L in wells MW-17 and MW-19, respectively. Dissolved DRO was reported in 12 out of 16 wells, and ranged from 1.1 to 11 mg/L, in wells MW-17 and MW-11, respectively. Dissolved DROr using a silica gel rinse were reported in 10 out of 16 wells with concentrations of 0.3 to 1.7 mg/L, as measured in wells MW-10 and MW-11, respectively. The reduction in measured dissolved DROr using silica gel indicates appreciable ongoing biodegradation of petroleum hydrocarbons in groundwater. Dissolved Benzene, Toluene, Ethylbenzene or Total Xylenes were reported in five out of 16 wells; MW-8, MW-9, MW-11, MW-12, and MW-19. Dissolved Benzene, however, was reported in only three on-site wells at concentrations of 46, 90 and 5100 ug/L in wells MW-8, MW-9 and MW-11, respectively.

MTBE was reported in five wells at concentrations of 11, 32, 19, 26 and 130 ug/L in wells MW-1A, MW-8, MW-13, MW-16 and MW-17, respectively. Tert-Butanol was reported in two wells; wells MW-8 and MW-12 at concentrations of 380 and 320 ug/L, respectively.

Eight other petroleum-related dissolved VOCs were reported. These constituents and their respective highest concentration reported, and associated wells, were:

Volatile Organic Compounds	Concentration (ug/L)
Isopropylbenzene	150 (MW-16)
4-Isopropylbenzene	25 (MW-12)
Naphthalene	420 (MW-12)
n-Butylbenzene	28 (MW-12)
n-Propylbenzene	130 (MW-12)
sec-Butylbenzene	35 (MW-12)
1,2,4-Trimethylbenzene	320 (MW-12)
1,2,5-Trimethylbenzene	730 (MW-12)

During sampling, relatively slight to strong hydrocarbon odors were noted in all wells with exception to well MW-18. No Light Non-aqueous Phase Hydrocarbons (LNAPL) were observed.

Dissolved hydrocarbons exist beneath the former refinery site, and have migrated hydraulically offsite toward the west, south and southwest, and marginally toward the east of the Western Parcel beneath Walnut Avenue. GRO and DRO, including relatively low levels of DROr using a silica gel rinse, were reported in most perimeter wells and thus have migrated hydraulically off-site toward the south and southwest, marginally toward the west, and east of well MW-9. Dissolved Benzene component was reported in on-site wells MW-8, MW-9 and MW-11, and has marginally migrated toward the east of the Western Parcel, east of well MW-9. Certain dissolved VOCs have migrated off-site toward the south and southwest, west, and marginally toward the east of the Western Parcel beneath Walnut Avenue.

Dissolved MTBE is noted in groundwater west and southwest of the Western Parcel. Relatively elevated dissolved MTBE in groundwater for offsite well MW-17, in addition to its presence being reported in select soil samples from this location, suggest an off-site source situated west or northwest of the site, with migration toward the east and beneath the former Chemoil refinery site. Dissolved Tert-Butanol appears to have migrated marginally off-site to the south and southwest.

A soil gas survey was performed in 2009 along the perimeter of the site, and updated in 2010 to extend our understanding of soil gas presence and risk off-site and south of the site. Hazard risk values generated were all below 1, indicating that potential exposure to chemicals of potential concern in indoor air by residents adjacent to the southern property boundary pose a negligible noncancer health risk under the conditions evaluated. The estimated excess cancer risks were at or below the generally acceptable risk range based on maximum Chemicals of Potential Concern (COPC) concentrations and one-half the minimum detection limits in soil vapor, but they fall in the lower end of the risk range based on maximum COPC concentrations and one-half the maximum detection limits in soil vapor, or based on maximum COPC concentrations in groundwater. Methylene chloride was not detected in soil vapor but was the largest contributor to the estimated cancer risk based on soil vapor data. The only chemical detected in soil vapor that contributed to the estimated cancer risk was Benzene, which was detected at concentrations that are roughly 30 to 40 times lower than the maximum detected concentration reported in the previous evaluation using 2009 soil vapor data along the southern boundary.

The estimated excess cancer risks based on the maximum detected benzene concentrations were well below the generally acceptable risk range (6×10–7 and 3×10–7, at 5 and 10 ft bgs, respectively). Finally, estimated risks based on groundwater data were driven by naphthalene, which was not detected in the soil vapor samples. Estimated health risks based on groundwater data are likely more uncertain than those based on soil vapor data because of additional assumptions required in the model and potential biodegradation of the COPCs in the vadose zone. In summary, potential soil vapor intrusion is not likely to be of concern for current off-site residents south of the property boundary.

Quarterly groundwater gauging and sampling will continue, with the next events to be performed in June, September and December 2011, with resultant reports submitted in July and October 2011, and January 2012. Based on results of the updated Human Health Risk Assessment, soil gas data generated south of the site, no emergency remedial response is deemed necessary. No remediation goals have been developed since the site is currently undeveloped, and no development concept exists at this time. Until a future site use is determined, and development plans formulated, actual clean-up goals remain premature, albeit, at this time such remediation goals should assume commercial as an end use.

Upon review of the report presented herein by the CRWQCB-LAR, a meeting with the CRWQCB-LAR is recommended to discuss results and salient elements for development of a site closure strategy with consideration of subsequent site use and timing. A site closure strategy should be developed in consideration of comments received from the CRWQCB-LAR following their review of the Phase III report, updated Human Health Risk Assessment, and updated Site Conceptual Model.

2.0 INTRODUCTION

2.1 Site Description

The former Chemoil refinery site is located in the city of Signal Hill, California (Figure 2-1). Prior to Chemoil acquiring the refinery site, the refinery was previously known as the MacMillan-Ring Free refinery. MacMillan Ring Free operated the refinery and associated facilities from 1922 until August 1988. Following purchase of the refinery by the Chemoil Corporation in 1988, the site has been the responsibility of SHHC.

The former refinery site is divided into two main parcels: the Western Parcel and the Eastern Parcel. The Western Parcel is situated immediately west of Walnut Avenue, whereas the Eastern Parcel is situated immediately east of Walnut Avenue. The Western Parcel is further divided into three subparcels: two subparcels situated in the northern portion of the site, and a southern subparcel. A figure showing the various parcels and subparcels, and former layout of specific operational units, is presented in Figure 2-2.

The Western Parcel encompasses approximately 5.7 acres. The northern portion of the Western Parcel, or northern subparcel, is further subdivided into two parts. The western part faces Gundry Avenue and is rectangular in shape, and encompasses approximately 0.53 acres and is 150 x 154.5 feet. A scale house and a part of a truck scale previously occupied this area, in part. The eastern part is also rectangular in shape, faces Walnut Avenue, and encompasses approximately 0.75 acres and is 125 x 261 feet. This area was previously occupied by a scale house, several warehouses, truck scale, and a crude oil unloading rack.

The southern portion of the Western Parcel, or southern subparcel, encompasses approximately 4.42 acres, and is further divided into two sections separated by 21st Street. The north section is rectangular in shape and formerly included a warehouse, inspection lab, truck loading racks, about 40 above ground storage tanks, and piping. The south section is triangular in shape and formerly included about 25 above ground storage tanks, boilers, heater units, loading racks, desalter and cooling tower.

The Eastern Parcel encompasses approximately 2.5 acres. Somewhat rectangular in shape with exception of its southern perimeter, the site was formerly occupied by six above ground storage tanks (Nos. 15, 14, 11, 3, 504 and 230). These tanks were reportedly used for the storage of heavy crude oil. An adjoining office, maintenance, truck washing and repair structure, supervisor's office, and adjoining laboratory and warehouse facility, also formerly occupied the site.

2.2 Site Operations

Prior to 1922, the property was used as a dairy farm. From 1922 to 1988, the facility was solely owned and operated by the MacMillan Ring-Free Oil Company. Chemoil purchased the former refinery in August 1988, and operated it until February 14, 1994, when the refinery was shut down with occasional operation of its waste water system. Since early 1997, operation of the waste water system was discontinued, and all above ground structures were dismantled. The oldest active area lies within the triangular (southwest) portion of the Western Parcel formed by the intersection of Walnut Avenue, 21st Street and the Southern Pacific Railroad right-of-way. The oldest operations occurred in the northeast corner of this area where crude oil processing related activities took place. Prior to 1922, the property was used as a dairy farm. The site is currently vacant, albeit divided into several subparcels (Figure 2-4), with no above ground or subsurface structures remaining (Figure 2-5).

2.3 Site Vicinity

The site is situated in what is referred to as the Civic Center Neighborhood (Signal Hill General Plan, Land Use Element, 2001). The site is surrounded by commercial and light industrial to the west, north and northeast (Figure 2-5). The boundary between the City of Signal Hill and City of Long Beach forms the southern perimeter of the site. Underground oil pipelines exist beneath east-west oriented Hill Street, north of the site, and beneath north-south oriented Walnut Avenue which separates the Western Parcel from the Eastern Parcel. In the vicinity of the site, surface water flow is depicted by the City of Signal Hill Public Works Department as toward the south-southwest.

2.4 Regulatory Background

2.4.1 Previous Regulatory Discussions (1985 – 2008)

Subsurface environmental-related activities have been performed since 1985. A listing of prior reports submitted to the CRWQCB-LAR is tabulated in Table 2-1. A chronology of pertinent activities and regulatory events is summarized in Table 2-2.

Meetings with the CRWQCB-LAR to discuss site closure related-issues were initiated in 1998, as documented in agency correspondence (Exhibit I). Discussions dealing strictly with the Eastern Parcel initiated in 1999 with the submittal to the CRWQCB-LAR of a "Workplan for Closure Sampling at the East Parcel" by The Source Group (TSG) dated September 23, 1999 (TSG, 1999). The actual work discussed in this workplan was performed, although to our knowledge, no formal report was ever produced by TSG.

Further discussions were held between Chemoil, TEC and the CRWQCB-LAR on August 30, 2001. During this meeting, the CRWQCB-LAR indicated that they would consider site closure, or partial site closure, of the Eastern Parcel and possibly other portions of the former refinery site, provided further assessment was performed. The quarterly groundwater quality gauging and monitoring program was resumed as noted in the CRWQCB-LAR's letter dated September 12, 2001. In addition, a proposed workplan titled "Proposal for Subsurface Assessment, Eastern Parcel, Former Chemoil Refinery," dated September 4, 2001 was prepared and submitted to the CRWQCB-LAR for review and comment prior to implementation (TEC, 2001a). Following review and minor modifications as noted in the CRWQCB-LAR's correspondence dated September 19, 2001, additional subsurface assessment activities were performed as prescribed in the September 4, 2001, workplan (TEC, 2001c). A revised Remedial Action Plan was developed by Chemoil to accommodate sale of the site for development, and subsequently approved by the CRWQCB-LAR (TEC, 2002a). However, sale of the site did not proceed, and the Remedial Action Plan was not implemented.

A development-related workplan dated November 18, 2001, was also prepared to address the need for additional subsurface assessment to be performed at the Western Parcel (TEC, 2001b). Following comments received from the CRWQCB-LAR in their letter dated January 8, 2002, a revised workplan dated July 24, 2002, was prepared which included responses to 14 comments set forth by the CRWQCB-LAR (TEC, 2002b). Sale of the property did not proceed, and the scope of work outlined in this workplan was not performed. Since July 2002, quarterly groundwater gauging and sampling has continued.

A limited subsurface site characterization was performed by parties interested in purchasing this site. This characterization was performed during May and June, 2006. The soil and water quality data generated was compiled and subsurface conditions re-assessed in light of this information. This information has been incorporated into the existing subsurface data base for this site.

2.4.2 Recent Regulatory Discussions (2008 - Present)

A proposed workplan dated October 12, 2008, was implemented to address various outstanding issues and data gaps, necessary in order to formulate a closure strategy for the site. Following completion of such work, certain data gaps were identified, and a proposed workplan for further site characterization was prepared, dated March 2, 2009. This workplan was reviewed and subsequently approved by the CRWQCB-LAR, in their correspondence dated March 24, 2009. A soil gas survey was also included in the scope of work to be performed as requested by the CRWQCB-LAR in their correspondence dated June 10, 2009. Phase I and Phase II reports reflecting a summary of additional subsurface assessment related activities performed were completed and subsequently submitted to the CRWQCB-LAR in January and September 2009, respectively.

Following a meeting on November 16, 2009, a review of data and investigatory reports prepared to date was performed and data gaps identified. Recognizing the need for further subsurface assessment south and west of the site, a Phase III workplan dated January 4, 2010, was prepared and implemented. The purpose of the Phase III workplan was to provide the data necessary to complete characterization of subsurface hydrogeologic and environmental conditions, including 1) lateral delineation of dissolved hydrocarbons in groundwater, 2) generation of additional subsurface data for re-evaluation of human health risks reflecting future on-site land use, and adjacent residential land use to the south, and 3) updating of the Site Conceptual Model (SCM). The workplan included conduct of a soil gas survey south of the site, and installation of additional groundwater monitoring wells (MW-17, MW-18 and MW-19) were installed south and west of the site.

3.0 PURPOSE AND SCOPE

3.1 Purpose

The purpose of the Phase II workplan for additional site characterization is to provide the data necessary to complete the characterization of subsurface environmental site conditions, which would form the basis for development of a site closure strategy. Although the site is currently vacant and no development plans are imminent, site closure under several development scenarios with time would be considered.

3.2 Scope of Work

To accomplish the objectives summarized above, the scope of work that comprised Phase I, II and III related activities, is summarized in Table 3-1 and summarized below. The scope of work was outlined in TEC's Revised Proposed Workplan dated October 12, 2008, Proposed Phase II workplan, dated March 2, 2009, Revised Proposed Workplan for Soil Gas Survey, dated May 8, 2009, Proposed Phase III workplan dated January 4, 2010. These workplans reflected review of previous studies, identification of outstanding data gaps, and issues and concerns reflected in the CRWQCB-LAR correspondence dated March 24, 2009, and June 10, 2009.

Table 3-1
Task Summary

Phase No.	Task No.	Task Description
Phase I	1.0	Identification of Responsible Parties
	2.0	Re-evaluation of Overall Groundwater Flow Directions
	3.0	Re-establishment of Former Recovery and Monitoring Wells
	4.0	Analytical Program to Assess Dissolved Phased Hydrocarbons
	5.0	Phase I Report and Proposed Workplan Preparation
Phase II	1.0	Identification of Responsible Parties
	2.0	Well Abandonment
	3.0	Drilling and Sampling Program
	4.0	Analytical Program
	5.0	Soil Gas Survey
	6.0	Development of Site Conceptual Model
	7.0	Phase II Report Preparation
	8.0	Preparation of Site Closure Strategy
Phase III	1.0	Additional Environmental Assessment
	2.0	Soil Stockpiles Characterization
	3.0	Drilling and Sampling Program
	4.0	Analytical Program
	5.0	Forensic and Plume Stability Analysis
	6.0	Human Health Risk Analysis
	7.0	Site Conceptual Model (SCM) Update
	8.0	Phase III Report Preparation

Work completed as part of Phase I and II related activities, and previously reported, included:

- Abandonment of three former LNAPL wells (R-4, R-5 and R-6) and one groundwater monitoring well (MW-7);
- Installed six new groundwater monitoring wells (MW-11 through MW-16) for a total of 13 groundwater monitoring wells, four of which are situated off-site;
- Re-establishment of horizontal coordinates and top of casing elevations;

- Retrieval of approximately 52 soil samples for subsequent chemical testing;
- Retrieval of 13 groundwater samples on a quarterly basis for subsequent chemical testing;
- Conduct of a soil gas survey which included the drilling of 22 probes at select on- and off-site locations;
- Updated the Site Conceptual Model; and
- Updated Human Health Risk Assessment.

Phase III tasks included the following:

Task No. 1.0 - Additional Environmental Assessment: Available information and records pertaining to the current and past presence of underground tanks, utilities and pipeline right-of-ways, in close proximity to the site were retrieved and reviewed. Notably, records and information were searched that may shed light on potential off-site hydrocarbon sources and which may explain the presence of soil gas along Hill street and the presence of certain dissolved hydrocarbons reflective of refined petroleum hydrocarbons to the west of the site (Exhibit 2).

Task No. 2.0 – Soil Stockpiles Characterization: Approximately 60 soil stockpiles are situated in the southern portion of the Eastern Parcel. It is assumed that the soil stockpiles originated from rough grading activities performed during dismantling of the refinery. The quality of the soil comprising the stockpiles is uncertain, thus, representative samples were retrieved for chemical testing.

Task No. 3.0 – Drilling and Sampling Program: The drilling and sampling program included the drilling of three new off-site borings to be subsequently converted to groundwater monitoring wells, and the retrieval of continuous soil samples. The three borings were situated south and southwest of the Western Parcel. All boring logs and well construction details are provided in Exhibit 3.

Drilling and Well Installation Program: The three soil borings were drilled using a mobile, truck-mounted push-drive drilling rig at approximate locations shown in Figure 1. Soil samples will be continuous retrieved for chemical testing at depths of one- foot, followed by retrieval of soil samples at fivefoot intervals thereafter, or significant changes in lithology, to an approximate depth of ten-feet below the piezometric surface.

Soil Sampling Program: It is estimated that approximately 10 additional soil samples were retrieved during conduct of the drilling program for chemical testing. All soil samples retrieved were characterized in accordance with the Unified Soil Classification System. Samples were retrieved in standard chemically inert acrylic sleeves. Potential volatile organics were monitored during drilling using a hand-held photoionization detector (PID) or flame ionization detector (FID). Detailed boring logs describing soil types with depth, approximate moisture content, and potential presence of hydrocarbon vapor, were maintained.

Well Installation Program: As with all groundwater monitoring wells, the three additional soil borings were readily converted to flush-mounted 4-inch diameter PVC groundwater monitoring wells and installed in a manner consistent with those currently installed off site, and consistent with industry standards (i.e., locking well casings, etc.). The monitoring well screens extended from approximately 5 feet above to 15 feet below the water table at the time of drilling. Nearby wells were gauged to confirm the depth of the water table at the time of drilling. Permits for installation of monitoring wells were obtained from the City of Long Beach Department of Public Works, prior to the drilling of soil borings and subsequent installation of monitoring wells, as appropriate.

No sooner than 24 hours after well installation, the wells were developed until the produced water was clear and field parameters have stabilized. The wells were subsequently gauged, purged and sampled. The wells without sheen or measurable LNAPL were purged until the produced water was clear and the field parameters have stabilized, with a minimum of three casing volumes evacuated. The wells were sampled using the same methods as for the quarterly groundwater monitoring program.

Task No. 4 – Analytical Program for Soil and Groundwater Samples:

Soil Analytical Program: Analytical reports for soil are provided in Exhibit 4. Chemical testing of representative soil samples retrieved from the soil borings and soil stockpiles was performed for the following parameters:

Volatile organic compounds (VOCs) and oxygenated compounds using EPA Method 8260B;

Polycyclic aromatic hydrocarbons (PAHs) using EPA Method 8270C SIM; and

Diesel Range Organics and Gasoline Range Organics using EPA Method 8015B (modified for diesel [DRO] and gasoline [GRO]).

Such analyses were performed by a California-certified laboratory, notably, Analytical Technologies, Inc., located in Signal Hill, California.

Groundwater Analytical Program: Gauging data is provided in Exhibit 5. Graphs showing fluctuations of certain dissolved constituents with time and analytical reports are provided in Exhibit 6. As part of the periodic quarterly groundwater gauging and sampling program, all existing 16 groundwater monitoring wells, including the three additional groundwater monitoring wells MW-17, MW-18 and MW-19, continued to be gauged and monitored on a quarterly basis.

Chemical testing of representative groundwater samples continued to be performed for the following parameters:

Volatile organic compounds (VOCs) and oxygenated compounds using EPA Method 8260B;

Semi-volatile organic compounds (SVOCs) using EPA Method 8270C; and

Diesel Range Organics and Gasoline Range Organics using EPA Method 8015B (modified for diesel [DRO] and gasoline [GRO]).

Such analyses were performed by a California-certified laboratory, notably, Analytical Technologies, Inc., located in Signal Hill, California

Task No. 5.0 – Forensic and Plume Stability Analysis: Although no Light Non-aqueous Phase Liquid (LNAPL) hydrocarbons are present, a review of certain ratios of various dissolved hydrocarbon constituents was reviewed to evaluate whether a distinct off-site source(s) of subsurface hydrocarbons was evident. In addition, a contaminant plume stability analysis was performed to further document natural attenuation of dissolved hydrocarbon constituents in groundwater. To evaluate the stability of the dissolved hydrocarbon plume(s), historic trends in various plume characteristics including area, average concentration, contaminant mass and center of mass, were assessed and contaminant distribution isopeths developed. A statistical trend analysis was performed on the calculated values to assess plume stability.

__Task No. 6.0 - Human Health Risk Assessment:__ Following our November 16, 2009, meeting, and in our correspondence dated December 8, 2009, a proposed workplan was developed to document concentrations of petroleum constituents in soil gas immediately south of the site. Specific tasks as proposed in our December 8, 2009, correspondence, are summarized below.

__Task No. 6.1 – Access Clearance and Permitting:__ Dig Alert/ Underground Service Alert will be contacted to assure clearance from underground structures and utilities. Required permits will be obtained from the cities of Long Beach and Signal Hill, as appropriate.

__Task No.6.2 – Drilling and Sampling Program:__ A mobile, truck-mounted push-drive drilling rig was used, in conjunction with an on-site mobile laboratory. The drilling and sampling program included the drilling of six soil vapor probes.

__Task No. 6.3 – Analytical Program:__ An on-site mobile laboratory with laboratory-grade certifiable instrumentation and procedures for real-time analysis of individual VOCs was used, in accordance with the guidelines set forth by the CRWQCB-LAR (1997). Soil gas samples were analyzed using modified EPA Method 8260B. In addition, two confirmation samples were collected at residential area locations in Summa Canisters, to be analyzed at a fixed-base laboratory for VOCs using EPA Method TO-15. Laboratory reporting limits were to be greater than CHHSL-residential levels.

__Task No. 6.4 – Human Health Risk Assessment:__ Upon completion of soil gas survey field and laboratory related activities, a revised and updated human health risk assessment will be performed based on the results obtained from the soil vapor survey. Soil gas data generated is provided in Exhibit 7. The 2009 and updated 2010 Human Health Risk Assessment are provided in Exhibit 8.

The "Johnson and Ettinger model" (Johnson and Ettinger model; USEPA, 2004; Johnson and Ettinger, 1991) will be used to estimate the indoor air exposure point concentrations (EPCs) for benzene. This one-dimensional model is a Microsoft Excel-based spreadsheet model which incorporates both convection and diffusion mechanisms for estimating the transport of vapors emanating from soil and groundwater into indoor spaces. This model assumes that vapors only migrate upward from the impacted soils and directed exclusively into a prospective building. In addition, was assumed that vapors have already reached their peak concentration at the prospective floor slab of a building, regardless of the depth to the top of contamination. Other assumptions and limitations, as with all models, also exist.

__Task No. 6.5 – Report Preparation:__ Upon completion of Task Nos. 6.1 through 6.4, a comprehensive soil gas survey report was prepared. The report included, but was not be limited to, field and analytical methodology, subsurface soil conditions encountered, and analytical results. The report also included, based on the results obtained, a revised and updated human health risk assessment.

Task No. 7.0 – Site Conceptual Model (SCM) Update: The SCM was revised and updated to reflect the results from the offsite soil gas survey performed south of the site and installation of three additional offsite groundwater monitoring wells, and conclusions set forth in the updated Human Health Risk Assessment (Exhibit 9).

Task No. 8.0 – Phase III Report Preparation: Upon completion of Task Nos. 1.0 through 7.0, a comprehensive Phase III report contained herein was prepared.

4.0 HYDROGEOLOGIC CONDITIONS ENCOUNTERED

Evaluations of geologic and hydrogeologic conditions beneath the site have been performed since 1985 (Table 2-2). Current refinement of subsurface hydrogeologic conditions is based on data generated from the drilling of soil borings, former LNAPL recovery wells, and groundwater monitoring wells, and soil gas probes, as summarized on Table 4-1 (Exhibit 3). A summary of subsurface soil conditions encountered is presented in Table 4-2. Discussion of geologic and hydrogeologic subsurface conditions is presented below.

4.1 Geologic Conditions

4.1.1 Regional Geologic Conditions

Regionally, the site is underlain by a thin veneer of artificial fill overlying Holocene non-marine terrace and marine terrace deposits of the Upper Pleistocene Formation (Poland, et al., 1956 and 1959; Zielbauer, et al., 1962; Testa, et al., 1998). Terrace deposits consist predominantly of an unconsolidated, stratified, lateral and vertically discontinuous sequence of sand, silty sand, silt and clay. Contacts between soil types are commonly gradational. The shallow Pleistocene strata are subhorizontal with a gentle dip toward the southwest produced by active uplift and deformation of the adjacent southwest flank of the Signal Hill anticline along the Newport-Inglewood Structural Zone (NISZ; Cherry Hill Fault segment; Hauksson, 1987). The NISZ is about 40 miles in length and ranges from 1.5 to 2.5 miles in width, and is characterized by topographic highs separated by topographic lows or gaps. A schematic block diagram showing regional hydrogeologic conditions beneath the site, based on compilation of data obtained from adjacent water well logs, is presented in Figure 4-1. The site location relative to the NISZ is shown in Figure 4-2.

4.1.2 Site Specific Geologic Conditions:

The site is underlain by deposits of unconsolidated, stratified, laterally discontinuous sequences of fine-grained soil with an intervening fine-to coarse-grained sand layer. Predominantly coarse-grained soils consist of sand (SP) and silty sand (SM); whereas, subordinate fine-grained soils consists predominantly of silt (ML and MH) and to a lesser degree clay (CL). Subsurface geologic data is summarized in Table 4-2.

4.1.2.1 Western Parcel

Beneath the Western Parcel, relatively fine-grained sandy silt and clayey silt predominate from ground surface to approximately 10 to 20 feet bgs, with exception to an area in the southern portion of the Western Parcel, where relatively more permeable very fine to medium-grained sand and silty sand predominate (Figures 4-3 and 4-4). A very fine-grained, relatively low permeability clayey silt and silty clay is encountered at a depth of about 37 to 50 feet bgs (Figures 4-3 and 4-4). This fine-grained soil strata varies in maximum depth ranging from about 35 to 45 feet bgs, and is inferred to extend laterally beneath the Western Parcel.

4.1.2.2 Eastern Parcel

Geologic conditions beneath the Eastern Parcel are similar to those encountered beneath the Western Parcel. However, beneath the northern portion of the Eastern Parcel, relatively very fine to medium-grained sand and silty sand predominate, with a subordinate amount of very fine-grained sandy silt extending from the ground surface to about 12 feet below ground surface, in the northeastern portion of the Eastern Parcel (Figure 4-2). Very fine-grained, relatively impermeable clayey silt and silty clay is encountered beneath the southeast portion of the Eastern Parcel (Figure 4-3). These fine-grained soils are encountered at ground surface and extend to a depth of about 18 feet bgs, and at a depth of about 28 to 30 feet bgs.

4.2 Hydrogeologic Conditions

4.2.1 Regional Hydrogeologic Conditions

Shallow groundwater beneath the site is encountered within the Semi-perched Aquifer within the southern portion of the West Coast groundwater basin. Regionally, native groundwater in this area is deemed of poor quality as characterized by Piper, et al., (1953), Poland, et al., (1956), and Poland, et al., (1959). This in part is related to the NISZ which serves as a barrier, or partial barrier, to groundwater flow and saltwater intrusion, and overall groundwater flow (Figure 4-5). About 30 feet of differential head (water levels) have been reported across the NISZ within shallow water bearing zones. Data pertaining to regional shallow groundwater flow in the vicinity of the site is sparse. Chapter IV of the September 2007 Groundwater Basin Reports, Los Angeles County Coastal Plain Basins – West Coast Basin, shows regional groundwater flow at depth to be regionally toward the south-southwest. Only one regional contour is shown in the general vicinity of the site. Overall groundwater quality within the deep aquifers beneath the general vicinity of the site is poor and degraded, and deemed unusable due to high salinity (Figure 4-5).

4.2.2 Site Specific Hydrogeologic Conditions

A contour map of the unconfined piezometric level beneath the site is presented in Figure 4-6. A summary of gauging data generated since 1994 and hydrographs are provided in Exhibit 5, Parts I and II, respectively.

As of March 2011, overall groundwater occurred at elevations of 5.31 and 6.52 feet relative to mean sea level, respectively (depths ranging from 12.60, to 15.70 and 41.50 bgs, respectively), as measured in wells MW-8, and MW-1 and MW-3, respectively. Depth to groundwater ranged from 10.80 to 41.50 feet bgs, as measured in wells MW-19 and MW-3, respectively. Beneath the Eastern Parcel, groundwater was encountered at elevations of 5.39 and 5.50 feet (i.e., depths of 24.60 to 26.10 feet) as measured in wells MW-2 and MW-10, respectively. Overall, the elevation of the upper unconfined piezometric surface in comparison to June 2010 rose, with a change in fluctuation ranging from 0.8 to 2.0 feet as measured in wells MW-3 and MW-15, respectively. Groundwater flow beneath the site was generally toward the south-southeast, slight mounding beneath the southwest portion of the Western Parcel. Hydraulic gradient is on the order of 0.003 to 0.006 ft/ft.

During sampling, pH, dissolved oxygen (DO), temperature and Total Dissolved Solids (TDS) were field determined. pH ranged from 6.81 to 7.67 as measured in wells MW-3 and MW-2, respectively. DO ranged from 1.27 to 3.78 mg/L as measured in wells MW-8 and MW-18, respectively. Temperature ranged from 18.3 to 21.0 °C as measured in well MW-3, and wells MW-2 and MW-15, respectively. TDS ranged from 1222 to 4370 uS in wells MW-17 and MW-19, respectively.

4.3 Hydrocarbon Vapor Detection during Gauging

During sampling, relatively slight to strong hydrocarbon odors were noted in all wells with exception to well MW-18.

5.0 SOIL QUALITY

5.1 Soil Quality

5.1 Overview of Soil Analytical Program

Overall soil quality beneath the Western and Eastern Parcels was previously evaluated by Engineering Enterprises, Inc. (1988) and Testa Environmental Corporation (1999) (Figures 5-1 and 5-2). Additional assessment of soil quality conditions beneath the Eastern Parcel was performed in 2001(TEC, 2001). In addition, an environmental due diligence evaluation was performed in 2006 (Tetra Tech, Inc., 2006; Figure 5-3); this latter evaluation was performed for potential purchase and development considerations. To date, about 137 soil samples have been retrieved and submitted for chemical testing since subsurface related activities commenced in 1988. Additional soil sample were retrieved for chemical testing at 5-feet intervals during the drilling of wells MW-11 through MW-16). All soil sampling locations are presented in Figure 5-1. Soil boring logs are provided in Appendix E; whereas, laboratory reports on select soil samples are provided in Exhibit 4.

5.1.1 Engineering Enterprises, Inc. (1986-1988)

Subsurface assessment of soil quality conditions beneath the former Chemoil refinery site was initially performed by Engineering Enterprises, Inc. (EEI) in 1986 (EEI, 1986). EEI initially retrieved soil samples for chemical testing during drilling and subsequent installation of monitoring and former recovery wells (1987). Eight soil samples were obtained from a depth of 6-7.5 and 20-21.5 feet below ground surface during the drilling of MW-1, MW-4, R-5, MW-7 and MW-8 (only one sample from a depth of 20-21.5 was retrieved from MW-1 and MW-7). The samples were analyzed for oil and grease, phenols, total organic carbon, total organic halogens, selected volatile organics, pH and certain metals. Analytical results are summarized in Table 5-1.

In 1987, EEI (1988) retrieved thirty (30) representative soil samples from twenty-eight (28) locations at depths of 2 and 10 feet below ground surface. Within the confines of the Western Parcel, twelve (12) soil samples were retrieved from a depth of 2 feet bgs, and twenty-six (26) soil samples were retrieved from a depth of 10 feet bgs (Figures 5-2 and 5-3). The remaining three locations were situated on the Eastern Parcel. Analytical data for soil generated by EEI (1988) is also summarized in Table 5-1.

Diesel-and gasoline-affected soil was reported to occur beneath the majority of the central and southern portion of the Western Parcel. TPH as gasoline and diesel ranged up to 4,000 and 61,000 mg/Kg, respectively. Undifferentiated hydrocarbon concentrations ranged up to 12,000 mg/Kg. TRPH ranged up to 49,000 mg/Kg. The lateral extent of hydrocarbon impacted soil at the 2-and 10-foot depth is shown in Figures 5-4 and 5-5, respectively.

5.1.2 Testa Environmental Corporation (1999)

On-site Soil Sampling Program: In 1998, soil quality was further assessed by TEC (1998). This work included the drilling of three soil borings (B-1, B-2 and B-3 to depths of 35, 30 and 25 feet bgs, respectively). The boring locations selected reflected areas considered to be the most heavily impacted. Eighteen (18) soil samples were analyzed for TPH modified for gasoline and diesel, TRPH, BTEX, and MTBE. Three geoprobes were also drilled and representative soil samples retrieved off-site immediately south of the Western Parcel. Analytical results are summarized in Table 5-2.

TPHg ranged up to 1,130 mg/Kg, whereas, TPHd ranged up to 11,200 mg/Kg as reported for S-2-10 (depth of 10 feet bgs). TRPH ranged from 11 to 20,800 mg/Kg. BTEX ranged up to 1,560, 14,000, 60, 800 and 105,000 mg/Kg, respectively. MTBE was reported as non-detect in all samples analyzed.

In general, hydrocarbon concentration increased with depth with the highest concentrations occurring in close proximity to the water table. It was concluded that hydrocarbon-impacted soil extended from the ground surface downward to the water table beneath certain areas of the site, notably, within the central portion of the site. It was also concluded that the volume of hydrocarbon-impacted soil exceeding 100 mg/Kg, and occurring between ground surface and a depth of 10 feet bgs, was on the order of 56,000 cubic yards.

Off-site Probes: Three off-site geoprobes (GP-1, GP-2 and GP-3) were also drilled in June 1999. The geoprobes were drilled to a depth of approximately 20 feet bgs immediately south of the site along Wesley Drive. Soil samples were retrieved at five-foot intervals, and hydrocarbon soil vapors monitored at depths of 5 and 10 feet bgs. The soil samples were analyzed for TPHg, TPHd and VOCs. TPHd was reported at concentrations of 950, 220 and 170 mg/Kg in samples retrieved at 20 feet bgs in GP1, GP-2 and GP-3, respectively. TPHg was reported at 96 and 270 mg/Kg at depths of 15 and 20 feet bgs in GP-1, 500 mg/Kg at 20 feet bgs in GP-2, and 1.6 and 21 mg/Kg at depths of 15 and 20 feet bgs, respectively, in GP-3 (Table 5-2).

One groundwater sample was also retrieved from each geoprobe location. TRPH was reported at 19 and 33 mg/L in GP-2 and GP-3, respectively. TPHg was reported at 5.8, 16 and 2.4 mg/L in GP-1, GP-2 and GP-3, respectively.

In November 2001, subsurface assessment of the Eastern Parcel was performed by TEC (2001), and a remedial strategy subsequently developed, but not implemented. This subsurface assessment included the drilling of nine soil borings, and chemical testing of 69 soil samples.

5.1.3 Environmental Due Diligence Evaluation (Tetra Tech, 2006)

In 2006, the site was being considered for purchase and an environmental due diligence evaluation was performed (Tetra Tech, Inc., 2006). This evaluation was performed in May and June, 2006. The Phase I field characterization program performed in May 2006 included five soil borings, soil gas probes, and analytical testing for TPH (carbon range), VOCs with oxygenates, PAHs (select samples) and metals. The Phase II field characterization program performed in June 2006 included 17 soil borings to a depth of about 40 feet bgs, with an additional 5 soil borings on the Eastern Parcel with soil sampling at every 5 feet, one soil gas probe installed, and two groundwater samples retrieved. Boring locations drilled by Tetra Tech are shown in Figure 5-4. A summary of Tetra Tech's analytical results for soil is presented in Exhibit 4.

Tetra Tech reported similar soil conditions as previously described by TEC beneath the northern portion of the Western Parcel, with contamination (i.e., light to heavy range TPH concentrations, and significantly high benzene concentrations) observed in the central and southern portion of this area. Beneath the southern portion of the Western Parcel, soil contamination was also reported beneath this area, as previously discussed by TEC, ranging from the ground surface to groundwater.

Beneath the Eastern Parcel, localized TPH affected soil (and low level fuel related compounds with no benzene reported) was observed in the northwestern corner of this parcel, consistent with previous studies performed by TEC.

5.1.4 Phase II Characterization of Soil Quality (TEC, 2009)

As part of the Phase II additional site characterization efforts, 52 soil samples were retrieved during the drilling of six new monitoring wells (MW-11 through MW-16) for laboratory testing. Analytical results are summarized on Tables 5-3a, b and c).

On-site wells: Soil quality data generated for on-site borings/wells MW-11 and MW-13, were consistent with subsurface condition previously reported. Well MW-11 was a replacement well for former LNAPL recovery well R-4, and where hydrocarbon impacted soils were known to exist from the ground surface downward to the water table. As shown in Table 5-4a, GRO and DRO were reported ranging in concentrations from 1.9 to 8,800 mg/Kg and 1,100 to 23,000 mg/Kg, respectively, throughout the soil column. In addition, elevated benzene was reported at depths of 10, 15, 30, 40 and 45 feet bgs, at concentrations of 1100●, 3400, 8400, 7800 and 9400 ug/Kg, respectively. Elevated concentrations of other VOCs such as Ethylbenzene, 4-Isopropyltoluene, Isopropylbenzene, Naphthalene, n-Propylbenzene, sec-Butylbenzene, 1,2,4-Trimethylbenzene, 1,2,5-Trimethylbenzene and total Xylenes, were also reported throughout the soil sequence. Newly installed well MW-13 was a replacement well for former hydraulically downgradient well MW-7. No significant VOCs or semi-VOCs were reported with exception to Isopropylbenzene (980 to 640 ug/Kg), Naphthalene (2700 to 2300 ug/Kg), n-Propylbenzene (1200 to 850 ug/Kg) and sec-Butylbenzene (920 to 590 ug/Kg), which was encountered at depths of 25 to 30 feet bgs.

Off-site wells: During Phase II, four offsite wells were installed: well MW-12 situated immediately west of the site as a replacement of former on-site recovery well R-5, and from east to west, wells MW-14, MW-15 and MW-16, situated off-site along the southern perimeter of the southern portion of the Western Parcel.

For the area immediately west of the site (MW-12), GRO and DRO concentrations were reported from depths of 5 and from 20 to 30 feet bgs. GRO concentrations ranged from 130 to 960 mg/Kg; whereas, DRO concentrations was reported at 6400 at five feet bgs and from 20 to 30 feet bgs ranged from 260 to 650 mg/Kg. Semi-VOCs concentrations of Isopropylbenzene (1300 to 3000 ug/Kg), Naphthallene (1400 to 3600 ug/Kg), n-Propylbenzene (2000 to 4500 ug/Kg), n-Butylbenzene (750 ug/Kg) and sec-Butylbenzene (1100 to 2000), were reported primarily at depths of 25 to 30 feet bgs.

Along the southern perimeter and immediately south of the site, from east to west wells MW-14, MW-15 and MW-16, were drilled and installed. No hydrocarbon impacted soils were reported for samples retrieved from well MW-14, situated southeast of the Western Parcel. GRO and DRO concentrations ranged were reported in wells MW-15 and MW-16 from depths of 15 to 25 feet bgs. GRO concentrations ranged from 100 to 250 mg/Kg; whereas, DRO concentrations ranged from 10 to 1400 mg/Kg. For well MW-15, relatively low concentrations of Isopropylbenzene (320 to 350 ug/Kg), Naphthalene 580 (ug/Kg), and several semi-VOC, were reported primarily from 20 to 25 feet bgs. For well MW-16, sec-Butylbenzene was reported at 25 ug/Kg at a depth of 25 feet bgs, along with relatively low concentrations of several semi-VOCs.

5.1.5 Phase III Characterization of Soil Quality

During Phase III, three offsite wells were installed (MW-17, MW-18 and MW-19). During drilling of MW-17, soil samples were retrieved from depths of 2, 5, 10, 15, 20 and 25 feet bgs, and subsequently submitted to a state-certified laboratory and chemical tested for:

- Volatile organic compounds (VOCs) and oxygenated compounds using EPA Method 8260B;
- Semi-volatile organic compounds (SVOCs) using EPA Method 8270C; and
- Gasoline Range Organics (GRO) and Diesel Range Organics (DRO) using EPA Method 8015B.

A tabulation of analytical results for soil at these off-site well locations is summarized in Table 5-4, with laboratory reports provided in Exhibit 4.

In summary, GRO was reported at a concentration of 16● mg/Kg for the soil sample retrieved from a depth of 25 feet bgs. DRO was reported for soil samples retrieved from depths of 2, 15, 20 and 25, at concentrations of 150, 11, 170 and 100 mg/K. Only one volatile organic compound was reported at or above its respective analytical detection limit. MTBE was reported at concentrations of 5.3 and 6.5 ug/Kg, and at depths of 10 and 20 bgs, respectively.

Off-site well MW-18 was installed in December 2010, is situated west of the Western Parcel. and is the westernmost offsite well. No volatiles organics or hydrocarbon vapors were observed or detected during the drilling and installation of monitoring well MW-18. Thus, no chemical testing of soils retrieved during drilling was performed.

Off-site well MW-19 was installed in February 2011, is situated south of the site, and is the southernmost offsite well. In summary, GRO was reported at concentrations of 2.4 and 3.2 mg/Kg at depths of 15 and 20 feet bgs, respectively. DRO was reported at concentrations of 23, 28, 280 and 360 mg/Kg at depths of 5, 10, 15 and 20 feet bgs. No VOC or semi-VOCs were reported; however, the detection limit for the semi-VOCs was reported at concentration ranging from 330 to 1600 ug/Kg.

Overall, the vertical extent of hydrocarbon impacted soils as inferred from subsurface soil data generated to date is illustrated in Figures 5-5 and 5-6.

5.1.6 Soil Stockpiles Characterization

Approximately 50 soil stockpiles are situated on the Eastern Parcel. The stockpiles were derived from regarding activities when the former refinery and associated facilities were dismantled. Six representative soil samples (SS-EP-1 through SS-EP-6) were extracted and chemical testing was performed for Diesel Range Organics using a silica gel cleanup (DROr) using EPA Method 8015B(M), Gasoline Range Organics (GRO) using EPA Method 8015B(M), Volatile Organic Compounds (VOCs) using EPA Method 8260B, and Semi-volatile Organic Volatiles (semi-VOCs) using EPA Method 8270C. In addition, one composite sample (SS-EP-COMPOSITE) was analyzed for total metals using EPA Method 6010B and Mercury using EPA Method 7471A. Laboratory reports are provided in Exhibit 4.

No GRO or VOCs were reported at levels at of exceeding their respective analytical detection limit. Analytical results for DRO and semi-VOCs are summarized in Table 5-5. Notably, DRO was reported for all six samples ranging from 42 to 150 mg/Kg. Semi-VOCs reported, and their maximum concentration and respective sample, are:

Benzo(a)anthracene	68 ug/Kg	(SS-EP-2)
Benzo(a)pyrene	83 ug/Kg	(SS-EP-2)
Benzo(b)fluoranthene	100 ug/Kg	(SS-EP-2)
Benzo(g,h,i)perylene	95 ug/Kg	(SS-EP-2)
Benzo(k)fluorathene	27 ug/Kg	(SS-EP-2)
Chrysene	87 ug/Kg	(SS-EP-1)
Dibenz(a,h)anthacene	48 ug/Kg	(SS-EP-3)
Fluoranthene	110 ug/Kg	(SS-EP-2)
Indeno(1,2,3-cd)pyrene	57 ug/Kg	(SS-EP-2)
Phenanthrene	40 ug/Kg	(SS-EP-2)
Pyrene	140 ug/Kg)	(SS-EP-2)

No mercury was reported for the composite sample (SS-EP-COMPOSITE). Relatively low concentrations of certain metals were reported.

6.0 GROUNDWATER QUALITY

6.1 Groundwater Monitoring Network

Monitoring of groundwater quality beneath the former refinery site has been periodically performed since 1985, with a hiatus from monitoring between July 1999 and October 2001. Eight groundwater monitoring wells and three former LNAPL recovery wells were originally installed at the site. Following dismantling of the refinery from 1997 to 1998, monitoring well MW-7 and former recovery wells R-5 and R-6, were found to be no longer operational. These wells were inoperable following dismantling of the above ground facilities, and subsequently properly abandoned, and replaced. Former LNAPL recovery well R-4 was abandoned, and replaced by well MW-11. Former LNAPL recovery well R-5 was abandoned, and replaced with well mW-12, albeit relocated to the west along Gundry Avenue. Former recovery well R-6 was abandoned, and replaced by well MW-14, albeit relocated offsite and southeast of its former location. Former groundwater monitoring well MW-7 was abandoned and replaced by well MW-13.

Currently, the groundwater monitoring network is comprised of 16 wells. Seven monitoring wells (MW-1, MW-1A, MW-3, MW-8, MW-9, MW-11 and MW-13) are situated on the Western Parcel. Two groundwater monitoring wells, MW-2 and MW-10, are situated on the Eastern Parcel. Seven monitoring wells (MW-12, MW-14, MW-15, MW-16, MW-17, MW-18 and MW-19) are located off-site. The location of the groundwater monitoring and former recovery wells is presented in Figure 3-1. A summary of general well construction details is presented in Table 4-2. Dissolved hydrocarbons reported at concentrations at or above their respective analytical detection limit are summarized in Table 6-1. The lateral extents of dissolved hydrocarbons in groundwater are illustrated on Figures 6-1 through 6-4. Boring logs and associated groundwater monitoring construction details are provided in Exhibit 3. Graphs showing fluctuations of certain dissolved hydrocarbon constituents with time, and analytical reports for March 2011, are provided in Exhibit 6.

6.2 March 2011 Analytical Results

During the March 2011 groundwater sampling event, dissolved GRO was reported in 10 out of 16 wells, and ranged from non-detect to 0.35 to 19 mg/L in wells MW-17 and MW-19, respectively. Dissolved DRO was reported in 12 out of 16 wells, and ranged from 1.1 to 11 mg/L, in wells MW-17 and MW-11, respectively. Dissolved DROr using a silica gel rinse were reported in 10 out of 16 wells with concentrations of 0.3 to 1.7 mg/L, as measured in wells MW-10 and MW-11, respectively. The reduction in measured dissolved DROr using silica gel indicates appreciable ongoing biodegradation of petroleum hydrocarbons in groundwater (Table 6-2). Dissolved Benzene, Toluene, Ethylbenzene or Total Xylenes were reported in five out of 16 wells; MW-8, MW-9, MW-11, MW-12, and MW-19. Dissolved Benzene, however, was reported in only three on-site wells at concentrations of 46, 90 and 5100 ug/L in wells MW-8, MW-9 and MW-11, respectively.

MTBE was reported in five wells at concentrations of 11, 32, 19, 26 and 130 ug/L in wells MW-1A, MW-8, MW-13, MW-16 and MW-17, respectively. Tert-Butanol was reported in two wells; wells MW-8 and MW-12 at concentrations of 380 and 320 ug/L, respectively.

Eight other petroleum-related dissolved VOCs were reported. These constituents and their respective highest concentration reported, and associated wells, were:

Volatile Organic Compounds	Concentration (ug/L)
Isopropylbenzene	150 (MW-16)
4-Isopropylbenzene	25 (MW-12)
Naphthalene	420 (MW-12)
n-Butylbenzene	28 (MW-12)
n-Propylbenzene	130 (MW-12)
sec-Butylbenzene	35 (MW-12)
1,2,4-Trimethylbenzene	320 (MW-12)
1,2,5-Trimethylbenzene	730 (MW-12)

Table 6-2
Summary of Total Diesel and Gasoline Range Organics Analyses (mg/l)

Well No.	Location	DRO diesel	DRO diesel with silica gel rinse	GRO gasoline
MW-1	Western Parcel	5.5	0.65	ND(0.20)
MW-1A	Western Parcel	2.4	0.46	1.2
MW-2	Eastern Parcel	ND (0.20)	ND (0.20)	ND (0.20)
MW-3	Western Parcel	ND (0.21)	ND (0.20)	ND (0.20)
MW-8	Western Parcel	6.5	1.1	1.8
MW-9	Western Parcel	2.3	ND (0.20)	5.2
MW-10	Eastern Parcel	4.9	0.3	ND (0.20)
MW-11	Western Parcel	11	1.7	19
MW-12	Off-site to west	9.2	1	14
MW-13	Western Parcel	8.5	1.1	0.89
MW-14	Off-site to south	ND (0.20)	ND (0.20)	ND (0.20)
MW-15	Off-site to south	5.5	0.57	0.77
MW-16	Off-site to south	2.6	0.66	2.7
MW-17	Off-site to west	1.1	ND(0.20)	0.35
MW-18	Off-site to west	ND (0.20)	ND (0.20)	ND (0.20)
MW-19	Offsite to south	3.7	0.45	1.3

6.3 Lateral Extent of Dissolved Hydrocarbons in Groundwater

Dissolved hydrocarbons exist beneath the former refinery site, and have migrated hydraulically offsite toward the west, south and southwest, and marginally toward the east of the Western Parcel. GRO and DRO, including relatively low levels of DROr using a silica gel rinse, were reported in most perimeter wells and thus have migrated hydraulically off-site toward the south and southwest, marginally toward the west, and east of well MW-9. Dissolved Benzene component was reported in on-site wells MW-8, MW-9 and MW-11, and has marginally migrated toward the east of the Western Parcel, east of well MW-9. Certain dissolved VOCs have migrated off-site toward the south and southwest, west, and marginally toward the east of well MW-9.

Dissolved MTBE is noted in groundwater west and southwest of the Western Parcel. Relatively elevated dissolved MTBE in groundwater for offsite well MW-17, in addition to its presence being reported in select soil samples from this location, suggest an off-site source situated west or northwest of the site, with migration toward the east and beneath the former Chemoil refinery site. Dissolved Tert-Butanol appears to have migrated marginally off-site to the south and southwest.

6.4 Dissolved Hydrocarbon Plume Stability

Several factors can be considered in evaluating overall dissolved plume stability including source identification, migration potential, demonstrating of attenuation processes, plume mass stability, and absence of significant fluctuation of dissolved constituents, among other factors. With dismantling and removal of all site structures, no onsite and ongoing source exist. Despite residual hydrocarbon in subsurface soils beneath the site, individual wells versus time plots show attenuating trends, with minimal temporal changes evident. In addition, dissolved hydrocarbon constituents are an asymptotic phase, and the central plume mass (i.e., dissolved benzene) has generally remained consistent since asymptotic conditions have been achieved.

7.0 SOIL GAS PRESENCE

A soil gas survey was performed on four occasions: TEC (1999), Tetra Tech (2006), TEC (2009) as part of the Phase II additional site characterization efforts, and most recently TEC (2010) as part of Phase III activities. The locations of soil gas probes are shown in Figure 7-1.

The 2009 survey was performed in a manner consistent with the intent of two guidance documents: 1) CRWQCB-LAR Interim Guidance for Active Soil Gas Investigation, dated February 15, 1997, and 2) Department of Toxic Substances Control Advisory – Active Soil Gas Investigations, dated January 23, 2003. Previous soil gas surveys, and the current survey performed in 2009, are discussed below.

7.1 Previous Soil Gas Surveys

Previous Off-Site Soil Gas Assessment (TEC, 1999): To evaluate potential health risk to the residential areas situated immediately south of the former refinery site, an off-site hydrocarbon soil vapor assessment was previously performed on June 24, 1999 (TEC, 1999; Attachment I). Soil vapor testing was performed at three off-site locations situated immediately south of the former refinery site, between the site and residential areas to the south: geoprobe boring locations GP-1, GP-2 and GP-3, at depths of 5 and 10 feet below ground surface (Figure 7-1). No soil vapor was detected at or above the respective analytical detection limits for the series of target compounds analyzed using a modified EPA Methods 8010/8020.

Previous On-site Soil Gas Survey (Tetra Tech, Inc., 2006): Soil gas assessment was selective performed by Tetra Tech (2006) at five locations in the Northern (SB1, SB2 and SB4) and Southern (SB3) Western Parcels, and the Eastern (E1) Parcels (Figure 7-1; Attachment I). Samples were retrieved from depths of 5 and 15-16.5 feet below ground surface. VOCs detected included BTEX, MTBE, 1,2,4-Trimethylbenzene, and 1,3,5-Trimethylbenzene, consistent with VOCs reported in site soil and groundwater samples. A summary for the soil gas survey performed by Tetra Tech (2006) for is provided in Table 7-1.

7.2 Phase II Perimeter Soil Gas Survey (TEC, 2009)

A soil gas survey was performed along the perimeter of the site. A total of 22 probes were drilled, with samples retrieved at a depth of 5 and 15 feet bgs at each location. Constituents reported included Benzene, Cyclohexane, Ethylbenzene, Heptane, Isopropylbenzene, MTBE, Propylene, n-Propylbenzene, sec-Butylbenzene, Tert-Butylbenzene, Toluene, 1,2,4-Trimethylbenzene, 1,2,5-Trimethylbenzene, and Xylenes. These constituents are typical of those encountered on site. Laboratory reports are provided in Exhibit 7.

Southern Perimeter: Seven (7) probes were drilled on-site along the southern perimeter of the site (from east to west, SGP-1 through SGP-7, respectively), with soil gas samples retrieved a depths of 5 and 15 feet bgs. Elevated levels of soil gas were reported (Table 7-2a). Various components of elevated BTEX were reported for all probes with exception to westernmost SGP-7. Benzene concentrations where reported ranged from 36 to 2,100 ug/m^3 in SGP-1 and SGP-6 at a depth of 15 and 5 feet bgs, respectively.

Western Perimeter: Seven (7) probes were drilled off-site along the western perimeter of Gundry Avenue (from south to north, Gdy-1 through Gdy-7, respectively), with soil gas samples retrieved at depths of 5 and 15 feet bgs. Elevated levels of soil gas were reported (Table 7-2b). Various components of BTEX were reported for two locations: Gdy-1 and Gdy-4 at depths of 5 feet bgs, Benzene was reported at concentrations of 89 and 51 ug/m^3, respectively.

Eastern Perimeter: Four (4) probes were drilled off-site along the eastern perimeter of Walnut Avenue (from south to north, Wnt-1 through 4, respectively), with soil gas samples retrieved a depths of 5 and 15 feet bgs. Elevated levels of soil gas were reported (Table 7-2c). Various components of BTEX were reported for all four probe locations. Elevated Benzene was reported at depths of 5 and 15 feet bgs in Wnt-1 at concentrations of 43 and 5,600 ug/m^3, respectively, and Wnt-3 at a depth of five feet bgs at a concentration of 51 ug/m^3.

Northern Perimeter: Four (4) probes were drilled off-site along the northern perimeter of Hill Street. (from east to west, Hill-1 through 4, respectively), with soil gas samples retrieved a depths of 5 and 15 feet bgs. Elevated levels of soil gas were reported (Table 7-2d). Various components of BTEX were reported at three locations. Benzene was reported in Hill-1 and Hill-3 at depths of five feet bgs, and concentrations of 50 and 86 ug/m^3.

7.3 Phase III Offsite Soil Gas Survey South of the Subject Site (TEC, 2011)

Immediately south of the site, six additional soil gas probes were drilled (from west to east SGP-WD-1 through SGP-WD-6, respectively), with soil gas samples retrieved a depths of 5 and 10 feet below ground surface (bgs) with exception to SGP-WD-1 where a soil gas sample was retrieved at 5 feet bgs only due to a shallow water table (Figure 7-1). Analytical results for soil gas were compared to the California Human Health Screening Levels (CHHSLs) for soil gas for residential land use, and are summarized in Table 7-3. Laboratory reports are provided in Exhibit 7.

TABLE 7-3
SUMMARY OF SOIL GAS PROBE PARAMETERS SOUTH OF SITE

Soil Gas Probe Designation	Depth to Groundwater (feet bgs)	Sampling Depth (feet below ground surface)	Remarks
SGP-WD-1	7	5	
SGP-WD-2	12	5 5 (EPA TO-15) 10	
SGP-WD-3	12	5 10	
SGP-WD-4	12	5 10 10 (EPA TO-15))	
SGP-WD-5	12	5 10	 Tight soil.
SGP-WD-6	12	5 10	Tight soil. Tight soil.

Benzene was reported at concentrations of 56, 47, 39 and 71 ug/m^3 at a depth of 5 feet in SGP-WD-1, SGP-WD-2, SGP-WD-5 and SPG-WD-6. Benzene was also reported at a level of 53 ug/m^3 at a depth of 10 feet bgs in SGP-WD-6.

Total petroleum hydrocarbons (C4-C12 range volatile organic compounds) ranged from non-detect to 9,100 micrograms per liter (ug/L) as reported in the furthest probe SGP-WD-4 at a depth of ten feet.

8.0 LNAPL OCCURRENCE

8.1 Former LNAPL Occurrence and Residual Hydrocarbon Overview

Historically, LNAPL presence was previously reported as three separate and localized thin pools of limited lateral extent, overlying the shallow semi-perched saturated zone beneath the Western Parcel (Figure 8-1). Former Pool No. I encompassed former recovery well R-4 and monitoring well MW-9, and was characterized as a combination of naphtha, kerosene and gas-oil, with an API gravity ranging between 44.9 and 47.3, and total lead content between 10.9 and 198.2 ppm, as measured in R-4 and MW-9, respectively. Pool No. II was situated in the vicinity of former recovery well R-6, and characterized as heavy crude oil or lubricating oil, with an API gravity of 19.0. Pool No. III was situated in the vicinity of former recovery well R-5, and characterized as a combination of naphtha, kerosene and gas-oil, with an API gravity of 40.9 and a total lead content of 179.0 ppm. Physical characteristics of the former LNAPL pools are summarized in Table 8-1. LNAPL histograms are presented in Figures 8-2 through 8-4.

8.2 Former LNAPL Recovery Efforts

Operation of a LNAPL recovery program on the Western Parcel was initiated in former recovery wells R-4 and R-6 in March 1987, and R-5 in December 1988. The estimated volume of total fluids removed since July 1988 was approximately 253,902 barrels. Of this volume, an estimated volume of 27.9 barrels of LNAPL was recovered. The LNAPL recovery system was terminated in February 1994, with subsequent hand bailing of residual LNAPL in certain wells thereafter (notably, former recovery well R-4 and monitoring MW-9).

In December 2002, LNAPL was solely encountered in former LNAPL recovery well R-4. Apparent LNAPL thickness was measured at 2.65 feet, whereas, actual thickness was less than 0.51 feet. A light sheen was observed in monitoring well MW-9. These conditions were consistent with previous gauging events. The presence of residual LNAPL is not unusual reflecting a continued fluctuation in the unconfined piezometric level since the recovery wells were deemed no longer efficient for LNAPL recovery in 1994, and continued contact with hydrocarbon-saturated soil at the hydrocarbon affected soil above the water table and adjacent to the screened interval (termed the "smear zone"). Approximately 12.5 gallons of LNAPL had been periodically bailed from R-4 during the period between June and December, 2002.

8.3 Current LNAPL Occurrence

No LNAPL has been detected during gauging efforts in 2009 for all wells. In addition, no LNAPL has been detected during gauging of existing wells during the past several years of gauging.

9.0 DISCUSSION

For discussion purposes, elevated hydrocarbon constituents reported in respect to soil gas and groundwater have been compared with established screening levels and/or Maximum Contaminant Levels (MCLs). Such levels are not used at this time for the purpose of developing clean up levels for the site. Actual clean up levels will be developed in concert with preparation of a site closure strategy.

9.1 Soil Quality

Soil quality overall is consistent with past site operations. Notably, significant portions of the southern portion of the Western Parcel are impacted by hydrocarbons. Such impact extends from the existing ground surface vertically downward to the water table. Soils in the northern portion of the Western Parcel are not significantly impacted by the subsurface presence of residual hydrocarbons. The vertical extent of hydrocarbon impacted soil is shown in Figures 5-7 and 5-8. In addition, a small localized area in the northwestern corner of the Eastern Parcel was also delineated.

Soil quality data generated during Phase II and III related activities noted the presence of residual hydrocarbons in the vicinity of the piezometric level (i.e. water table) south of the site as reported in wells MW-12 and MW-17, situated west of the Western Parcel, and wells MW-15, MW-16, MW-17 and MW-19, situated south-southwest of the Western Parcel.

9.2 Groundwater Quality

Groundwater beneath the site is not a source or potential source for drinking water. The source(s) of dissolved hydrocarbon constituents in groundwater beneath the site is inferred to be related to the presence of former LNAPL pools and associated "smear" zones (Figure 9-1), with exception to dissolved MTBE which is inferred to have migrated onsite from an off-site source west-northwest of the site. Residual hydrocarbons are notably evident at the piezometric surface and within the "smear zone" which developed in part by a fluctuating water table over time, and past depression of the water table during LNAPL recovery activities (Testa and Winegardner, 2000; Testa, 1994).

Recent published studies (Zemo and Foote, 2003) report that Total Petroleum Hydrocarbons (TPH) when used as a regulatory instrument may not accurately differentiate between dissolved petroleum hydrocarbons related to LNAPL or "smear" zones and non-dissolved petroleum or polar non-hydrocarbon compounds. This differentiation is important should TPH ultimately be used for regulatory decision-making because the comparison of total concentration data to the regulatory criteria may not be correct when simply analyzing for TPH. Results reported for groundwater samples retrieved in December 2008, and included in the *Report on Phase I Additional Subsurface Assessment*, demonstrated that natural biodegradation of residual hydrocarbons within the "smear zone" is occurring.

To further clarify the actual concentration of dissolved DRO and GRO in groundwater, and the ongoing process of natural attenuation via biodegradation, DRO and GRO were also analyzed with a silica gel rinse. This data indicated that the vast majority of the mass measured in groundwater as "DRO" are polar non-hydrocarbons, likely resulting from the intrinsic biodegradation of the petroleum. The fact that the polar biodegradation byproducts are measured as "DRO" has been widely known since the mid-1990s, and use of the silica gel rinse removes or reduces these polar compounds. The petroleum hydrocarbons are non-polar and are not removed by the silica gel rinse. The DRO with silica gel rinse more closely represents the concentration of dissolved petroleum hydrocarbons in the groundwater. Evaluation of chromatograms indicates that minor amounts of non-dissolved diesel are present in the groundwater samples, likely from minor amounts of petroleum affected soil within the sample. Therefore, the actual concentration of dissolved petroleum constituents in the groundwater is likely lower than the concentrations reported herein.

The majority of dissolved hydrocarbon constituents reported appear to be related to past site operations, and locations of former LNAPL pools. However, the presence of dissolved MTBE is inferred to be derived from an off-site source east-northeast of the Western Parcel.

9.3.1 Soil Gas Presence

Analytical results generated in 2009 for soil gas were compared to the California Human Health Screening Levels (CHHSLs) for soil gas for commercial land use. CHHSLs established for commercial or industrial land use for Benzene, Toluene, Xylenes and MTBE are 122, 378,000, 887,000, and 13,400 ug/m^3, respectively. Analytical results for soil gas were compared to the California Human Health Screening Levels (CHHSLs) for soil gas for commercial land use.

Elevated volatiles were encountered during drilling and periodic sampling. As part of the soil gas survey, elevated Benzene levels exceeding the established CHHSL of 122 ug/m^3 for commercial/industrial land use were reported at several locations along the southern perimeter of the site, and locally along the eastern portion of the site. Benzene levels ranged up to 2,100, 5,600, 89 and 86 ug/m^3 along the southern, eastern, western and northern perimeter. Other elevated constituents included the localized presence of Ethylbenzene along the southern perimeter, and 1,2-Dichloroethan, 1,2-Dichloroethane, Ethylbenzene, MTBE and Toluene, beneath portions of Walnut Avenue. Other elevated concentrations of certain constituents that do not have established screening levels were also reported in certain areas. The source of elevated benzene at localized areas along Hill Street is uncertain.

In 2010, south of the site, Benzene was the only carcinogen reported at concentrations in soil gas to be above the CHHSL of 36.2 ug/m^3 at certain locations off-site south of the site. Only Benzene marginally exceeded the CHHSL of 36.2 ug/m^3 for residential land use. Benzene was reported at concentrations of 56, 47, 39 and 71 ug/m^3 at a depth of 5 feet in SGP-WD-1, SGP-WD-2, SGP-WD-5 and SPG-WD-6. Benzene was also reported at a level of 53 ug/m^3 at a depth of 10 feet bgs in SGP-WD-6. Benzene in soil gas essentially occurs along most of the southern perimeter and southwest corner of the site, and exists off-site immediately southwest of the site.

Previous soil gas data detected benzene at 2,100 ug/m^3 (soil gas probe Sgp-6-5), which was used in the 2009 risk assessment. Based on additional soil gas survey data for benzene off-site and south of the site, the highest concentration was reported to be 71 ug/m^3 a factor of about 30 times lower in comparison to what was reported on-site. Thus, the estimated risk is much lower than previously reported in the 2009 Phase II report.

9.4 LNAPL Occurrences

No detectable LNAPL was encountered during gauging of both onsite and off-site wells. All recoverable LNAPL has been recovered, and no further action is required in regards to LNAPL.

10.0 HUMAN HEALTH RISK ASSESSMENT

The Human Health Risk Assessment was performed by E^{x}ponent in 2009 and updated in 2010 (Exhibit 8). The March 2010 soil vapour sampling locations that are included in this evaluation are farther south of the southern boundary and closer to the offsite residents than the sampling locations that were evaluated previously along the southern boundary. The evaluation was based on maximum detected concentrations, which were assumed to be representative of concentrations to which offsite residents would be exposed for 30 years. This latter assumption is particularly conservative, because aromatic hydrocarbons are known to biodegrade over time. Estimated noncancer hazard indexes, assuming a residential scenario, were below levels generally considered acceptable by regulatory agencies.

Potential noncancer risks are expressed in terms of a hazard index, and potential cancer risks are expressed in terms of a theoretical lifetime excess cancer risk. A hazard index less than 1 is generally considered acceptable by regulatory agencies. Theoretical lifetime excess cancer risks are generally compared to an acceptable risk range of 1×10^{-6} to 1×10^{-4}; cancer risk estimates of less than 1×10^{-6} are considered to be so low as to warrant no further investigation or analysis.

Hazard risk values generated are all below 1, indicating that potential exposure to chemicals of potential concern in indoor air by residents adjacent to the southern property boundary pose a negligible noncancer health risk under the conditions evaluated. The estimated excess cancer risks are at or below the generally acceptable risk range based on maximum Chemicals of Potential Concern (COPC) concentrations and one-half the minimum detection limits in soil vapor, but they fall in the lower end of the risk range based on maximum COPC concentrations and one-half the maximum detection limits in soil vapor, or based on maximum COPC concentrations in groundwater. Methylene chloride was not detected in soil vapor but was the largest contributor to the estimated cancer risk based on soil vapor data. The only chemical detected in soil vapor that contributed to the estimated cancer risk is benzene, which was detected at concentrations that are roughly 30 to 40 times lower than the maximum detected concentration reported in the previous evaluation using 2009 soil vapor data along the southern boundary.

The estimated excess cancer risks based on the maximum detected benzene concentrations are well below the generally acceptable risk range ($6\times10-7$ and $3\times10-7$, at 5 and 10 ft bgs, respectively). Finally, estimated risks based on groundwater data are driven by naphthalene, which was not detected in the soil vapor samples. Estimated health risks based on groundwater data are likely more uncertain than those based on soil vapor data because of additional assumptions required in the model and potential biodegradation of the COPCs in the vadose zone.

In summary, potential soil vapor intrusion is not likely to be of concern for current off-site residents south of the property boundary.

11.0 SITE CONCEPTUAL MODEL

A Site Conceptual Model (CSM) was formulated based on the known history of the site and subsurface geologic, hydrogeologic and environmental conditions encountered and subsequently reported since the late 1980s. The SCM is divided into four sections, and is aimed at integration and interpretation of all data obtained to date, and is dynamic, that being, changes as additional information and data is generated and interpreted. The four sections discuss 1) introductory information, 2) summary of previous work, 3) evaluation of the lateral and vertical extent, and stability, of subsurface hydrocarbons, and 4) a preliminary assessment of subsurface hydrocarbons impact on public health and the environment. The updated SCM is provided in Exhibit 9.

12.0 CONCLUSIONS, RECOMMENDATIONS AND PLANNED ACTIVITIES

Based on the information and results presented herein, the following conclusions are offered:

- The site is underlain by deposits of unconsolidated, stratified, laterally discontinuous sequences of fine-grained soil with an intervening fine-to coarse-grained sand layer, which is exists at depths from about 13 feet to 45 feet below ground surface (bgs);

- Groundwater beneath the site is not a source or potential source for drinking water. As of March 2011, overall groundwater occurred at elevations of 5.31 and 6.52 feet relative to mean sea level, respectively (depths ranging from 12.60, to 15.70 and 41.50 bgs, respectively), as measured in wells MW-8, and MW-1 and MW-3, respectively. Depth to groundwater ranged from 10.80 to 41.50 feet bgs, as measured in wells MW-19 and MW-3, respectively. Beneath the Eastern Parcel, groundwater was encountered at elevations of 5.39 and 5.50 feet (i.e., depths of 24.60 to 26.10 feet) as measured in wells MW-2 and MW-10, respectively. Groundwater flow beneath the site was generally toward the south-southeast, with slight mounding beneath the southwest portion of the Western Parcel. Hydraulic gradient is on the order of 0.003 to 0.006 ft/ft.

- During sampling, relatively slight to strong hydrocarbon odors were noted in all wells with exception to well MW-18. No Light Non-aqueous phase liquid (LNAPL) hydrocarbons were encountered during gauging and sampling of the wells;

- In regards to overall soil quality, additional characterization activities associated with Phases I, II and III, were consistent with past site operations and reported results. Notably, significant portions of the soil column beneath the Western Parcel are impacted by residual hydrocarbons. Such impact extends from the existing ground surface vertically downward to the water table, notably, beneath the southern portion of the Western Parcel. The northern portion of the Western Parcel is least impacted by the subsurface presence of residual hydrocarbons. In addition, a small localized area in the northwestern corner of the Eastern Parcel was also delineated.

  Soil quality data generated during Phase II and III related activities noted the presence of residual hydrocarbons in the vicinity of the piezometric table south of the site as reported in wells MW-12 and MW-17, situated west of the Western Parcel, and wells MW-15, MW-16, MW-17 and MW-19, situated south-southwest of the Western Parcel;

- During the March 2011 groundwater sampling event, dissolved GRO was reported in 10 out of 16 wells, and ranged from non-detect to 0.35 to 19 mg/L in wells MW-17 and MW-19, respectively. Dissolved DRO was reported in 12 out of 16 wells, and ranged from 1.1 to 11 mg/L, in wells MW-17 and MW-11, respectively. Dissolved DROr using a silica gel rinse were reported in 10 out of 16 wells with concentrations of 0.3 to 1.7 mg/L, as measured in wells MW-10 and MW-11, respectively. These data confirm that most of the materials being measured in groundwater as "DRO" are polar non-hydrocarbons likely resulting from intrinsic biodegradation of the petroleum. The DRO with silica gel cleanup more closely represents the concentrations of dissolved petroleum hydrocarbons in the groundwater. Dissolved Benzene, Toluene, Ethylbenzene or Total Xylenes were reported in five out of 16 wells; MW-8, MW-9, MW-11, MW-12, and MW-19. Dissolved Benzene, however, was reported in only three on-site wells at concentrations of 46, 90 and 5100 ug/L in wells MW-8, MW-9 and MW-11, respectively.

  MTBE was reported in five wells at concentrations of 11, 32, 19, 26 and 130 ug/L in wells MW-1A, MW-8, MW-13, MW-16 and MW-17, respectively. Tert-Butanol was reported in two wells; wells MW-8 and MW-12 at concentrations of 380 and 320 ug/L, respectively.

Eight other petroleum-related dissolved VOCs were reported. These constituents and their respective highest concentration reported, and associated wells, were:

Volatile Organic Compounds	Concentration (ug/L)
Isopropylbenzene	150 (MW-16)
4-Isopropylbenzene	25 (MW-12)
Naphthalene	420 (MW-12)
n-Butylbenzene	28 (MW-12)
n-Propylbenzene	130 (MW-12)
sec-Butylbenzene	35 (MW-12)
1,2,4-Trimethylbenzene	320 (MW-12)
1,2,5-Trimethylbenzene	730 (MW-12)

- Dissolved hydrocarbons exist beneath the former refinery site, and have migrated hydraulically offsite toward the west, south and southwest, and marginally toward the east of the Western Parcel. GRO and DRO, including relatively low levels of DROr using a silica gel rinse, were reported in most perimeter wells and thus have migrated hydraulically off-site toward the south and southwest, marginally toward the west, and east of well MW-9. Dissolved Benzene component was reported in on-site wells MW-8, MW-9 and MW-11, and has marginally migrated toward the east of the Western Parcel, east of well MW-9. Certain dissolved VOCs have migrated offsite toward the south and southwest, west, and marginally toward the east of well MW-9.

  Dissolved MTBE is noted in groundwater west and southwest of the Western Parcel. Relatively elevated dissolved MTBE in groundwater for offsite well MW-17, in addition to its presence being reported in select soil samples from this location, suggest an off-site source situated west or northwest of the site, with migration toward the east and beneath the former Chemoil refinery site. Dissolved Tert-Butanol appears to have migrated marginally off-site to the south and southwest.

- A soil gas survey was performed in 2009 along the perimeter of the site, and updated in 2010 to extend our understanding of soil gas presence and risk off-site and south of the site. Hazard risk values generated were all below 1, indicating that potential exposure to chemicals of potential concern in indoor air by residents adjacent to the southern property boundary pose a negligible noncancer health risk under the conditions evaluated. The estimated excess cancer risks were at or below the generally acceptable risk range based on maximum Chemicals of Potential Concern (COPC) concentrations and one-half the minimum detection limits in soil vapor, but they fall in the lower end of the risk range based on maximum COPC concentrations and one-half the maximum detection limits in soil vapor, or based on maximum COPC concentrations in groundwater. Methylene chloride was not detected in soil vapor but was the largest contributor to the estimated cancer risk based on soil vapor data. The only chemical detected in soil vapor that contributed to the estimated cancer risk was Benzene, which was detected at concentrations that are roughly 30 to 40 times lower than the maximum detected concentration reported in the previous evaluation using 2009 soil vapor data along the southern boundary.

  The estimated excess cancer risks based on the maximum detected benzene concentrations were well below the generally acceptable risk range (6×10–7 and 3×10–7, at 5 and 10 ft bgs, respectively). Finally, estimated risks based on groundwater data were driven by naphthalene, which was not detected in the soil vapor samples. Estimated health risks based on groundwater data are likely more uncertain than those based on soil vapor data because of additional assumptions required in the model and potential biodegradation of the COPCs in the vadose zone.

In summary, potential soil vapor intrusion is not likely to be of concern for current off-site residents south of the property boundary.

The following recommendations are offered:

- Quarterly groundwater gauging and sampling will continue, with the next events to be performed in June, September and December 2011, with resultant reports submitted in July and October 2011, and January 2012;

- Based on analysis of results of soil, groundwater, and soil gas testing, no interim remedial response is deemed necessary.

- On-site clean-up goals will be proposed once future site use is determined, and development plans are formulated.

- Upon review of the report presented herein by the CRWQCB-LAR, a meeting with the CRWQCB-LAR will be held to discuss results and salient elements for development of a site closure strategy with consideration of subsequent site use and scheduling.

- A site closure strategy should be developed in consideration of comments received from the CRWQCB-LAR following their review of the Phase III report, updated Human Health Risk Assessment, and updated Site Conceptual Model.

13.0 REFERENCES

California Regional Water Quality Control Board, 1996, Interim Site Assessment & Cleanup Guidebook - Preventing Groundwater Pollution: Assessing your Site for Chemical Contaminants: Los Angeles and Ventura Counties, Region 4, May 1996.

Engineering Enterprises, Inc., 1986, Groundwater Assessment Phase II Report: unpublished report dated August 11, 1986, prepared for MacMillan Ring-Free Refinery, Signal Hill, California.

Engineering Enterprises, Inc., 1988, Biannual Interim Report, July, 1988, MacMillan Ring-Free Refinery: unpublished report dated July 10, 1988, prepared for MacMillan Ring-Free Refinery, Signal Hill, California.

GEM, K2 and Tetra Tech, 2006, Environmental Due Diligence, Former Chemoil Refinery, Signal Hill, California, unpublished report dated June 30, 2006.

Hauksson, E., 1987, Seismotectonics of the Newport-Inglewood Fault Zone in the Los Angeles Basin, Southern California: Bulletin of the Seismological Society of America, v. 77, no. 2, pp. 539-561.

Piper, A. M., Garrett, A. A., et al., 1953, Native and Contaminated Groundwater in the Long Beach – Santa Ana Area, California: United States Geological Survey Water Supply Paper No. 1136, 320p.

Poland, J. F., Piper, A. M., et al., 1956, Ground Water Geology of the Coastal Zone, Long Beach – Santa Ana Area, California: United States Geological Survey Water Supply Paper 1109, 162p.

Poland, J. F., 1959, Hydrology of the Long Beach – Santa Ana Area, California: United States Geological Survey Water Supply Paper 1471, 257p.

Testa Environmental Corporation, 1999, Report on Additional Subsurface Assessment, August 1999, Former Chemoil Refinery, Signal Hill, California: unpublished report dated November 12, 1999, prepared for the Signal Hill Holding Corporation.

Testa Environmental Corporation, 2001a, Proposed Workplan for Subsurface Assessment, Eastern Parcel, Former Chemoil Refinery, Signal Hill, California: unpublished report prepared for the Signal Hill Holding Corporation.

Testa Environmental Corporation, 2001b, Proposed Workplan for Additional Subsurface Assessment, Western Parcel, Former Chemoil Refinery, Signal Hill, California: unpublished report dated November 18, 2001, prepared for the Signal Hill Holding Corporation.

Testa Environmental Corporation, 2001c, Report on Additional Subsurface Assessment, Former Chemoil Refinery – Eastern Parcel, Signal Hill, California: Former Chemoil Refinery, Signal Hill, California: unpublished report dated December 14, 2001, prepared for the Signal Hill Holding Corporation.

Testa Environmental Corporation, 2002a, Report on Quarterly Groundwater Quality, July 2002, Former Chemoil Refinery, Signal Hill, California: unpublished report dated July 15, 2002, prepared for the Signal Hill Holding Corporation.

Testa Environmental Corporation, 2002b, Revised Workplan for Subsurface Assessment, July 2002, Former Chemoil Refinery, Signal Hill, California: unpublished report dated July 24, 2002, prepared for the Signal Hill Holding Corporation.

Testa Environmental Corporation, 2002c, Report on Quarterly Groundwater Monitoring, October 2002, Former Chemoil Refinery, Signal Hill, California: unpublished report dated October 15, 2002, prepared for the Signal Hill Holding Corporation.

Testa Environmental Corporation, 2003a, Report on Quarterly Groundwater Monitoring, January 2003, Former Chemoil Refinery, Signal Hill, California: unpublished report dated January 15, 2003, prepared for the Signal Hill Holding Corporation.

Testa Environmental Corporation, 2003b, Report on Quarterly Groundwater Monitoring, March 2003, Former Chemoil Refinery, Signal Hill, California: unpublished report dated March 15, 2003, prepared for the Signal Hill Holding Corporation.

Testa Environmental Corporation, 2003c, Report on Quarterly Groundwater Monitoring, July 2003, Former Chemoil Refinery, Signal Hill, California: unpublished report dated July 15, 2003, prepared for the Signal Hill Holding Corporation.

Testa Environmental Corporation, 2003d, Report on Quarterly Groundwater Monitoring, October 2003, Former Chemoil Refinery, Signal Hill, California: unpublished report dated October 15, 2003, prepared for the Signal Hill Holding Corporation.

Testa Environmental Corporation, 2004a, Report on Quarterly Groundwater Monitoring, January 2004, Former Chemoil Refinery, Signal Hill, California: unpublished report dated January 15, 2004, prepared for the Signal Hill Holding Corporation.

Testa Environmental Corporation, 2004b, Report on Quarterly Groundwater Monitoring, April 2004, Former Chemoil Refinery, Signal Hill, California: unpublished report dated April 15, 2004, prepared for the Signal Hill Holding Corporation.

Testa Environmental Corporation, 2004c, Report on Quarterly Groundwater Monitoring, July 2004, Former Chemoil Refinery, Signal Hill, California: unpublished report dated July 15, 2004, prepared for the Signal Hill Holding Corporation.

Testa Environmental Corporation, 2004d, Report on Quarterly Groundwater Monitoring, October 2004, Former Chemoil Refinery, Signal Hill, California: unpublished report dated October 15, 2004, prepared for the Signal Hill Holding Corporation.

Testa Environmental Corporation, 2005a, Report on Quarterly Groundwater Monitoring, January 2005, Former Chemoil Refinery, Signal Hill, California: unpublished report dated January 15, 2005, prepared for the Signal Hill Holding Corporation.

Testa Environmental Corporation, 2005b, Report on Quarterly Groundwater Monitoring, April 2005, Former Chemoil Refinery, Signal Hill, California: unpublished report dated April 15, 2005, prepared for the Signal Hill Holding Corporation.

Testa Environmental Corporation, 2005c, Report on Quarterly Groundwater Monitoring, July 2005, Former Chemoil Refinery, Signal Hill, California: unpublished report dated July 15, 2005, prepared for the Signal Hill Holding Corporation.

Testa Environmental Corporation, 2005d, Report on Quarterly Groundwater Monitoring, October 2005, Former Chemoil Refinery, Signal Hill, California: unpublished report dated October 15, 2005, prepared for the Signal Hill Holding Corporation.

Testa Environmental Corporation, 2006a, Report on Quarterly Groundwater Monitoring, January 2006, Former Chemoil Refinery, Signal Hill, California: unpublished report dated January 15, 2006, prepared for the Signal Hill Holding Corporation.

Testa Environmental Corporation, 2006b, Report on Quarterly Groundwater Monitoring, April 2006, Former Chemoil Refinery, Signal Hill, California: unpublished report dated April 15, 2006, prepared for the Signal Hill Holding Corporation.

Testa Environmental Corporation, 2006c, Report on Quarterly Groundwater Monitoring, July 2006, Former Chemoil Refinery, Signal Hill, California: unpublished report dated July 15, 2006, prepared for the Signal Hill Holding Corporation.

Testa Environmental Corporation, 2006d, Report on Quarterly Groundwater Monitoring, October 2006, Former Chemoil Refinery, Signal Hill, California: unpublished report dated October 15, 2006, prepared for the Signal Hill Holding Corporation.

Testa Environmental Corporation, 2007a, Report on Quarterly Groundwater Monitoring, January 2007, Former Chemoil Refinery, Signal Hill, California: unpublished report dated January 15, 2007, prepared for the Signal Hill Holding Corporation.

Testa Environmental Corporation, 2007b, Report on Quarterly Groundwater Monitoring, April 2007, Former Chemoil Refinery, Signal Hill, California: unpublished report dated April 15, 2007, prepared for the Signal Hill Holding Corporation.

Testa Environmental Corporation, 2007c, Report on Quarterly Groundwater Monitoring, July 2007, Former Chemoil Refinery, Signal Hill, California: unpublished report dated July 15, 2007, prepared for the Signal Hill Holding Corporation.

Testa Environmental Corporation, 2007d, Report on Quarterly Groundwater Monitoring, October 2007, Former Chemoil Refinery, Signal Hill, California: unpublished report dated October 15, 2007, prepared for the Signal Hill Holding Corporation.

Testa Environmental Corporation, 2008a, Report on Quarterly Groundwater Monitoring, January 2008, Former Chemoil Refinery, Signal Hill, California: unpublished report dated January 15, 2008, prepared for the Signal Hill Holding Corporation.

Testa Environmental Corporation, 2008b, Report on Quarterly Groundwater Monitoring, March 2008, Former Chemoil Refinery, Signal Hill, California: unpublished report dated March 15, 2008, prepared for the Signal Hill Holding Corporation.

Testa Environmental Corporation, 2008c, Report on Quarterly Groundwater Monitoring, July 2008, Former Chemoil Refinery, Signal Hill, California: unpublished report dated July 15, 2008, prepared for the Signal Hill Holding Corporation.

Testa Environmental Corporation, 2008d, Report on Quarterly Groundwater Monitoring, October 2008, Former Chemoil Refinery, Signal Hill, California: unpublished report dated October 15, 2008, prepared for the Signal Hill Holding Corporation.

Testa Environmental Corporation, 2009a, Report on Phase I Additional Site Characterization, January 2009, Former Chemoil Refinery, Signal Hill, California: unpublished report dated January 15, 2009, prepared for the Signal Hill Holding Corporation.

Testa Environmental Corporation, 2009b, Report on Quarterly Groundwater Monitoring, April 2009, Former Chemoil Refinery, Signal Hill, California: unpublished report dated April 15, 2009, prepared for the Signal Hill Holding Corporation.

Testa Environmental Corporation, 2009c, Report on Phase II Additional Site Characterization: September 2009, Former Chemoil Refinery, Signal Hill, California: unpublished report dated September 30, 2009, prepared for the Signal Hill Holding Corporation.

Testa Environmental Corporation, 2009d, Report on Quarterly Groundwater Monitoring, October 2009, Former Chemoil Refinery, Signal Hill, California: unpublished report dated October 15, 2009, prepared for the Signal Hill Holding Corporation.

Testa Environmental Corporation, 2010a, Report on Quarterly Groundwater Monitoring, January 2010, Former Chemoil Refinery, Signal Hill, California: unpublished report dated January 15, 2010, prepared for the Signal Hill Holding Corporation.

Testa Environmental Corporation, 2010b, Report on Quarterly Groundwater Monitoring, April 2010, Former Chemoil Refinery, Signal Hill, California: unpublished report dated April 15, 2010, prepared for the Signal Hill Holding Corporation.

Testa Environmental Corporation, 2010c, Report on Off-Site Soil Gas Survey, April 2010, Former Chemoil Refinery, Signal Hill, California: unpublished report dated April15, 2010, prepared for the Signal Hill Holding Corporation.

Testa Environmental Corporation, 2010d, Report on Updated Human Health Risk Assessment, May 2010, Former Chemoil Refinery, Signal Hill, California: unpublished report dated May10, 2010, prepared for the Signal Hill Holding Corporation.

Testa Environmental Corporation, 2010e, Report on Quarterly Groundwater Monitoring, July 2010, Former Chemoil Refinery, Signal Hill, California: unpublished report dated July 15, 2010, prepared for the Signal Hill Holding Corporation.

Testa Environmental Corporation, 2010f, Report on Quarterly Groundwater Monitoring, October 2010, Former Chemoil Refinery, Signal Hill, California: unpublished report dated October 15, 2010, prepared for the Signal Hill Holding Corporation.

Testa Environmental Corporation, 2011a, Report on Quarterly Groundwater Monitoring, January 2011, Former Chemoil Refinery, Signal Hill, California: unpublished report dated January 15, 2011, prepared for the Signal Hill Holding Corporation.

Testa Environmental Corporation, 2011b, Report on Quarterly Groundwater Monitoring, APRIL 2011, Former Chemoil Refinery, Signal Hill, California: unpublished report dated April 15, 2011, prepared for the Signal Hill Holding Corporation.

The Source Group, 1999, Workplan for Closure Sampling at the East Parcel, Former Chemoil Refinery, Signal Hill, California: Unpublished analytical report for Environmental Investments, LLC.

Zielbauer, E. J. and others, 1962, Dominguez Gap Barrier Project, Geologic Investigation: Los Angeles Flood Control District, 30p.

14.0 LIMITATIONS

The observations, conclusions and recommendations presented in this report are based upon:

- Review of data and referenced material noted in this report;
- Observations of TEC personnel and representatives during drilling of soil and soil gas borings, installation of groundwater monitoring wells, gauging and groundwater sampling, and other field-related activities performed between April 2009 and March 2011; and
- Review of results of laboratory analyses performed on select groundwater samples as reported by a California State-certified analytical laboratory.

It is possible that variations in soil and groundwater conditions may exist beyond the limits of or between the data points and locations explored during this assessment. Also, changes may occur in surface and groundwater conditions encountered in the site area at some time in the future due to variations in rainfall, temperature, regional water level fluctuations and usage, or other factors, which may ultimately impact the conditions discussed herein.

The services performed by TEC have been conducted in a manner consistent with the level of care and skill ordinarily exercised by members of the profession currently practicing under similar conditions. No other warranty, expressed or implied, is made.

TABLE 2-1
SUMMARY OF PREVIOUS REPORTS

Date	Report Title
Engineering Enterprises, Inc. (EEI	
Dec-85	Groundwater Assessment Phase I Report, MacMillan Ring-Free Oil Company
Aug-86	Groundwater Assessment Phase II Report, MacMillan Ring-Free Oil Company
Oct-86	Groundwater Assessment Phase II Report Clarifications
Mar-87	First Quarterly Groundwater Monitoring Report, MacMillan Ring-Free Refinery, Signal Hill, CA
Apr-87	Second Quarterly Groundwater Monitoring Report, MacMillan Ring-Free Refinery, Signal Hill, CA
Sep-87	Third Quarterly Groundwater Monitoring Report, MacMillan Ring-Free Refinery, Signal Hill, CA
Jan-88	Fourth Quarterly Groundwater Monitoring Report, MacMillan Ring-Free Refinery, Signal Hill, CA
Jan-88	Revised Workplan to Address Outstanding Issues. California Regional Water Quality Control Board File No 85-15, MacMillan Ring-Free Refinery
Jul-88	Biannual Interim Monitoring Report, MacMillan Ring-Free Refinery, Signal Hill, CA
Jan-89	Biannual Interim Monitoring Report, January 1989, Chemoil Refinery, Signal Hill, CA
Jul-89	Biannual Interim Monitoring Report, July 1989, Chemoil Refinery, Signal Hill, CA
Jan-90	Biannual Interim Monitoring Report. January 1990. Chemoil Refinery, Signal Hill, CA
Applied Environmental Services, Inc. (AES)	
Jul-90	Biannual Interim Monitoring Report, July 1990, Chemoil Refinery, Signal Hill, CA
Jan-91	Biannual Interim Monitoring Report, January 1991, Chemoil Refinery, Signal Hill, CA
Jul-91	Biannual Interim Monitoring Report, July 1991, Chemoil Refinery, Signal Hill, CA
Jan-92	Biannual Interim Monitoring Report, January 1992, Chemoil Refinery, Signal Hill, CA
Jul-92	Biannual Interim Monitoring Report, July 1992, Chemoil Refinery, Signal Hill, CA
Jan-93	Biannual Interim Monitoring Report, January 1993, Chemoil Refinery, Signal Hill, CA
Jul-93	Biannual Interim Monitoring Report, July 1993, Chemoil Refinery, Signal Hill, CA
Jan-94	Biannual Interim Monitoring Report, January 1994, Chemoil Refinery, Signal Hill, CA
Jul-94	Biannual Interim Monitoring Report, July 1994, Chemoil Refinery, Signal Hill, CA
Testa Environmental Corporation	
Jan-95	Biannual Interim Monitoring Report, January 1995, Chemoil Refinery, Signal Hill, CA
Jul-95	Biannual Interim Monitoring Report, July 1995, Chemoil Refinery, Signal Hill, CA
Jan-96	Biannual Interim Monitoring Report, January 1996, Chemoil Refinery, Signal Hill, CA
Jul-96	Biannual Interim Monitoring Report, July 1996, Chemoil Refinery, Signal Hill, CA
Jan-97	Biannual Interim Monitoring Report, January 1997, Chemoil Refinery, Signal Hill, CA
Jul-97	Biannual Interim Monitoring Report, July 1997, Chemoil Refinery, Signal Hill, CA
Dec-97	Proposal for Subsurface Soil Quality Assessment. December 1997, Former Chemoil Refinery, Signal Hill, CA
May-98	Report of Additional Subsurface Assessment and Groundwater Monitoring, May 1998, Former Chemoi Refinery, Signal Hill, CA
Nov-98	Proposed Workplan for Off-site Subsurface Soil and Groundwater Quality Conditions, November 6, 1998, Former Chemoil Refinery, Signal Hill, CA
Aug-99	Report on Additional Subsurface Assessment, August 1999, Former Chemoil Refinery, Signal Hill, CA
Sep-01	Proposed Workplan for Subsurface Assessment, Eastern Parcel, Former Chemoil Refinery, Signal Hill, CA
Nov-01	Report on Additional Subsurface Assessment, Eastern Parcel, Former Chemoil Refinery, Signal Hill, CA

TABLE 2-1
SUMMARY OF PREVIOUS REPORTS

Date	Report Title
Mar-02	Proposed Remedial Action Plan, Eastern Parcel, Former Chemoil Refinery, Signal Hill, CA
Jun-02	Revised Remedial Action Plan, Eastern Parcel, Former Chemoil Refinery, Signal Hill, CA
Jul-02	Report on Quarterly Groundwater Quality, July 2002, Former Chemoil Refinery, Signal Hill, CA
Jul-02	Revised Workplan for Subsurface Assessment, Western Parcel, Former Chemoil Refinery, Signal Hill, CA
Oct-02	Report on Quarterly Groundwater Quality, October 2002, Former Chemoil Refinery, Signal Hill, CA
Jan-03	Report on Quarterly Groundwater Quality, January 2003, Former Chemoil Refinery, Signal Hill, CA
Apr-03	Report on Quarterly Groundwater Quality, April 2003, Former Chemoil Refinery, Signal Hill, CA
Jul-03	Report on Quarterly Groundwater Quality, July 2003, Former Chemoil Refinery, Signal Hill, CA
Oct-03	Report on Quarterly Groundwater Quality, October 2003, Former Chemoil Refinery, Signal Hill, CA
Jan-04	Report on Quarterly Groundwater Quality, January 2004, Former Chemoil Refinery, Signal Hill, CA
Apr-04	Report on Quarterly Groundwater Quality, April 2004, Former Chemoil Refinery, Signal Hill, CA
Jul-04	Report on Quarterly Groundwater Quality, July 2004, Former Chemoil Refinery, Signal Hill, CA
Oct-04	Report on Quarterly Groundwater Quality, October 2004, Former Chemoil Refinery, Signal Hill, CA
Jan-05	Report on Quarterly Groundwater Quality, January 2005, Former Chemoil Refinery, Signal Hill, CA
Apr-05	Report on Quarterly Groundwater Quality, April 2005, Former Chemoil Refinery, Signal Hill, CA
Jul-05	Report on Quarterly Groundwater Quality, July 2005, Former Chemoil Refinery, Signal Hill, CA
Oct-05	Report on Quarterly Groundwater Quality, October 2005, Former Chemoil Refinery, Signal Hill, CA
Jan-06	Report on Quarterly Groundwater Quality, January 2006, Former Chemoil Refinery, Signal Hill, CA
Apr-06	Report on Quarterly Groundwater Quality, April 2006, Former Chemoil Refinery, Signal Hill, CA
Jul-06	Report on Quarterly Groundwater Quality, July 2006, Former Chemoil Refinery, Signal Hill, CA
Oct-06	Report on Quarterly Groundwater Quality, October 2006, Former Chemoil Refinery, Signal Hill, CA
Jan-07	Report on Quarterly Groundwater Quality, January 2007, Former Chemoil Refinery, Signal Hill, CA
Apr-07	Report on Quarterly Groundwater Quality, April 2007, Former Chemoil Refinery, Signal Hill, CA
Jul-07	Report on Quarterly Groundwater Quality, July 2007, Former Chemoil Refinery, Signal Hill, CA
Oct-07	Report on Quarterly Groundwater Quality, October 2007, Former Chemoil Refinery, Signal Hill, CA
Jan-08	Report on Quarterly Groundwater Quality, January 2008, Former Chemoil Refinery, Signal Hill, CA
Apr-08	Report on Quarterly Groundwater Quality, April 2008, Former Chemoil Refinery, Signal Hill, CA
Jul-08	Report on Quarterly Groundwater Quality, July 2008, Former Chemoil Refinery, Signal Hill, CA
Oct-08	Report on Quarterly Groundwater Quality, October 2008, Former Chemoil Refinery, Signal Hill, CA
Oct-08	Revised Proposed Workplan, October 12, 2008, Former Chemoil Refinery, Signal Hill, CA
Jan-09	Report on Phase I Additional Site Characterization, January 2009, Former Chemoil Refinery, Signal Hill, CA
Mar-09	Proposed Phase II Workplan, March 2, 2009, Former Chemoil Refinery, Signal Hill, CA
Apr-09	Report on Quarterly Groundwater Quality, April 2009, Former Chemoil Refinery, Signal Hill, CA
May-09	Revised Proposed Workplan for Soil Gas Survey, May 8, 2009, Former Chemoil Refinery, Signal Hill, C
Sep-09	Report on Phase II Additional Subsurface Characterization, Former Chemoil Refinery, Signal Hill, CA
Oct-09	Report on Quarterly Groundwater Quality, October 2009, Former Chemoil Refinery, Signal Hill, CA
Jan-10	Report on Quarterly Groundwater Quality, January 2010, Former Chemoil Refinery, Signal Hill, CA
Apr-10	Report on Quarterly Groundwater Quality, April 2010, Former Chemoil Refinery, Signal Hill, CA
Apr-10	Report on Off-Site Soil Gas Survey, Former Chemoil Refinery, Signal Hill, CA
May-10	Report on Updated Human Health Risk Assessment, Former Chemoil Refinery, Signal Hill, CA
Jul-10	Report on Quarterly Groundwater Quality, July 2010, Former Chemoil Refinary Site, Signal Hill, CA
Oct-10	Report on Quarterly Groundwater Quality, October 2010, Former Chemoil Refinery, Signal Hill, CA
Jan-11	Report on Quarterly Groundwater, January 2011, Former Chemoil Refinery, Signal Hill, CA
Apr-11	Report on Quarterly Groundwater Quality, April 2011, Former Chemoil Refinery, Signal Hill, CA

TABLE 2-2

CHRONOLOGY OF PERTINENT ACTIVITIES AND REGULATORY EVENTS

Date	Event/Activity
Pre-1922	Dairy Farm
MacMillan Ring-Free Oil Company Era	
1922/Aug-88	Refinery operated by MacMillan Ring-Free Oil Company.
Late-85/Oct-86	Subsurface assessment and characterization commenced.
Mar-87	Quarterly groundwater quality monitoring program commenced.
Mar-87	LNAPL recovery program implemented with recovery wells R-4 and R-6; both hydrocarbon impacted groundwater and LNAPL is recovered.
Jul-88	Biannual groundwater monitoring program commenced.
Dec-88	LNAPL recovery well R-5 is installed.
Chemoil Refining Corporation - Signal Hill Holding Company (SHHC) Era	
Aug-88	Refinery purchased by Chemoil Refining Corporation.
Aug-88	Biannual groundwater monitoring and LNAPL recovery programs continued.
Dec-94	LNAPL recovery system terminated; continued with episodic hand bailing of LNAPL in R-4 with CRWQCB-LAR approval.
Dec-94	Approximately 253,902 barrels of total fluids recovered, with approximately 27.9 barrels of LNAPL recovered.
Aug-95	Preliminary assessment of Gundry Avenue Property, situated immediately west of the Western Parcel, was performed to evaluate potential off-site environmental impact.
1997	All above and below ground structures dismantled and removed, along with dismantling of the waste water system.
Oct-97	Chemoil Refining Corporation changes its name to Signal Hill Holding Corporation.
May-98	Additional subsurface assessment performed.
Nov-98	Additional subsurface assessment, including off-site to the south, to assess potential health risk to residential area performed.
Jul-99/Oct-01	Hiatus from groundwater monitoring
Aug-01	Meeting with CRWQCB-LAR on August 29, 2001, to discuss development-driven site closure, or partial closure, of Eastern Parcel and possibly portions of the Western Parcel at request of SHHC.
Fall 2001	Additional subsurface assessment of Eastern Parcel performed.
Jun-02	Remedial Action Plan (RAP) for Eastern Parcel developed to accommodate sale of site for development. RAP not implemented since development considerations were deferred or ceased; CRWQCB-LAR was notified.
Jul-02	Additional subsurface assessment of Western Parcel considered and workplan prepared reflecting development interests; workplan not implemented since development considerations were deferred or ceased, CRWQCB-LAR was notified.
Jul-02	Groundwater quality monitoring revised from biannual to quarterly as a result of deferred development considerations, among other factors, and continues to present at request of CRWQCB-LAR.
Jul-05/Mar-06	SHHC in contract to sell property to an entity managed by Richard McAuley, the current manager of MPO Walnut Partners, pursuant to a Stock Purchase Agreement. The proposed sale of SHHC's stock was terminated in March 2006.
May-06/Aug-06	Subsurface assessment performed by Tetra Tech on behalf of development interests. Results generally confirmed previous understanding of site conditions, with indication of high residual saturation at smear zone along western perimeter of site in proximity of former LNAPL recovery well R-5.
Oct-08	Additional site characterization proposed and subsequently implemented.
Initial off site soil ga	Phase I report completed.
Sep-09	Phase II report completed.
Jan-10	Phase III workplan prepared and work commenced; in progress.
Mar-10	Off site soil gas probe survey south of site, and updated Human Health Risk Assessment completed.
Aug-10	Installation of off site well MW-17 west of site.
Dec-10	Installation of off site well MW-18 south of site.
Dec-10	Continued quarterly groundwater monitoring.
Feb-11	Installation of off site well MW-19 south of site

Table 4 - 1

Summary of Boring and Well Data

Soil Boring No.	Boring Depth (feet)	Depth Interval (feet)	Soil Type	Soil Symbol (USCS)	Location	Remarks
Engineering Enterprises, Inc. (1988)						
B-1	10	0 - 7.5	Sandy silt	ML	Western Parcel North	
		7.5 - 10	Sand	SP		
B-2	10	0 - 10	Silty sand	SM	Western Parcel North	Moderate hydrocarbon odor
B-3	10	0 - 7.5	Silty sand	SM	Western Parcel North	
		7.5 - 9	Sandy silt	ML		
		9 - 10	Sand	SP		
B-4	10	0 - 10	Sandy silt	ML	Western Parcel North	Slight hydrocarbon odor
B-5	10	0 - 4	Sandy clay	CL	Western Parcel North	Strong hydrocarbon odor
		4 - 10	Sandy silt	ML		Slight hydrocarbon odor
B-6	10	0 - 10	Silty sand	SM	Western Parcel North	Hydrocarbon saturation at 5' bgs
B-7	10	0 - 6	Sandy silt	ML	Western Parcel North	
		6 - 10	Sand	SP		Moderate sweet odor
B-8	10	0 - 9	Sandy silt	ML	Western Parcel North	
		9 - 10	Silty sand	SM		
B-9	10	0 - 3	Silty sand	SM	Western Parcel North	
		3 - 10	Sandy silt	ML		
B-10	10	0 - 7	Silty sand	SM	Western Parcel North	Slight hydrocarbon odor
		7 - 10	Sandy silt	ML		Slight hydrocarbon odor
B-11	10	0 - 2	Clay	CL	Western Parcel North	Slight hydrocarbon odor
		2 - 10	Silty sand	SM		Moderate hydrocarbon odor
B-12	10	0 - 2	Silty sand	SM	Western Parcel North	Moderate hydrocarbon odor
		2 - 6	Sandy silt	ML		Moderate hydrocarbon odor
		6 - 10	Silty sand	SM		Moderate hydrocarbon odor
B-13	10	0 - 3	Sandy silt	ML	Western Parcel North	Slight hydrocarbon odor
		3 - 10	Silty sand	SM		Moderate hydrocarbon odor

Table 4 - 1
Summary of Soil Boring Data

Soil Boring No.	Boring Depth (feet)	Depth Interval (feet)	Soil Type	Soil Symbol (USCS)	Location	Remarks
B-14	10	0 - 3	Silty sand	SM	Western Parcel North	
		3 - 10	Sandy silt	ML		
B-15	10	0 - 10	Silty sand	SM	Western Parcel South	Slight hydrocarbon odor
B-16	10	0 - 1	Silty sand	SM	Western Parcel South	Moderate hydrocarbon odor
		1 - 5	Sandy silt	ML		Slight hydrocarbon odor
		5 - 10	Silty sand	SM		Slight hydrocarbon odor
B-17	10	0 - 10	Silty sand	SM	Western Parcel South	
B-18	10	0 - 8	Silty sand	SM	Western Parcel South	
		8 - 10	Sand	SP		
B-19	10	0 - 3	Silty sand	SM	Western Parcel South	Hydrocarbon saturation
		3 - 4	Clay	CL		Strong hydrocarboon odor
		4 - 10	Silty sand	SM		
B-20	10	0 - 1.5	Sand	SP	Western Parcel South	Strong hydrocarbon odor
		1.5 - 5	Sandy silt	ML		Hydrocarbon saturation 3-4' bgs
		5 - 10	Silty sand	SM		Slight hydrocarbon odor
B-21	10	0 - 2	Sandy silt	ML	Western Parcel South	
		2 - 3	Clay	CL		
		3 - 8	Silty sand	SM		
		8 - 10	Sand	SP		
B-22	10	0 - 2.5	Sandy silt	ML	Western Parcel South	Strong hydrocarbon odor
		2.5 - 10	Silty sand	SM		
B-23	10	0 - 2	Sandy silt	ML	Western Parcel South	Strong hydrocarbon odor
		2 - 10	Silty sand	SM		
B-24	10	0 - 1.5	Sand	SP	Western Parcel South	Hydrocarbon saturation
		1.5 - 10	Silty sand	SM		Slight hydrocarbon odor to 5' bgs
B-25	10	0 - 1	Gravelly sand	SP	Western Parcel South	Hydrocarbon saturation
		1 - 10	Sandy silt	ML		Moderate hydrocarbon odor

Table 4 - 1

Summary of Soil Boring Data

Soil Boring No.	Boring Depth (feet)	Depth Interval (feet)	Soil Type	Soil Symbol (USCS)	Location	Remarks
B-26	10	0 - 3	Silty sand	SM	Western Parcel South	Strong hydrocarbon odor
		3 - 10	Sandy silt	ML		Slight hydrocarbon odor
B-27	5	0 - 5	Clayey silt	ML	Western Parcel North	
B-28	10	0 - 3	Silty sand	SM	Western Parcel North	Strong hydrocarbon odor
		3 - 10	Clayey sand	ML		
Monitoring and LNAPL Recovery Wells (Engineering Enterprises, Inc., 1987)						
MW-1	45	0 - 7	Sandy silt	ML	Western Parcel South	
		7 - 15	Clayey silt	MH		
		15 - 20	Sandy silt	ML		
		20 - 40	Sandy silt	SP		
		40 - 45	Clayey silt	MH		
MW-1A	35	0 - 15	Sandy silt	ML	West of Western Parcel North	
		15 - 35	Sandy silt	SP		
MW-2	45	0 - 7	Sandy silt	ML	Eastern Parcel	
		7 - 12.5	Clayey silt	MH		
		12.5 - 20	Sandy silt	ML		
		20 - 37.5	Sand	SP		
		37.5 - 45	Clayey silt	MH		
MW-3	45	0 - 7.5	Sandy silt	ML	Western Parcel North	
		7.5 - 15	Silt	ML		
		15 - 25	Sandy silt	ML		
		25 - 37.5	Sand	SP		
		37.5 - 45	Clayey silt	ML		

Table 4 - 1
Summary of Soil Boring Data

Soil Boring No.	Boring Depth (feet)	Depth Interval (feet)	Soil Type	Soil Symbol (USCS)	Location	Remarks
R-4	45	0 - 7.5	Silty sand	SM	Western Parcel North	
		7.5 - 12.5	Silty sand	ML		
		12.5 - 20	Clayey silt	MH		
		20 - 25	Silty sand	SM		
		25 - 40	Sand	SP		Hydrocarbon odor noted at 30' bgs
		40 - 45	Clayey silt	MH		
R-5	45	0 - 7.5	Silt	ML	Western Parcel North	
		7.5 - 17.5	Silty sand	SM		
		17.5 - 37.5	Sand	SP		Hydrocarbon odor noted at 35' bgs
		37.5 - 45	Clayey silt	MH		
R-6	45	0 - 7.5	Sandy silt	ML	Western Parcel South	
		7.5 - 12.5	Clayey silt	MH		
		12.5 - 22.5	Silty sand	SM		
		22.5 - 37.5	Sand	SP		Hydrocarbon odor noted at 15 - 25' bgs
		37.5 - 45	Clayey silt	MH		
MW-7	45	0 - 7.5	Silty sand	ML	Western Parcel South	
		7.5 - 15	Clayey silt	MH		
		15 - 25	Silty sand	SM		
		25 - 40	Sand	SP		Hydrocarbon odor at 35' bgs
		40 - 45	Clayey silt	MH		
MW-8	45	0 - 10	Silt	ML		
		10 - 17.5	Sandy silt	ML	Western Parcel North	
		17.5 - 40	Sand	SP		
		40 - 45	Sandy silt	ML		
MW-9	35	0 - 15	Sandy silt	ML	Western Parcel North	Shell fragments at 15' bgs
		15 - 35	Sand	SP		Well installed to 49' bgs

Table 4 - 1
Summary of Soil Boring Data

Soil Boring No.	Boring Depth (feet)	Depth Interval (feet)	Soil Type	Soil Symbol (USCS)	Location	Remarks
MW-10	40	0 - 15	Sandy silt	ML	Eastern Parcel	
		15 - 35	Sand	SP		Shell fragments from 20-25' bgs
		35 - 40	Silty sand	SM		Some organics
		40 - 41	Sand	SP		Some shell fragments
Soil Borings (Testa Environmental Corporation, 1998)						
B-1	35	0 - 2.5	Silty sand	SM	Western Parcel North	Slight hydrocarbon odor to 35' bgs
		2.5 - 7.5	Silty clay	CL		
		7.5 - 35	Sand	SP		
B-2	30	0 - 2.5	Silty sand	SM	Western Parcel North	Slight hydrocarbon odor to 30' bgs; strong from 5 - 25' bgs
		2.5 - 7.5	Clayey silt	CL		
		7.5 - 12.5	Silty sand	SM		
		12.5 - 30	Sand	SP		
B-3		0 - 2.5	Clayey silt	SM	Western Parcel South	Strong hydrocarbon odor to 25' bgs
		2.5 - 7.5	Sandy silt	ML		
		7.5 - 12.5	Silty sand	SM		
		12.5 - 22.5	Sand	SP		
		22.5 - 25	Silty sand	SM		
Off-site Geprobes (Testa Environmental Corporation, 1999)						
GP-1	20	0 - 12.5	Clayey silt	CL	South of Western Parcel	
		12.5 - 17.5	Silty sand	SM		
		17.5 - 20	Sand	SP		

Table 4 - 1

Summary of Soil Boring Data

Soil Boring No.	Boring Depth (feet)	Depth Interval (feet)	Soil Type	Soil Symbol (USCS)	Location	Remarks
GP-2	20	0 - 12.5	Clayey silt	CL	South of Western Parcel	
		12.5 - 17.5	Silty sand	SM		
		17.5 - 20	Sand	SP		
GP-3	20	0 - 20	Clayey silt	CL	South of Western Parcel	
Soil borings (Tetra Tech, Inc., 2006)						
SB-1	40	0 - 3.5	Silty sand	SM	Western Parcel North	Strong hydrocarbon odor from 2.5 - 35' bgs
		3.5 - 4.5	Silty clay	SC		
		4.5 - 14	Silty sand	SM		
		14 - 25	Sand	SP		
		25 - 34	Silty sand	SM		
		34 - 40	Sand	SP		
SB-2	45	0 - 23	Silt	ML	Western Parcel North	Hydrocarbon odor throughout depth
		23 - 45	Sand	SP		Strong hydrocarbon odor throughout depth
SB-3	34	0 - 11	Silty sand	SM	Eastern Parcel South	
		11 - 14	Clay	CL		
		14 - 34	Sand	SP		
SB-3	15	0 - 15			Western Parcel North	
SB-4	45	0 - 11	Silty sand	SM	Western Parcel North	Strong hydrocarbon odor throughout depth
		11 - 15	Sand	SP		
		15 - 16	Silty sand	SM		
		16 - 41	Sand	SP		
		41-45	Silty sand	SM		
E-1	10				Eastern Parcel	Cone Penetration Test
E-1A	40				Eastern Parcel	Cone Penetration Test
E-1B	25				Eastern Parcel	Cone Penetration Test

Table 4 - 1

Summary of Soil Boring Data

Soil Boring No.	Boring Depth (feet)	Depth Interval (feet)	Soil Type	Soil Symbol (USCS)	Location	Remarks
E-1C	25				Eastern Parcel	Cone Penetration Test
E-3A	10				Eastern Parcel	Cone Penetration Test
Monitoring wells (Testa Environmental Corporation, 2009)						
MW-11	45	0 - 13	Silt	ML	Western Parcel North	Strong hydrocarbon odor throughout depth
		13 - 27.5	Silty sand	SM		
		27.5 - 32.5	Sandy silt	ML		
		32.5 - 42.5	Silty sand	SM		
		42.5 - 45.5	Sandy silt	ML		
MW-12	35	0 - 7.5	Clayey silt	ML	West of Western Parcel	Strong hydrocarbon odor from 10 - 30' bgs
		7.5 - 12.5	Silt	ML		
		12.5 - 17.5	Sandy silt	ML		
		17.5 - 22	Sand	SP		
		22 - 22.5	Silty sand	SM		
		22.5 - 32.5	Sandy silt	ML		
		32.5 - 35	Silty sand	SM		
MW-13	35	0 - 6	Sandy silt	ML	Western Parcel South	
		6 - 11	Clayey silt	CL		
		11 - 35	Sand	SP		Strong hydrocarbon odor from 15 - 35' bgs
MW-14	27	0 - 12.5	Clayey silt	ML	South of Western Parcel	
		12.5 - 27	Sand	SP		
MW-15	17	0 - 7.5	Silt	ML	South of Western Parcel	
		7.5 - 17	Sand	SP		Moderate hydrocarbon odor from 10 - 17' bgs

Table 4 - 1

Summary of Soil Boring Data

Soil Boring No.	Boring Depth (feet)	Depth Interval (feet)	Soil Type	Soil Symbol (USCS)	Location	Remarks
MW-16	28	0 - 6	Silt	ML	South of Western Parcel	
		6 - 9.5	Sandy silt	ML		
		9.5 - 17.5	Silty sand	SM		
		17.5 - 28	Sand	SP		Moderate hydrocarbon odor at 25' bgs
MW-17	27	0-12.5	Clayey silt	ML	West of Western Parcel	
		12.5-15.0	Silt	ML		Slight to moderate hydrocarbon odor
		15.0-27.0	Sand	SP		from 15 - 27' bgs
MW-18	23	0-7.5	Clayey silt	ML	South of Western Parcel	
		7.5-12.5	Silt	ML	No hydrocarbon odor	
		12.5-17.5	Silty sand	SM		
		17.5-23	Sand	SP		
MW-19	21	0 - 7.5	Clayey silt	ML	South of Western Parcel	
		7.5 - 12.5	Sandy silt	ML		Slight hydrocarbon odor
		12.5 - 21.0	Sand	SP		Strong hydrocarbon odor

Table 4-2

Summary of Monitoring Well Data

Well No.	Top of Casing Elevation (feet)(a)(b)	Well Depth (feet)	Elevation of Screened Interval Upper (feet)	Lower (feet)	Depth to Peizometric Surface (feet)(c)	Piezometric Surface Elevation (feet)(c)	Paizometric Surface Elevation (feet) Rise or Decline (-)	Comments
MW-1	22.22	62	-7.87	-37.87	15.70	6.52	1.7	Slight hydrocarbon odor
MW-1A	23.02	64	8.86	-11.14	17.30	5.72	1.1	Slight hydrocarbon odor
MW-2	29.99	60	1.81	-28.19	24.60	5.39	1.1	Strong hydrocarbon odor
MW-3	48.02	72	6.48	-23.52	41.50	6.52	0.8	Strong hydrocarbon odor
MW-8	25.51	52	5.7	-24.3	20.50	5.31	1.1	Slight hydrocarbon odor
MW-9	36.88	49	7.73	-12.27	31.30	5.58	1.1	Slight hydrocarbon odor;
MW-10	31.6	46	5.39	-14.61	26.10	5.5	1.1	Slight hydrocarbon odor
MW-11	33.06	43	9.9	-20.01	27.00	6.05	1.1	Moderate hydrocarbon odor
MW-12	24.04	33	11.02	-8.98	17.90	6.14	1.1	Strong hydrocarbon odor
MW-13	21.33	30	11.2	-8.8	15.40	5.93	1.2	Slight hydrocarbon odor
MW-14	16.81	25	11.8	-8.7	11.10	5.71	1.1	Slight Hydrocarbon odor
MW-15	17.17	26	11.19	-8.81	11.30	5.87	2	Slight hydrocarbon odor
MW-16	18.41	27	11.43	-8.57	12.30	6.11	1	Slight hydrocarbon odor
MW-17	21.93	27	14.03	-5.07	16.10	5.83	1.3	Slight hydrocarbon odor
MW-18	17.72	23	11.72	-5.28	11.9	5.82	1.4	No hydrocarbon odor
MW-19	16.46	21	13.72	-3.28	10.8	5.66	ND	Slight hydrocarbon odor

(a) All elevations re-established on January 23, 2008; July 30, 2009, for wells MW-11 through MW-16; and February 22, 2011, for wells MW-17, MW-18 and MW-19.

All elevations referenced to City of Long Beach BenchmarkNo. 331

located on southwest corner of Walnut Avenue at 20th Street Brass Cap in West 28W/Curb 8' E/Catch Basin.

1985 elevatoins = 15.397 feet NGC029; horizontal datum NAD83, Zone 5; NGS PID Stations AJ3847 and AJ 1847 EPOCH DATE 2003.35.

Measured relative to top of PVC casing at well head.

(c) Fluid depths gauged on March 3-4, 2011.

(d) Relative to data generated on December 8-9, 2010.

(e) ND = Not determined.

Table 5-1
Summary of Analytical Results for Soil for the Western Parcel
Engineering Enterprises, Inc. (1987-1988)

Well Boring No.	Depth (feet)	Sample No.	TRPH[a] (mg/Kg)	Fuel Hydrocarbons (mg/Kg)[b] Gasoline	Kerosene	Diesel	Mineral Spirits	Undifferentiated Hydrocarbons (mg/Kg)
Former Monitoring and Recovery Wells (EEI, Nov. 1987)								
MW-1	20	S-1-20	NA[d]	NA	NA	NA	NA	NA
R-4	6	S-4-6	NA	NA	NA	NA	NA	NA
	20	S-4-20	NA	NA	NA	NA	NA	NA
R-5	6	S-5-6	NA	NA	NA	NA	NA	NA
	20	S-5-20	NA	NA	NA	NA	NA	NA
MW-7	20	S-7-20	NA	NA	NA	NA	NA	NA
MW-8	1.5	S-8-1.5	861	NA	NA	NA	NA	NA
	30	S-8-30	87	NA	NA	NA	NA	NA
Soil Borings (EEI, 1988)								
B-4	10	S-10-10	ND[c]	ND	ND	ND	ND	ND
B-5	2	S-5-2	38,000	NA	NA	NA	NA	NA
	10	S-5-10	NA	ND	ND	ND	ND	12,000
B-6	2	S-6-2	21,000	NA	NA	NA	NA	NA
	10	S-6-10	NA	690	ND	1900	ND	ND
B-7	10	S-7-10	NA	68	ND	ND	ND	ND
B-8	10	S-8-10	NA	ND	ND	ND	ND	ND
B-9	10	S-9-10	NA	ND	ND	6100	ND	TR<100
B-10	10	S-10-10	NA	ND	ND	2100	ND	ND
B-11	2	S-11-2	12,000	NA	NA	NA	NA	NA
	10	S-11-10	NA	4000	ND	ND	ND	ND
B-12	10	S-12-10	NA	780	ND	300	ND	ND
B-13	10	S-13-10	NA	ND	ND	ND	ND	12000
B-14	2	S-14-2	49,000	NA	NA	NA	NA	NA
	10	S-14-10	NA	ND	ND	ND	ND	4300
B-15	10	S-15-10	NA	ND	ND	ND	ND	320
B-16	10	S-16-10	NA	ND	ND	100	ND	ND
B-17	10	S-17-10	NA	ND	ND	ND	ND	290
B-18	10	S-18-10	NA	ND	ND	ND	ND	ND
B-19	2	S-19-2	16,000	NA	NA	NA	NA	NA
	10	S-19-10	NA	ND	ND	1000	ND	220
B-20	2	S-20-2	45,000	NA	NA	NA	NA	NA
	10	S-20-10	NA	ND	ND	1200	ND	420
B-21	2	S-21-2	NA	ND	ND	ND	ND	TR<100
	10	S-21-10	NA	500	ND	460	ND	TR<100
B-22	2	S-22-2	28,000	NA	NA	NA	NA	NA
	10	S-22-10	NA	ND	ND	ND	ND	2600
B-23	2	S-23-2	15,000	NA	NA	NA	NA	NA
	10	S-24-10	NA	ND	ND	320	ND	ND
B-24	2	S-24-2	48,000	NA	NA	NA	NA	NA
	10	S-24-10	NA	ND	ND	29	ND	ND
B-25	2	S-25-2	19,000	NA	NA	NA	NA	NA
	10	S-25-10	NA	ND	ND	ND	ND	520
B-26	2	S-26-2	48,000	NA	NA	NA	NA	NA
	10	S-26-10	NA	ND	ND	1900	ND	ND
B-27	10	S-27-10	NA	ND	ND	ND	ND	ND
B-28	2	S-28-2	40,000	NA	NA	NA	NA	NA
	10	S-28-10	NA	ND	ND	ND	ND	3400

(a) TRPH = Total petroleum hydrocarbons using EPA Method 418.1.
(b) mg/Kg = milligrams per kilogram or equivalent to parts per million.
(c) ND = Not detected at levels equal to or greater than the respective analytical detection limit.
(d) NA = Not analyzed.

Table 5-2
Summary of Analytical Data for Soil for the Western Parcel
Testa Environmental Corporation (1999)

Boring No.	Sample Depth	Sample No.	TPHg (mg/Kg)	TPHd (mg/Kg)	TRPH (mg/Kg)	Benzene (ug/Kg)	Toluene (ug/Kg)	Ethylbenzene (ug/Kg)	Total Xylenes (ug/Kg)	MTBE (ug/Kg)
Western Parcel (southern subparcel)										
B-1	5	B-1-5	65	1170	1590	ND	349	852	2780	ND
	10	B-1-10	23	652	705	ND	296	377	1630	ND
	15	B-1-15	ND	229	270	ND	189	2550	71	ND
	20	B-1-20	498	5750	8580	ND	4890	11000	18700	ND
	25	B-1-25	735	10700	11900	1560	7350	25400	48000	ND
	30	B-1-30	289	11200	20800	7140	14000	52200	105000	ND
	35	B-1-35	735	9250	15100	3110	8430	30700	15700	ND
B-2	5	B-2-5	334	8300	14100	3120	3120	981	4190	ND
	10	B-2-10	24	ND	ND	ND	ND	ND	ND	ND
	15	B-2-15	ND	ND	11	ND	ND	ND	ND	ND
	20	B-2-20	ND	ND	12	ND	ND	ND	ND	ND
	25	B-2-15	1540	5924	13900	3010	13900	60600	69400	ND
	30	B-2-30	1130	4400	7140	3580	12400	18900	63200	ND
B-3	5	B-3-5	175	4700	4940	931	1760	941	9160	ND
	10	B-3-10	209	5290	7740	901	1260	1150	9040	ND
	15	B-3-15	ND	94	99	ND	ND	ND	ND	ND
	20	B-3-20	308	9150	9480	941	1660	4280	18900	ND
	25	B-3-25	445	10400	11300	1370	2280	2050	34000	ND
Off-site Geoprobes										
GP-1	5		ND	ND	NA	ND	ND	ND	ND	NA
	10		ND	ND	NA	ND	ND	ND	ND	NA
	15		96	170	NA	ND	ND	ND	ND	NA
	20		270	950	NA	ND	ND	ND	ND	NA

Table 5-2
Summary of Analytical Data for Soil for the Western Parcel
Testa Environmental Corporation (1999)

Boring No.	Sample Depth	Sample No.	Parameter							
			TPHg [a] (mg/Kg) [e]	TPHd [b] (mg/Kg)	TRPH [c] (mg/Kg)	Benzene (ug/Kg) [f]	Toluene (ug/Kg)	Ethylbenzene (ug/Kg)	Total Xylenes (ug/Kg)	MTBE [d] (ug/Kg)
GP-2	5		270	950	NA	ND	ND	ND	ND	NA
	10		ND	ND	NA	ND	ND	ND	ND	NA
	15		ND	ND	NA	ND	ND	ND	ND	NA
	20		500	220	NA	ND	ND	ND	ND	NA
GP-3	5		ND	ND	NA	ND	ND	ND	ND	NA
	10		ND	ND	NA	ND	ND	ND	ND	NA
	15		1.5	ND	NA	ND	ND	ND	ND	NA
	20		21	170	ND	ND	ND	ND	ND	NA

(a) TPHg = Total petroleum hydrocarbons as gasoline using EPA Method 8015m modified for gasoline.
(b) TPHd = Total petroleum hydrocarbons as diesel using EPA Method 8015m modified for diesel.
(c) TRPH = Total recoverable petroleum hydrocarbons using EPA Method 418.1.
(d) MTBE = Methyl tertiary butyl ether.
(e) mg/Kg = Milligrams per kilogram or equivalent to parts per million.
(f) ug/Kg = Micrograms per kilogram or equivalent to parts per billion.

TABLE 5-3a

SUMMARY OF ANALYTICAL DATA FOR SOIL (a)

	Boring/Well Designation No. (b)												
Parameter	S-11-1	S-11-S	S-11-10	S-11-15	S-11-20	S-11-25	S-11-30	S-11-35	S-11-40	S-11-45	S-12-5	S-12-10	S-12-15
Gasoline (GRO) and Diesel (DRO) Range Organics using EPA Method 8015B Modified; units in mg/Kg (c)													
Gasoline (GRO)	1.9	1300	3800	2600	2000	1500	3400	1100	3200	8800	ND(1)(e)	ND(1)	ND(1)
Diesel (DRO)	1100	3000	23,000	8700	3500	3300	14000	18000	7000	4100	6400	ND(10)	ND(10)
Volatile Organic Compounds Using EPA Method 8260B; units in ug/Kg (d)													
Benzene	6.9	ND(2500)	11000	3400	ND(2500)	ND(2500)	8400	ND(2500)	7800	9400	ND(5)	ND(5)	ND(5)
cis-1,2, Dichloroethane	ND(5)	ND(2500)	ND(2500)	ND(2500)	ND(2500)	ND(2500)	ND(2500)	ND(2500)	ND(2500)	ND(2500)	ND(5)	ND(5)	ND(5)
Ethylbenzene	15	4100	20000	9800	6700	4700	16000	2800	25000	31000	ND(5)	ND(5)	ND(5)
Isopropylbenzene	ND(5)	ND(2500)	6800	3700	2800	ND(2500)	7600	ND(2500)	7800	9600	ND(5)	ND(5)	ND(5)
4-Isopropyltoluene	ND(5)	ND(2500)	6300	3100	ND(2500)	ND(2500)	6800	ND(2500)	3200	4800	ND(5)	ND(5)	ND(5)
MTBE	ND(5)	ND(2500)	ND(2500)	ND(2500)	ND(2500)	ND(2500)	ND(2500)	ND(2500)	ND(2500)	ND(2500)	ND(5)	ND(5)	ND(5)
Naphthalene	ND(5)	9900	27000	7200	5100	3500	21000	ND(2500)	9000	12000	ND(5)	ND(5)	ND(5)
n-Propylbenzene	ND(5)	2700	9500	4800	3700	2800	11000	2600	10000	13000	ND(5)	ND(5)	ND(5)
n-Butylbenzene	ND(5)	ND(2500)	ND(2500)	ND(2500)	ND(2500)	ND(2500)	7800	ND(2500)	4900	6700	ND(5)	ND(5)	ND(5)
sec-Butylbenzene	ND(5)	ND(2500)	5500	ND(2500)	ND(2500)	ND(2500)	5400	ND(2500)	3700	4900	ND(5)	ND(5)	ND(5)
Tert-Butanol	ND(100)	ND(2500)	ND(2500)	ND(2500)	ND(2500)	ND(2500)	ND(2500)	ND(2500)	ND(2500)	ND(2500)	ND(100)	ND(100)	ND(100)
1,2,4-Trimethylbenzene	9.3	ND(2500)	49000	21000	16000	12000	42000	ND(2500)	5200	7800	ND(5)	ND(5)	ND(5)
1,3,5-Trimethylbenzene	ND(5)	ND(2500)	19000	7800	5500	4000	10000	ND(2500)	6600	13000	ND(5)	ND(5)	ND(5)
Toluene	ND(5)	ND(50K)	ND(50K)	ND(50K)	ND(50K)	ND(50K)	ND(50K)	ND(2500)	ND(2500)	ND(2500)	ND(5)	ND(5)	ND(5)
Xylenes	31	4800	75000	26800	14000	8500	9800	ND(2500)	ND(2500)	ND(2500)	ND(5)	ND(5)	ND(5)
Semi-volatile Organic Compounds using EPD Method 8270C; units in ug/Kg													
Acenaphthene	ND(75)	200	1100	140	120	61	640	7.8	150	140	ND(12)	ND(5)	ND(5)
Acenaphthylene	ND(75)	130	480	120	58	29	340	ND(5)	65	62	ND(12)	ND(5)	ND(5)
Chrysene	75	5.3	21	6.8	ND(5)	ND(5)	34	ND(5)	ND(5)	ND(5)	ND(12)	ND(5)	ND(5)
Fluoranthene	ND(75)	ND(5)	46	5.3	ND(5)	ND(5)	46	ND(5)	ND(5)	ND(5)	ND(12)	ND(5)	ND(5)
Flourene	ND(75)	350	1900	120	51	28	1400	10	120	210	ND(12)	ND(5)	ND(5)
Naphthalene	ND(75)	4800	20000	4200	2100	1400	17000	55	6800	6200	13	5.8	ND(5)
Phenanthrene	ND(75)	520	2500	210	24	12	2200	6.8	73	320	ND(12)	ND(5)	ND(5)
Pyrene	89	20	89	11	ND(5)	ND(5)	86	ND(5)	ND(5)	16	ND(12)	ND(5)	ND(5)

TABLE 5-3b
SUMMARY OF ANALYTICAL DATA FOR SOIL (a)

Parameter	Boring/Well Designation No. (b)												
	S-12-20	S-12-25	S-12-30	S-12-35	S-13-1	S-13-5	S-13-10	S-13-15	S-13-20	S-13-25	S-13-30	S-14-5	S-14-10
Gasoline (GRO) and Diesel (DRO) Range Organics using EPA Method 8015B Modified; units in mg/Kg (c)													
Gasoline (GRO)	130	580	960	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	130	390	250	ND(1)	ND(1)
Diesel (DRO)	260	650	360	ND(10)	ND(10)	450	ND(10)	ND(10)	370	2200	1400	ND(10)	ND(10)
Volatile Organic Compounds Using EPA Method 8260B; units in ug/Kg (d)													
Benzene	ND(250)	ND(500)	ND(500)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(250)	ND(500)	ND(250)	ND(5)	ND(5)
cis-1,2, Dichloroethane	ND(250)	ND(500)	ND(500)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(250)	ND(250)	ND(250)	ND(5)	ND(5)
Ethylbenzene	ND(250)	ND(500)	ND(500)	15	ND(5)	ND(5)	ND(5)	ND(5)	ND(250)	ND(250)	ND(250)	ND(5)	ND(5)
Isopropylbenzene	ND(250)	1300	3000	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(250)	980	640	ND(5)	ND(5)
4-Isopropyltoluene	ND(250)	ND(500)	ND(500)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(250)	ND(250)	ND(250)	ND(5)	ND(5)
MTBE	ND(250)	ND(500)	ND(500)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(250)	ND(250)	ND(250)	ND(5)	ND(5)
Naphthalene	ND(250)	1400	3600	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(250)	2700	2300	ND(5)	ND(5)
n-Propylbenzene	ND(250)	2000	4500	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(250)	1200	850	ND(5)	ND(5)
n-Butylbenzene	ND(250)	ND(500)	750	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(250)	ND(250)	ND(250)	ND(5)	ND(5)
sec-Butylbenzene	ND(250)	1100	2000	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(250)	920	590	ND(5)	ND(5)
Tert-Butanol	ND(5000)	ND(10K)	ND(10K)	ND(100)	ND(100)	ND(100)	ND(100)	ND(100)	ND(5000)	ND(10K)	ND(100)	ND(100)	ND(100)
1,2,4-Trimethylbenzene	ND(250)	ND(500)	ND(500)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(250)	ND(250)	ND(250)	ND(5)	ND(5)
1,3,5-Trimethylbenzene	ND(250)	ND(500)	ND(500)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(250)	ND(250)	ND(250)	ND(5)	ND(5)
Toluene	ND(250)	ND(500)	ND(500)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(250)	ND(250)	ND(250)	ND(5)	ND(5)
Xylenes	ND(250)	ND(500)	ND(500)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(250)	ND(250)	ND(250)	ND(5)	ND(5)

TABLE 5-3b
SUMMARY OF ANALYTICAL DATA FOR SOIL (a)

Parameter	Boring/Well Designation No. (b)												
	S-12-20	S-12-25	S-12-30	S-12-35	S-13-1	S-13-5	S-13-10	S-13-15	S-13-20	S-13-25	S-13-30	S-14-5	S-14-10
Semi-volatile Organic Compounds using EPA Method 8270C; units in ug/L													
Acenaphthene	ND(5)	ND(5)	ND(5)	ND(5)	ND(75)	ND(5)	ND(5)	ND(5)	30	80	71	ND(5)	ND(5)
Acenaphthylene	ND(5)	ND(5)	ND(5)	ND(5)	ND(75)	ND(5)	ND(5)	ND(5)	ND(12)	33	26	ND(5)	ND(5)
Benzo(a)anthracene	ND(5)	ND(5)	ND(5)	ND(5)	280	ND(5)	ND(5)	ND(5)	ND(12)	ND(12)	ND(12)	ND(5)	ND(5)
Benzo(a)pyrene	ND(5)	ND(5)	ND(5)	ND(5)	240	ND(5)	ND(5)	ND(5)	ND(12)	ND(12)	ND(12)	ND(5)	ND(5)
Benzo(b)flouranthene	ND(5)	ND(5)	ND(5)	ND(5)	300	ND(5)	ND(5)	ND(5)	ND(12)	ND(12)	ND(12)	ND(5)	ND(5)
Benzo(a,h)perylene	ND(5)	ND(5)	ND(5)	ND(5)	120	ND(5)	ND(5)	ND(5)	ND(12)	ND(12)	ND(12)	ND(5)	ND(5)
Benzo(k)flouranthene	ND(5)	nd(5)	ND(5)	ND(5)	110	ND(5)	ND(5)	ND(5)	ND(12)	ND(12)	ND(12)	ND(5)	ND(5)
Chrysene	ND(5)	ND(5)	ND(5)	ND(5)	250	ND(5)	ND(5)	ND(5)	ND(12)	ND(12)	ND(12)	ND(5)	ND(5)
Fluoranthene	ND(5)	ND(5)	ND(5)	ND(5)	570	ND(5)	ND(5)	ND(5)	ND(12)	ND(12)	ND(12)	ND(5)	ND(5)
Flourene	ND(5)	ND(5)	ND(5)	ND(5)	51	ND(5)	ND(5)	ND(5)	37	120	ND(12)	ND(5)	ND(5)
Indeno(1,2,3-cd) pyrene	ND(5)	ND(5)	ND(5)	ND(5)	93	ND(5)	ND(5)	ND(5)	ND(12)	ND(12)	ND(12)	ND(5)	ND(5)
Naphthalene	ND(5)	450	340	ND(5)	2100	ND(5)	ND(5)	ND(5)	100	750	559	ND(5)	ND(5)
Phenanthrene	ND(5)	ND(5)	ND(5)	ND(5)	210	ND(5)	ND(5)	ND(5)	43	100	59	ND(5)	ND(5)
Pyrene	ND(5)	ND(5)	ND(5)	ND(5)	640	ND(5)	ND(5)	ND(5)	ND(12)	ND(12)	ND(12)	ND(5)	ND(5)

TABLE 5-3c
SUMMARY OF ANALYTICAL DATA FOR SOIL (a)

Parameter	Boring/Well Designation No. (b)												
	S-14-15	S-14-20	S-14-25	S-15-5	S-15-10	S-15-15	S-15-20	S-15-25	S-16-5	S-16-10	S-16-15	S-16-20	S-16-25
Gasoline (GRO) and Diesel (DRO) Range Organics using EPA Method 8015B Modified; units in mg/Kg (c)													
Gasoline (GRO)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	100	180	150	ND(1)	ND(1)	250	1.6	67
Diesel (DRO)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	440	1200	780	110	ND(10)	1400	10	37
Volatile Organic Compounds Using EPA Method 8260B; units in ug/Kg (d)													
Benzene	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(250)	ND(250)	ND(250)	ND(250)	ND(5)	ND(5)	ND(5)	ND(5)
cis-1,2, Dichloroethane	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(250)	ND(250)	ND(250)	ND(250)	ND(5)	ND(5)	ND(5)	ND(5)
Ethylbenzene	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(250)	ND(250)	ND(250)	ND(250)	ND(5)	ND(5)	ND(5)	ND(25)
Isopropylbenzene	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(250)	350	320	ND(250)	ND(5)	ND(5)	ND(5)	ND(25)
4-Isopropyltoluene	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(250)	ND(250)	ND(250)	ND(250)	ND(5)	ND(5)	ND(5)	ND(25)
MTBE	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(250)	ND(250)	ND(250)	ND(250)	ND(5)	ND(5)	ND(5)	ND(25)
Naphthalene	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(250)	ND(250)	580	ND(250)	ND(5)	ND(5)	ND(5)	ND(25)
n-Propylbenzene	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(250)	ND(250)	ND(250)	ND(250)	ND(5)	ND(5)	ND(5)	ND(25)
n-Butylbenzene	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(250)	ND(250)	ND(250)	ND(250)	ND(5)	ND(5)	ND(5)	ND(25)
sec-Butylbenzene	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(250)	ND(250)	ND(250)	ND(250)	ND(5)	ND(5)	ND(5)	25
Tert-Butanol	ND(100)	ND(100)	ND(100)	ND(100)	ND(100)	ND(5K)	ND(5K)	ND(5K)	ND(5000)	ND(100)	ND(100)	ND(100)	ND(500)
1,2,4-Trimethylbenzene	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(250)	ND(250)	ND(250)	ND(250)	ND(5)	ND(5)	ND(5)	ND(25)
1,3,5-Trimethylbenzene	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(250)	ND(250)	ND(250)	ND(250)	ND(5)	ND(5)	ND(5)	ND(25)
Toluene	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(250)	ND(250)	ND(250)	ND(250)	ND(5)	ND(5)	ND(5)	ND(2)
Xylenes	ND(250)	ND(5)	ND(5)	ND(5)	ND(5)	ND(250)	ND(250)	ND(250)	ND(250)	ND(5)	ND(5)	ND(5)	ND(25)

TABLE 5-3c

SUMMARY OF ANALYTICAL DATA FOR SOIL (a)

Parameter	Boring/Well Designation No. (b)												
	S-14-15	S-14-20	S-14-25	S-15-5	S-15-10	S-15-15	S-15-20	S-15-25	S-16-5	S-16-10	S-16-15	S-16-20	S-16-25
Semivolatile Organic Compounds using EPA Method 8270C; units in ug/Kg													
Acenaphthene	ND(5)	ND(5)	ND(5)	ND(12)	ND(5)	16	23	21	30	ND(12)	ND(5)	ND(5)	ND(5)
Acenaphthylene	ND(5)	ND(5)	ND(5)	ND(12)	ND(5)	6.1	8.9	7.6	ND(12)	ND(12)	ND(5)	ND(5)	ND(5)
Benzo(a)anthracene	ND(5)	ND(5)	ND(5)	ND(12)	ND(5)	ND(5)	ND(5)	ND(5)	ND(12)	ND(12)	ND(5)	ND(5)	ND(5)
Benzo(a)pyrene	ND(5)	ND(5)	ND(5)	ND(12)	ND(5)	ND(5)	ND(5)	ND(5)	ND(12)	ND(12)	ND(5)	ND(5)	ND(5)
Benzo(b)flouranthene	ND(5)	ND(5)	ND(5)	ND(12)	ND(5)	ND(5)	ND(5)	ND(5)	ND(12)	ND(12)	ND(5)	ND(5)	ND(5)
Benzo(a,h)perylene	ND(5)	ND(5)	ND(5)	ND(12)	ND(5)	ND(5)	ND(5)	ND(5)	ND(12)	ND(12)	ND(5)	ND(5)	ND(5)
Benzo(k)flouranthene	ND(5)	ND(5)	ND(5)	ND(12)	ND(5)	ND(5)	ND(5)	ND(5)	ND(12)	ND(12)	ND(5)	ND(5)	ND(5)
Chrysene	ND(5)	ND(5)	ND(5)	ND(12)	ND(5)	ND(5)	ND(5)	ND(5)	ND(12)	ND(12)	ND(5)	ND(5)	ND(5)
Fluoranthene	ND(5)	ND(5)	ND(5)	ND(12)	ND(5)	ND(5)	ND(5)	ND(5)	ND(12)	ND(12)	ND(5)	ND(5)	ND(5)
Flourene	ND(5)	ND(5)	ND(5)	ND(12)	ND(5)	25	34	31	37	ND(12)	ND(5)	ND(5)	ND(5)
Indeno(1,2,3-cd) pyrene	ND(5)	ND(5)	ND(5)	ND(12)	ND(5)	ND(5)	ND(5)	ND(5)	ND(12)	ND(12)	ND(5)	ND(5)	ND(5)
Naphthalene	ND(5)	450	340	ND(12)	ND(5)	24	50	230	100	ND(12)	ND(5)	ND(5)	33
Phenanthrene	ND(5)	ND(5)	ND(5)	15	ND(5)	34	47	35	42	ND(12)	ND(5)	ND(5)	ND(5)
Pyrene	ND(5)	ND(5)	ND(5)	ND(12)	ND(5)	ND(5)	5.2	ND(5)	ND(12)	ND(12)	ND(5)	ND(5)	ND(5)

Notes:

(a) Soil sampling for Boring/well MW-11 was performed on April 27, 2009; boring/well MW-12 on April 28, 2009; boring/well MW-13 on April 29, 2009; borings/wells MW-14 and MW-15 on June 25, 2009; boring/well MW-16 on June 26, 2009.

(b) Soil sample designation: S = soil; 11 = boring/well designtion; 5 = depth in feet below ground surface.

(c) mg/Kg = milligrams per liter, or equivalent to parts per million.

(d) ug/Kg = micrograms per liter, or equivalent of parts per billion.

(e) ND = Not detected at or above the analytical detection limit; as shown in parens.

Table 5-4

Summary of Analytical Results for Soil for Off-Site Wells MW-17, MW-18 and MW-19

Well No.	Soil Sample Number (feet)(a)	Sample Depth (feet)	Gasoline Range Organics (GRO) (mg/Kg)(b)	Diesel Range Organics (DRO) (mg/Kg)	MTBE (ug/Kg)(c)	Remarks
MW-17	S-17-2	2	ND(1.0)(d)	150	ND(5)	
	S-17-5	5	ND(1.0)	ND(10)	ND(5)	
	S-17-10	10	ND(1.0)	ND(10)	5.30	
	S-17-15	15	ND(1.0)	11	ND(5)	Slight hydrocarbon odor
	S-17-20	20	ND(1.0)	170	6.50	Slight hydrocarbon odor
	S-17-25	25	160	100	ND(5)	Moderate hydrocarbon odor
MW-18	NA	NA	NA	NA	NA	
MW-19	S-19-5	5	ND(1.0)	23	ND(5)	
	S-19-10	10	ND(1.0)	28	ND(5)	
	S-19-15	15	2.4	280	ND(5)	
	S-19-20	20	3.2	360	ND(5)	

(a) Drilling of MW-17 and soil sampling was performed on August 30, 2010, MW-18 on December 3, 2010, and MW-19 on February 12, 2011.

(b) mg/Kg = milligrams per kilogram, or equivalent to parts per million.

(c) ug/Kg = micrograms per kilogram, or equivalent ot parts per billion.

(d) ND = Not detected at or above the analytical detection limit as shown in parens.

TABLE 5-5

Summary of Soil Quality for Eastern Parcel Stockpiles (a)

Parameter	Soil Stockpile Sample Number						
	SS-EP-1	SS-EP-2	SS-EP-3	SS-EP-4	SS-EP-5	SS-EP-6	SS-EP-COMPOSITE
Gasoline (GRO) and Diesel (DRO) Range Organics using EPA Method 8015B Modified; units in mg/Kg (c)							
Gasoline (GRO)	ND(1.0)	ND(1.0)	ND(1.0)	ND(1.0)	ND(1.0)	ND(1.0)	
Diesel (DRO)	65	150	46	53	44	42	
Semi-Volatile Organic Compounds Using EPA Method 8270B; units in ug/Kg (d)							
Benzo(a)anthracene	59	68	34	ND(12)	ND(12)	ND(12)	
Benzo(a)pyrene	80	83	42	ND(12)	ND(12)	ND(12)	
Benzo(b)fluoranthene	95	100	49	ND(12)	ND(12)	ND(12)	
Benzo(g,h,i)perylene	89	95	52	ND(12)	13	ND(12)	
Benzo(k)fluoranthene	25	27	15	ND(12)	ND(12)	ND(12)	
Chrysene	87	81	42	ND(12)	ND(12)	ND(12)	
Dibenz(a,h)anthracene	14	17	ND(12)	ND(12)	ND(12)	ND(12)	
Fluoranthene	94	110	48	ND(12)	ND(12)	ND(12)	
Indeno(1,2,3-cd)pyrene	41	57	27	ND(12)	ND(12)	ND(12)	
Phenanthrene	36	40	16	ND(12)	ND(12)	ND(12)	
Pyrene	120	140	66	ND(12)	ND(12)	ND(12)	
Metals Using EPA Method 3050B/6010B in mg/Kg							
Arsenic							4.6
Barium							120
Chromium							17
Cobalt							7.5
Copper							23
Lead							8
Nickel							14
Vanadium							33
Zinc							53

TABLE 6-1
SUMMARY OF ANALYTICAL DATA FOR GROUNDWATER - MARCH 2011 (a)

Parameter	Well Designation No.															
	MW-1	MW-1A	MW-2	MW-3	MW-8	MW-9	MW-10	MW-11 R-4(b)	MW-12 R-5(b)	MW-13 MW-7(b)	MW-14 R-6(b)	MW-15	MW-16	MW-17	MW-18	MW-19
Gasoline and Diesel Range Organics using EPA Method 8015B Modified; Silica Gel Rinse also used for Diesel Range Organics; units in mg/L (c)																
Gasoline (GRO)	ND(0.20)	1.2	ND(0.20)	ND(0.20)	1.8	5.2	ND(0.20)	19	14	0.89	ND(0.20)	0.77	2.7	0.35	ND(0.20)	1.3
Diesel (DRO)	5.5	2.4	ND(0.20)	ND(0.21)	6.5	2.3	4.9	11	9.2	8.5	ND(0.20)	5.5	2.6	1.1	ND(0.20)	3.7
Diesel (DRO,sgr)	0.65	0.46	ND(0.20)	ND(0.20)	1.1	ND(0.20)	0.3	1.7	1	1.1	ND(0.20)	0.57	0.66	ND(0.20)	ND(0.20)	0.45
Volatile Organic Compounds Using EPA Method 8260B; units in ug/L (d)																
Benzene	ND(5.0)	ND(5.0)	ND(5.0)	ND(5.0)	46	90	ND(5.0)	5100	ND(20)	ND(5.0)	ND(5.0)	ND(5.0)	ND(5.0)	ND(5.0)	ND(5.0)	ND(5.0)
Ethylbenzene	ND(5.0)	6	ND(5.0)	ND(5.0)	13	59	ND(5.0)	610	470	ND(5.0)	ND(5.0)	ND(5.0)	ND(5.0)	ND(5.0)	ND(5.0)	47
Isopropylbenzene	ND(5.0)	42	ND(5.0)	ND(5.0)	68	55	ND(5.0)	120	130	51	ND(5.0)	59	150	ND(5.0)	ND(5.0)	85
4-Isopropyltoluene	ND(5.0)	ND(5.0)	ND(5.0)	ND(5.0)	ND(5.0)	ND(5.0)	ND(5.0)	ND(100)	88	ND(5.0)	ND(5.0)	ND(5.0)	ND(5.0)	ND(5.0)	ND(5.0)	ND(5.0)
MTBE	ND(5.0)	11	ND(5.0)	ND(5.0)	32	ND(5.0)	ND(5.0)	ND(100)	ND(20)	19	ND(5.0)	ND(5.0)	26	130	ND(5.0)	ND(5.0)
Naphthalene	ND(5.0)	120	ND(5.0)	ND(5.0)	130	130	ND(5.0)	240	420	250	ND(5.0)	18	78	ND(5.0)	ND(5.0)	250
n-Propylbenzene	ND(5.0)	1.6	ND(5.0)	ND(5.0)	57	53	ND(5.0)	120	130	44	ND(5.0)	16	87	ND(5.0)	ND(5.0)	31
n-Butylbenzene	ND(5.0)	ND(5.0)	ND(5.0)	ND(5.0)	ND(5.0)	ND(5.0)	ND(5.0)	ND(100)	28	ND(5.0)	ND(5.0)	ND(5.0)	ND(5.0)	ND(5.0)	ND(5.0)	ND(5.0)
sec-Butylbenzene	ND(5.0)	7.3	ND(5.0)	ND(5.0)	9.1	9	ND(5.0)	ND(100)	35	11	ND(5.0)	9.8	32	ND(5.0)	ND(5.0)	12
Tert-Butanol	ND(100)	ND(100)	ND(100)	ND(100)	380	ND(100)	ND(100)	ND(2000)	320	ND(100)	ND(100)	ND(100)	ND(100)	ND(100)	ND(100)	ND(100)
1,2,4-Trimethylbenzene	ND(5.0)	5.2	ND(5.0)	ND(5.0)	ND(5.0)	12	ND(5.0)	110	730	ND(5.0)	ND(5.0)	ND(5.0)	ND(5.0)	ND(5.0)	ND(5.0)	ND(5.0)
1,3,5-Trimethylbenzene	ND(5.0)	ND(5.0)	ND(5.0)	ND(5.0)	ND(5.0)	ND(5.0)	ND(5.0)	ND(100)	110	ND(5.0)	ND(5.0)	ND(5.0)	ND(5.0)	ND(5.0)	ND(5.0)	ND(5.0)
Toluene	ND(5.0)	ND(5.0)	ND(5.0)	ND(5.0)	ND(5.0)	5.4	ND(5.0)	ND(100)	ND(20)	ND(5.0)	ND(5.0)	ND(5.0)	ND(5.0)	ND(5.0)	ND(5.0)	ND(5.0)
m,p-Xylenes	ND(10.0)	ND(10)	ND(10)	ND(10)	ND(10)	82	ND(10)	210	270	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(5.0)
o-Xylene	ND(5.0)	ND(5.0)	ND(5.0)	ND(5.0)	ND(5.0)	6.5	ND(5.0)	ND(100)	ND(20)	ND(5.0)	ND(5.0)	ND(5.0)	ND(5.0)	ND(5.0)	ND(5.0)	ND(5.0)

TABLE 6-1
SUMMARY OF ANALYTICAL DATA FOR GROUNDWATER - MARCH 2011 (a)

Parameter	Well Designation No.															
	MW-1	MW-1A	MW-2	MW-3	MW-8	MW-9	MW-10	MW-11 R-4(b)	MW-12 R-5(b)	MW-13 MW-7(b)	MW-14 R-6(b)	MW-15	MW-16	MW-17	MW-18	MW-19
Semi-volatile Organic Compounds using EPA Method 8270C; units in ug/L																
2-Methylnaphthalene	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)
Naphthalene	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)
Phenol	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)

Notes:

(a) Groundwater sampling was performed on March 3-4, 2011.

(b) Wells MW-11, MW-12, MW-13 and MW-14 serve as replacement wells for former LNAPL recovery wells R-4 and R-5, former monitoring well MW-13, and former LNAPL recovery well R-6, respectively.

(c) mg/L = milligrams per liter, or equivalent to parts per million.

(d) ug/L = micrograms per liter, or equivalent of parts per billion.

(e) ND = Not detected at or above the analytical detection limit; as shown in parens.

(f) Highlighted concentrations exceed Maximum Contaminant Levels (MCLs) or State Notification Levels in ug/L.

TABLE 7-1

On-Site Soil Vapor Analytical Summary (Tetra Tech, 2006)
Western Parcel

Parameter	SB1		SB2		SB3		SB4		E1
	5 feet	15 feet	5 feet	15 feet	5 feet	15 feet	5 feet	15 feet	15 feet
Total VOCs(a)	6,400	55,280	257,200	338,000	37,700	31,630-67,740	43,420	1,307,500	10,000
Benzene	ND(1.0)(b)	24,000	242,000	230,000	12,100	2,500-7,140	10,100	802,000	ND(1.0)
Ethylbenzene	2,100	26,900	15,200	108,000	25,600	22,300-60,600	6,810	159,000	10,800
Methyl ter-butyl ether (MTBE)	ND(1.0)	ND(1.0)	ND(1.0)	ND(1.0)	ND(1.0)	ND(1.0)	1,680	ND(1.0)	ND(1.0)
Toluene	ND(1.0)	ND(1.0)	ND(1.0)	ND(1.0)	ND(1.0)	ND(1.0)	ND(1.0)	ND(1.0)	ND(1.0)
1,2,4-Trimethylbenzene	4,300	4,380	ND(1.5)	ND(1.5)	ND(1.5)	2,490-3,500	10,300	7,770	ND(1.5)
1,3,5-Trimethylbenzene	ND(1.5)	ND(1.5)	ND(1.5)	ND(1.5)	ND(1.5)	1,720-3,370	5,490	5,830	ND(1.5)
Xylenes, m-,p-	ND(1.0)	ND(1.0)	ND(1.0)	ND(1.0)	ND(1.0)	ND(1.0)	9,040	221,000	ND(1.0)
Xylenes, o-	ND(2.0)	ND(2.0)	ND(2.0)	ND(2.0)	ND(2.0)	ND(2.0)	ND(2.0)	41,100	ND(2.0)

(a) VOCs = Volatile organic compounds
(b) ND = Not detected at or above analytical reporting limits shown in parens
(c) Highlighted concentrations exceed California Human Health Screening Levels or CHHSLs (CalEPA, 2005)

TABLE 7-2a

SUMMARY OF SOIL GAS SURVEY DATA - SOUTHERN PERIMETER (a)

Location: Along the southern perimeter of the Western Parcel from west to east

Parameter	CHHSLs Residential Land Use	CHHSLs Commerical/Industrial Land Use	SGP-1-5 (b)	SGP-1-15	SGP-2-5	SGP-2-15	SGP-3-5	SGP-3-15	SGP-4-5	SGP-4-15	SGP-5-5	SGP-5-15	SGP-6-5	SGP-6-15	SGP-7-5	SGP-7-15
Benzene	36.2	222	220	36	ND	ND	53	ND	82	ND	77	ND	2,100	ND	76	ND
	36.2	222	430	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ethylbenzene	980*	3,300**	780	ND	ND	1,500	ND	580	990	ND	220	ND	ND	110	ND	ND
	980*	3,300**	960	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	980*	3,300**	180	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Isopropylbenzene	NLE	NLE	780	90	ND	580	ND	6,900	1,300	10,000	450	6,500	910	17,000	950	17,000
	NLE	NLE	150	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MTBE	4,000	13,400	ND	ND	60	410	3,400	ND	ND	ND	ND	ND	ND	ND	ND	ND
	4,000	13,400	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
n-Propylbenzene	NLE	NLE	80	ND	ND	ND	ND	5,900	640	ND	280	4,200	740	12,000	6,300	6,200
sec-Butylbenzene	NLE	NLE	ND	ND	ND	ND	1,600	ND	260	3,100	140	2,700	240	3,400	170	3,000
	NLE	NLE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Tert-Butylbenzene	NLE	NLE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Toluene	135,000	378,000	290	ND	ND	950	ND	ND	2,000	ND	ND	ND	ND	ND	ND	ND
	135,000	378,000	330	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,4-Trimethylbenzene	NLE	NLE	220	220	ND	130	ND	ND	ND	ND	150	ND	ND	ND	ND	ND
	NLE	NLE	190	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,3,5-Trimethylbenzene	NLE	NLE	50	ND	ND	60	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Xylenes	319,000	887,000	50	300	ND	5,200	ND	ND	3,230	ND	150	ND	ND	190	60	ND
	319,000	887,000	1,040	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	319,000	887,000	180	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

NOTES:

(a) All units in micrograms per cubic meter (ug/m3).

(b) SGP-1-5 = soil gas probe - probe number - depth in feet below ground surface.

(c) ND = Not detected at or above parameter's respective analytical detection level.

(d) D = Duplicate.

NLE = no level established.

* RWQCB Region 2; Environmental Screening Level, lowest residential.

** RWQCB Region 2; Environmental Screening Level, lowest commercial/industrial.

TABLE 7-2b

SUMMARY OF SOIL GAS SURVEY DATA - WESTERN PERIMETER (a)

Location: Along Gundry Avenue immediately west of the Western Parcel.

Parameter	CHHSLs Residential Land Use	CHHSLs Commerical/Industrial Land Use	Soil Gas Probe No. Gdy-1-5 (b)	Gdy-1-15	Gdy-2-5	Gdy-2-15	Gdy-3-5	Gdy-3-15	Gdy-4-5	Gdy-4-15	Gdy-5-5	Gdy-5-15	Gdy-6-5	Gdy-6-15	Gdy-7-5	Gdy-7-15	Gdy-7-15 (c)
Benzene	36.2	122	89	ND	ND	ND	ND	ND	51	ND	ND	ND	ND	ND	ND	ND	NA
Cyclohexane	NLE	NLE	NA(e)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	260
Ethylbenzene	980*	3,300**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA
Isopropylbenzene	NLE	NLE	100	9,200	ND	630	ND	1,100	ND	1,900	ND	ND	ND	ND	ND	15,000	NA
	NLE	NLE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA
MTBE	4,000	13,400	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA
n-Propylbenzene	NLE	NLE	ND	570	ND	ND	ND	670	ND	1,200	ND	ND	ND	ND	ND	5,900	NA
sec-Butylbenzene	NLE	NLE	ND	2,300	ND	1,800	580	3,000	ND	3,900	ND	2,100	ND	ND	ND	2,800	NA
	NLE	NLE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA
Tert-Butylbenzene	NLE	NLE	ND	510	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA
Toluene	135,000	378,000	250	ND	ND	ND	ND	ND	250	510	93	ND	ND	ND	ND	820	NA
1,2,4-Trimethylbenze	NLE	NLE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA
1,3,5-Trimethylbenze	NLE	NLE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA
Xylenes	319,000	887,000	120	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA

NOTES:

(a) All units in micrograms per cubic meter (ug/m3).

(b) Gdy-1-5 = Gundry Avenue - probe number - depth in feet below ground surface.

(c) EPA TO-15 analysis

(d) ND = Not detected at or above parameter's analytical detection level.

(e) NA = Not analyzed

(f) D = Duplicate sample.

* RWQCB Region 2: Environmental Screening Level, lowest residential

** RWQCB Region 2; Environmental Screening Level, lowest commercial/industrial

TABLE 7-2c

SUMMARY OF SOIL GAS SURVEY DATA - EASTERN PERIMETER(a)

Location: Along Walnut Avenue immediately west of the Western Parcel

Parameter			Soil Gas Probe Number							
	CHHSLs Residential Land Use	CHHSLs Commerical/Industrial Land Use	Wnt-1-5 (b)	Wnt-1-15	Wnt-1-15 (c)	Wnt-2-5	Wnt-2-15	Wnt-3-5	Wnt-3-15	Wnt-4-5
Benzene	36.2	122	43	ND	6	ND	ND	51	ND	ND
Cyclohexane	NLE	NLE	ND	ND	68	ND	ND	ND	ND	ND
cis-1,2-Dichloroethane	NLE	NLE	ND	ND	39	ND	ND	ND	ND	ND
1,1-Dichloroethane	1,500	5,100	ND	ND	3	ND	ND	ND	ND	ND
1,2-Dichloroethane	94	3,100	ND	ND	4	ND	ND	ND	ND	ND
Ethylbenzene	980*	3,300**	61	ND	21	ND	1,600	ND	620	260
Heptane	NLE	NLE	ND	ND	34	ND	ND	ND	ND	ND
Isopropylbenzene	NLE	NLE	ND	75	ND	23,000	ND	280	81,000	ND
MTBE	4,000	13,400	ND	ND	ND	ND	47,000	ND	ND	ND
n-Propylbenzene	NLE	NLE	ND	ND	ND	2,200	8,700	ND	17,000	ND
Propylene	NLE	NLE	ND	ND	190	ND	ND	ND	ND	ND
sec-Butylbenzene	NLE	NLE	ND	ND	ND	1,300	1,800	ND	8,900	ND
TertButylbenzene	NLE	NLE	ND	ND	ND	ND	ND	ND	630	ND
Toluene	135,000	378,000	150	88	290	840	600	130	740	130
1,1,1-Trichloroethane	NLE	NLE	ND	ND	33	ND	ND	ND	ND	ND
1,2,4-Trimethylbenzene	NLE	NLE	ND	ND	ND	ND	ND	ND	ND	ND
1,3,5-Trimethylbenzene	NLE	NLE	ND	ND	ND	ND	ND	ND	ND	ND
Xylenes	319,000	887,000	255	130	26	ND	ND	ND	ND	960

NOTES:

(a) All units in micrograms per cubic meter (ug/m3).

(b) Wnt-1-5 = Walnut Avenue - probe number - depth in feet below ground surface.

(c) EPA TO-15 analysis

(d) ND = Not detected at or above parameter's analytical detection level.

(e) NA = Not analyzed

NLE = no level established

* RWQCB Region 2; Environmental Screening Level, lowest residential

** RWQCB Region 2; Environmental Screening Level, lowest commercial/industrial

TABLE 7-2d

SUMMARY OF SOIL GAS SURVEY DATA - NORTHERN PERIMETER (a)

Parameter	CHHSLs Residential Land Use	CHHSLs Commercial/Industrial Land Use	Hill-1-5 (b)	Hill-1-15	Hill-2-15	Hill-2-15	Hill-3-5	Hill-3-15	Hill-4-5	Hill-4-15
			Soil Gas Probe Number							
Benzene	36.2	122	50	ND	ND	ND	86	ND	ND	ND
Ethylbenzene	980*	3,300**	ND	ND	ND	ND	ND	ND	ND	ND
Isopropylbenzene	NLE	NLE	ND	ND	ND	ND	ND	ND	ND	ND
MTBE	4,000	13,400	ND	ND	ND	ND	ND	ND	ND	ND
n-Propylbenzene	NLE	NLE	ND	ND	ND	ND	ND	ND	ND	ND
sec-Butylbenzene	NLE	NLE	ND	ND	ND	ND	ND	ND	ND	ND
Tert-Butylbenzene	NLE	NLE	ND	ND	ND	ND	ND	ND	ND	ND
Toluene	135,000	378,000	180	ND	ND	68	250	130	ND	ND
	135,000	378,000	ND	ND	ND	69	ND	ND	ND	ND
1,2,4-Trimethylbenzene	NLE	NLE	ND	ND	ND	110	ND	ND	ND	ND
	NLE	NLE	ND	ND	ND	99	ND	ND	ND	ND
1,3,5-Trimethylbenzene	NLE	NLE	ND	ND	ND	ND	ND	ND	ND	ND
Xylenes	319,000	887,000	ND	ND	ND	ND	120	ND	ND	ND

NOTES:

(a) All units in micrograms per cubic meter (ug/m3).

(b) Hill-1-5 = Hill Street - probe number - depth in feet below ground surface.

(c) ND = Not detected at or above parameter's respective analytical detection level.

NLE = no level established.

* RWQCB Region 2; Environmental Screening Level, lowest residential.

** RWQCB Region 2; Environmental Screening Level, lowest commercial/industrial.

TABLE 7-3

ANALYTICAL RESULTS FOR OFF SITE SOIL GAS SURVEY (a) - SOUTH OF SITE

Location: Adjacent to southern perimeter, off-site, along Wesley Drive

Parameter	CHHSLs Residential Land Use	CHHSLs Commerical/Industrial Land Use	Soil Gas Probe No. - Depth below ground surface in feet (b)												
			SGP-WD-1-5 (b)	SGP-WD-2-5	SGP-WD-2-5	SGP-WD-2-10	SGP-WD-3-5	SGP-WD-3-10	SGP-WD-4-5	SGP-WD-4-10	SGP-WD-4-10	SGP-WD-5-5	SGP-WD-5-10	SGP-WD-6-5	SGP-WD-6-10
				EPA TO-15							EPA TO-15				
Acetone	NLE (c)	NLE	ND (d)	ND	270	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Butanone	NLE	NLE	ND	ND	52	ND	ND	ND	ND	ND	ND	D	ND	ND	ND
Benzene	36.2	122	56(39)	47(DUP 47)(e)	47	ND	ND	ND	ND	ND	ND	39	ND	71	53
Chlorobenzene	NLE	NLE	ND	ND	180	ND	ND	ND	ND	ND	2,500	ND	ND	ND	ND
Ethylbenzene	NLE	NLE	ND	ND	81	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Isopropylbenzene	NLE	NLE	ND	ND	ND	62	ND	4,900	ND	ND	ND	ND	ND	ND	ND
4-Methyl-2-Pentanone	NLE	NLE	ND	ND	77	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MTBE	4,000	13,400	ND	ND	ND	150	ND	ND	ND	ND	ND	ND	ND	ND	ND
sec-Butylbenzene	NLE	NLE	ND	ND	ND	ND	ND	1,500	ND	510	ND	ND	ND	ND	ND
Toluene(1V)	135,800	378,000	77	ND	NA (f)	ND	ND	ND	ND	ND	NA	ND	ND	200	ND
Toluene 1V (3V)(7V)	135,800	378,000	77(150)(140)	160(DUP 160)	170	71	ND	ND	60	530	ND	130	ND	ND	130
1,1,1-Trichloroethane	NLE	NLE	100	350(DUP 340)	230	50	ND	ND	270	ND	ND	330	ND	420	170
Xylenes -m,p	319,400	857,000	ND	130(DUP 120)	120	ND	ND	ND	ND	ND	ND	ND	ND	100	ND
Xylenes -o	319,800	879,000	ND	ND	43	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Petroleum Hydrocarbons (ug/L; C4-C12)			ND (50)	ND (50)		99	5,400	5,300	380	9,100		180	160	ND(50)	100

NOTES:

(a) All units in micrograms per cubic meter (ug/m3).

(b) SGP-WD-1-5 = soil gas probe - Wesley Drive - probe number - depth in feet below ground surface.

(c) NLE = No level established.

(d) ND = Not detected at or above parameter's respective analytical detection level.

(e) DUP = Duplicate.

(f) NA = Not analyzed.

TABLE 8-1
Summary of Former LNAPL Characteristics

Pool No.	Well No.	Estimated Extent (acres)	Estimated Extent (feet)	Estimated Original Volume (barrels)[a]	Lead Content (ppm)	LNAPL Type	Specific Gravity	API Gravity	Apparent LNAPL Thickness[b] (feet)	Actual LNAPL Thickness[c] (feet)
I	R-4[d]	15,880	0.13	463	10.9	naphtha, kerosene and light gas-oil	0.8022	44.9[e]	2.65	0.53
	MW-9[f]				198.2	naphtha, kerosene, light gas-oil, and trace gasoline	0.7914	47.3	ND[g]	<0.01 (not detected)
II	R-6[d]	NA[h]	2.7	NA	ND	crude oil	0.9402	19.0	0.25[i]	<0.01
III	R-5[d]	1700	0.04	21	179	naphtha, kerosene and light to heavy gas-oil	0.8208	40.9	ND	<0.01

(a) Reflects total in-place LNAPL volume, rather than recoverable volume, prior to LNAPL recovery system operation. One barrel = 42 gallons.
(b) Data generated on June 29, 1999, with exception to that generated for R-4 and MW-9, which was generated on December 4, 2002.
(c) Actual volume is conservative and reflects actual LNAPL thickness in addition to the height of the capillary fringe based upon baildown testing conducted in February 1995 (Testa and Winegardner, 2000).
(d) Former LNAPL recovery wells R-4, R-5 and R-6 properly abandoned in 2009.
(e) Apparent LNAPL thickness prior to LNAPL recovery operations was 4.49 feet.
(f) Apparent LNAPL thickness prior to LNAPL recovery operations was 0.80 feet; current gauging results as of March 3-4, 2011, are reported as ND.
(g) ND = Not detected.
(h) NA = Not applicable.
(i) Apparent LNAPL thickness prior to LNAPL recovery operations was 0.28 feet.

Help

Date: Mon, 20 Jun 2011 17:45:49 -0700
From: Tom Graf <tgraf@jordangraf.com>
To: stesta <stesta@goldrush.com>
CC: hchang@lfvc.com, Jerry Lorenzo <jerry@footprintsinvestments.com>, Louis Johnston < .....
Subject: Re: Phase III Report - Figures

Stephen -

For figure 6-4 - the lower contour below MW-17 shouldn't be closed (and also MW-16), since we're indicating MTBE is from an off-site source.

I don't understand figure 7-2 - maybe we should just show concentrations, rather than contours. Soil gas concentrations likely underlie the site itself.

On Mon, Jun 20, 2011 at 11:09 AM, stesta <stesta@goldrush.com> wrote:

Dear Harry:

Attached is one pdf file that contains the following figures:

2-1, 2-2,2-3, 2-4 and 2-5

3-1

6-1, 6-2, 6-3 adn 6-4

7-1 and 7-2

Please note in the converting from an AutoCad file to a pdf file, certain formatting errors occur that do not show up on the originals. Other figures are forthcoming.

Warm regards.

Stephen

Dear Harry - Attached are the Tables that accompany the Phase III report. Please note that potential action levels are highlighted in yellow on the various tables where such levels are applicable.

Figures are being forwarded under a separate email later this morning.

Regards.

Stephen

Dear Harry:

Attached please find a draft of the Phase III report. Tables and pertinent figures will be forwarded under separate emails.

Based on our previous discussions, please note that I did not discuss proposed clean-up levels since it is my understanding that this discussion would be deferred until the Phase III report is reviewed by the water board (along with the risk assessment that was previously performed), we had an opportunity to meet with Ann Lin to discuss the report, and development plans are better defined. Let me know should this understanding not be consistent with yours and Tom's recollection.

I look forward to any comments received, and plan to assemble and have the report ready to be forwarded to the water board by end of week, notwithstanding comments that may need to be addressed.

I trust all is well.

Warm regards.

Stephen

--
Tom Graf
Jordan & Graf
855 Mahler Road
Burlingame, CA 94010
(415) 290-5034

REPORT ON PHASE III ADDITIONAL SITE CHARACTERIZATION
JUNE 2011
FORMER CHEMOIL REFINERY
SIGNAL HILL, CALIFORNIA

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(Continued)

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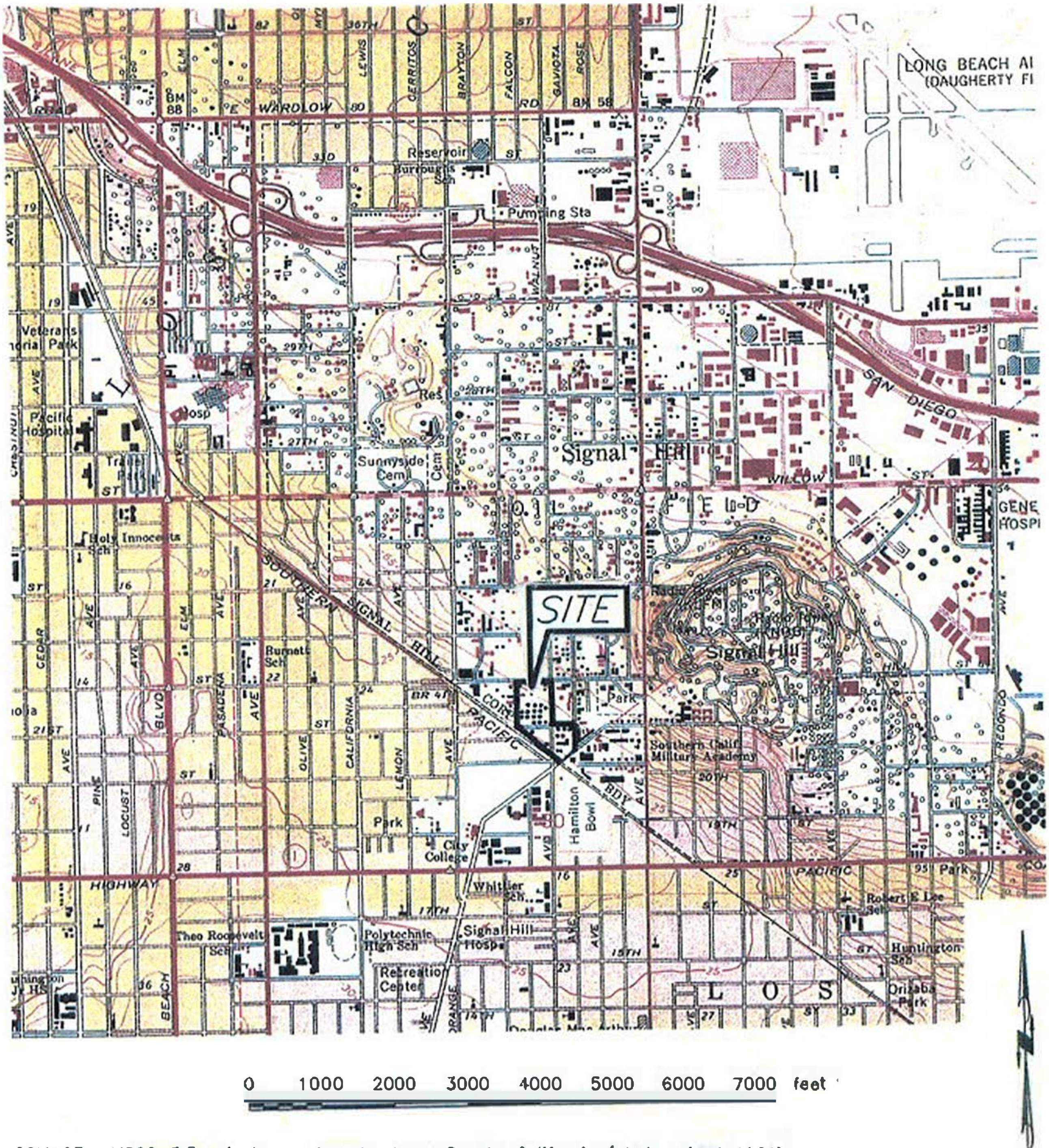


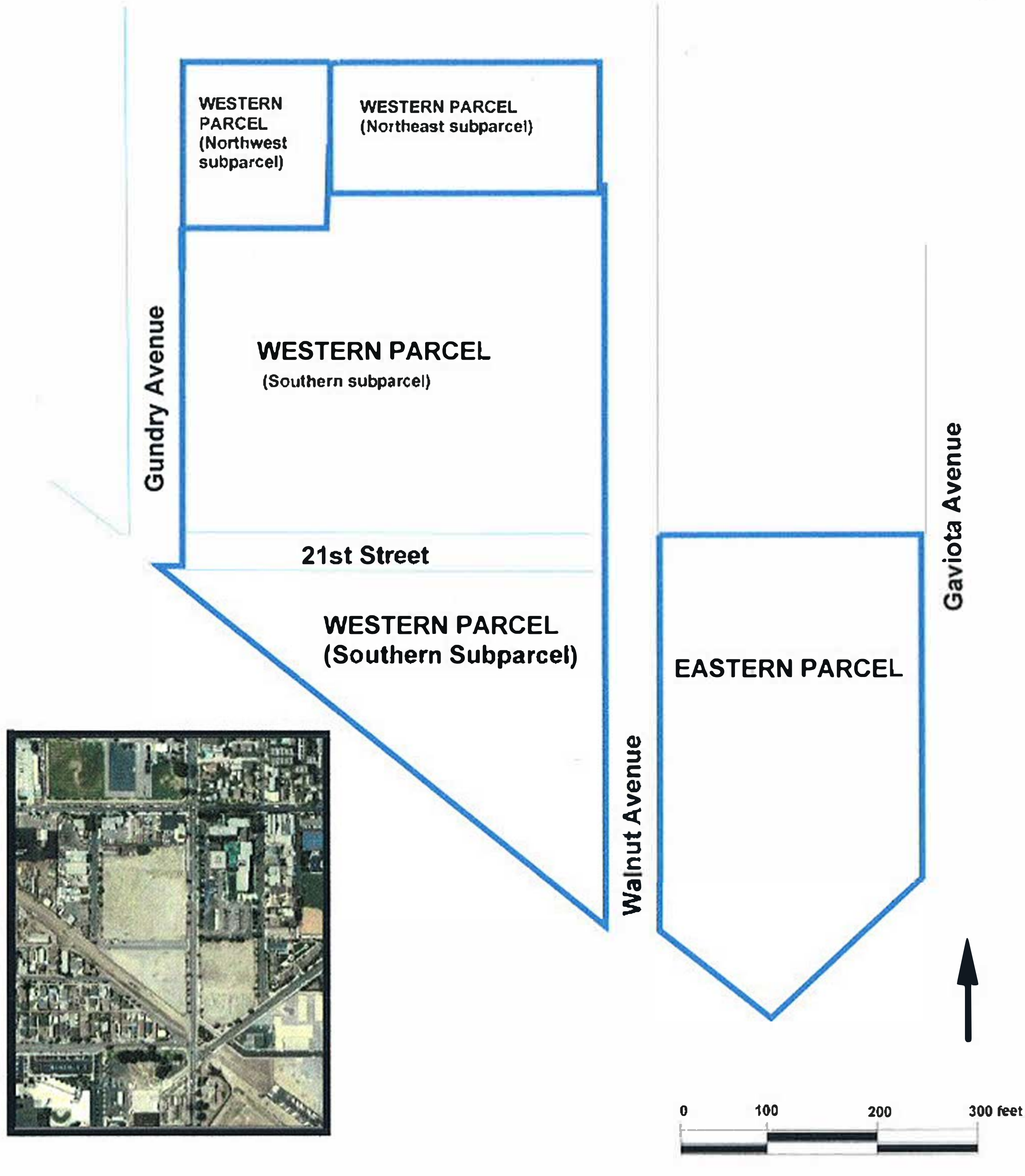
SOURCE: USGS 7.5-minute quadrangle, Long Beach, California (photorevised 1981).

SITE LOCATION MAP
FORMER CHEMOIL REFINERY
SIGNAL HILL, CALIFORNIA

Testa Environmental Corporation

Earth Sciences & Environmental Specialists

PROJECT NO.	FILE	FIGURE NO.
94-11-1008	.74	2-1
DATE: June 2011	DRAWN BY: SMT	



SITE LAYOUT MAP
FORMER CHEMOIL REFINERY SITE
SIGNAL HILL, CALIFORNIA

Testa Environmental Corporation

Earth Sciences & Environmental Specialists

PROJECT NO: 94-11-1008	FILE: .74	FIGURE NO:
DATE: June 2011	DRAWN BY: SMT	2-2

ZONING MAP (SOUTH-WEST)

EXPLANATION

CO = Commercial Office
LI = Light Industrial
OS = Open Space
RH = Residential High Density
RLM-2 = Residntial Low/Medium
SP-7 = Specific Purpose Housing Specific Plan

CITY OF SIGNAL HILL LAND USE MAP
FORMER CHEMOIL REFINERY
SIGNAL HILL, CALIFORNIA

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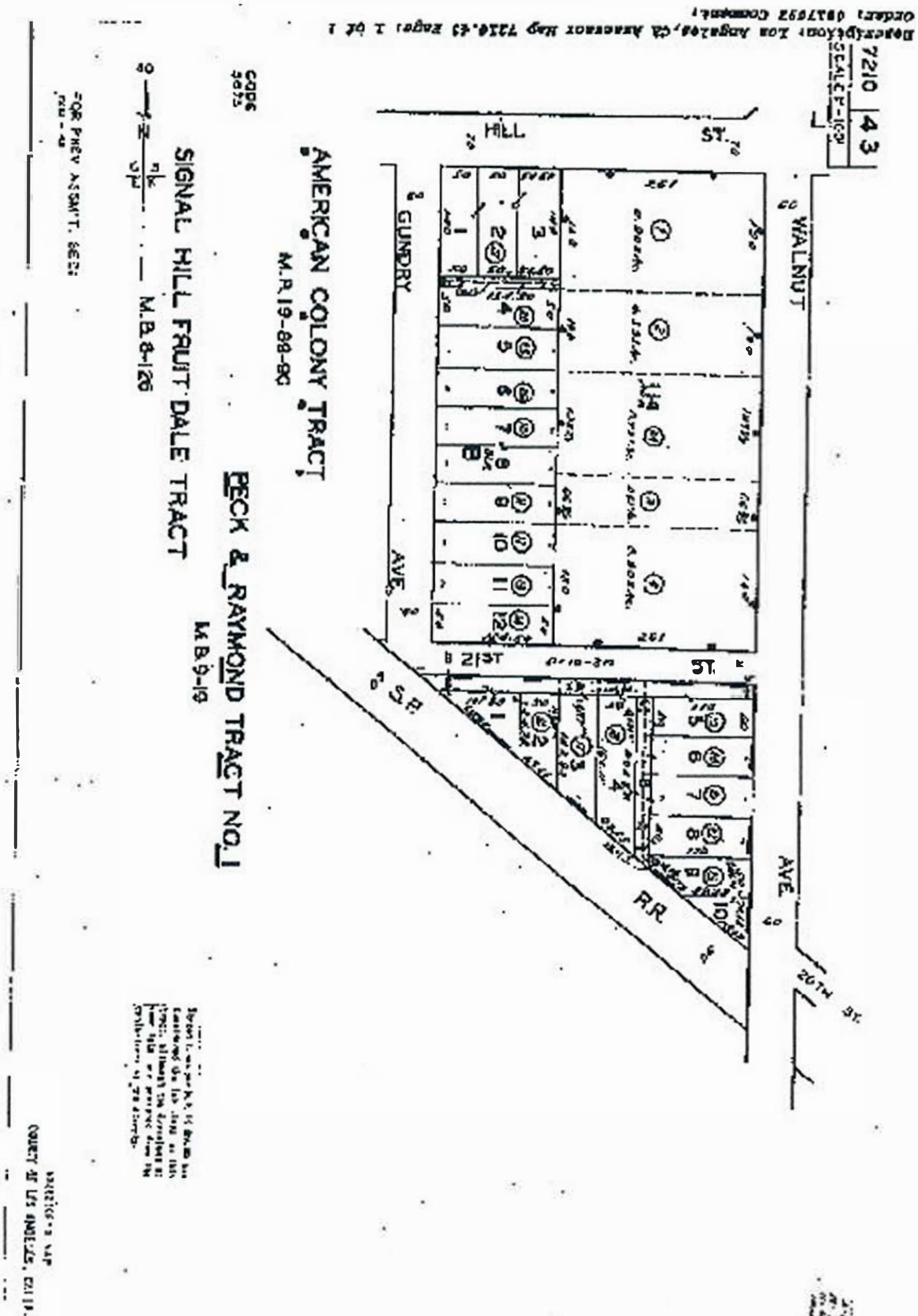
Earth Sciences & Environmental Specialists

PROJECT NO: 94-11-1008	FILE: .74	FIGURE NO:	
DATE: June 2011	DRAWN BY: SMT	2-3	



WESTERN PARCELS SUBPARCEL MAP
FORMER CHEMOIL REFINERY
SIGNAL HILL, CALIFORNIA

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Earth Sciences & Environmental Specialists

PROJECT NO: 94-11-1008	FILE: .74	FIGURE NO:	
DATE: June 2011	DRAWN BY: SMT	2-4	

CURRENT SITE CONDITIONS
FORMER CHEMOIL REFINERY
SIGNAL HILL, CALIFORNIA

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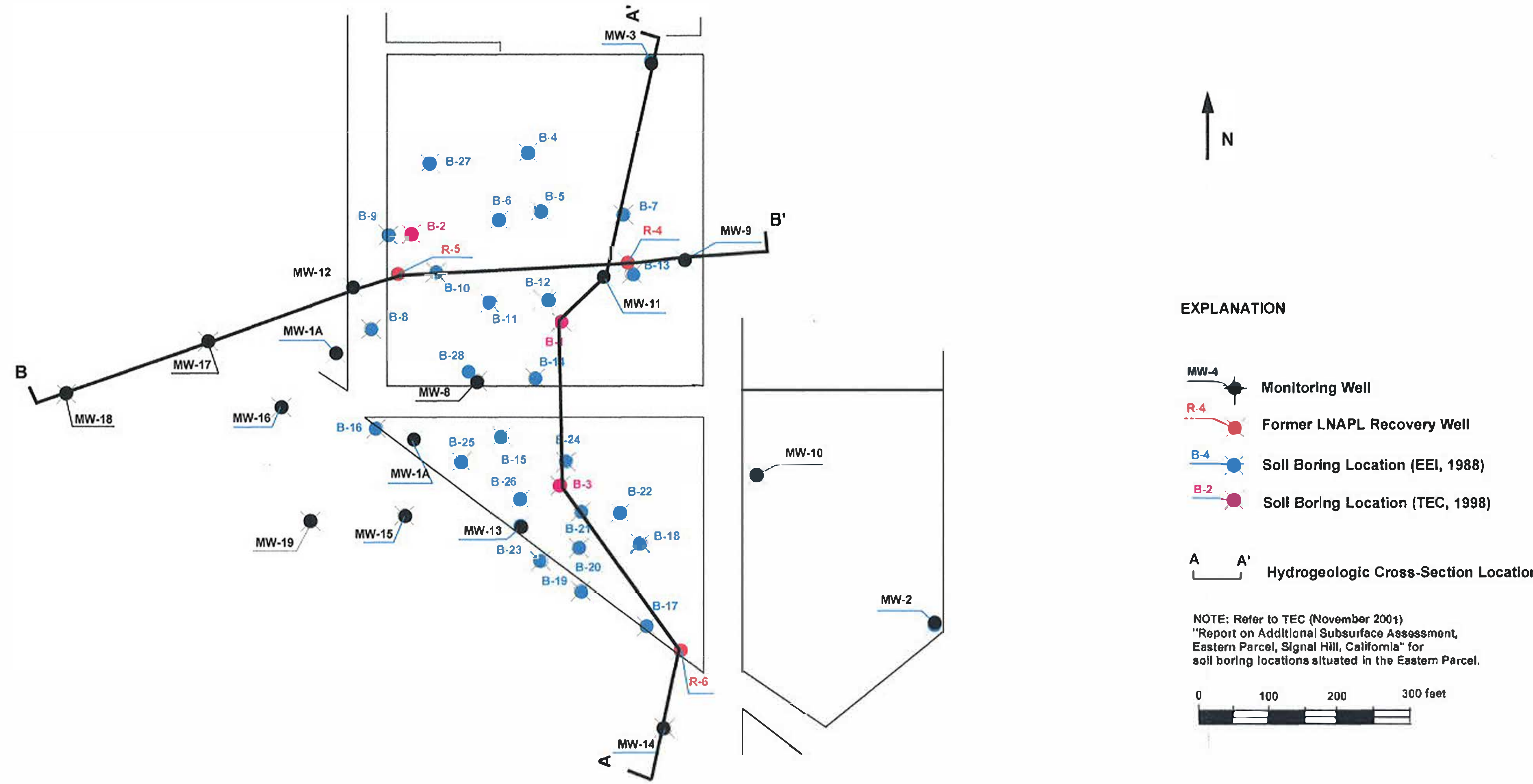
PROJECT NO. 94-11-1008	FILE: .74	FIGURE NO. 2-5
DATE: June 2011	DRAWN BY: SMT	

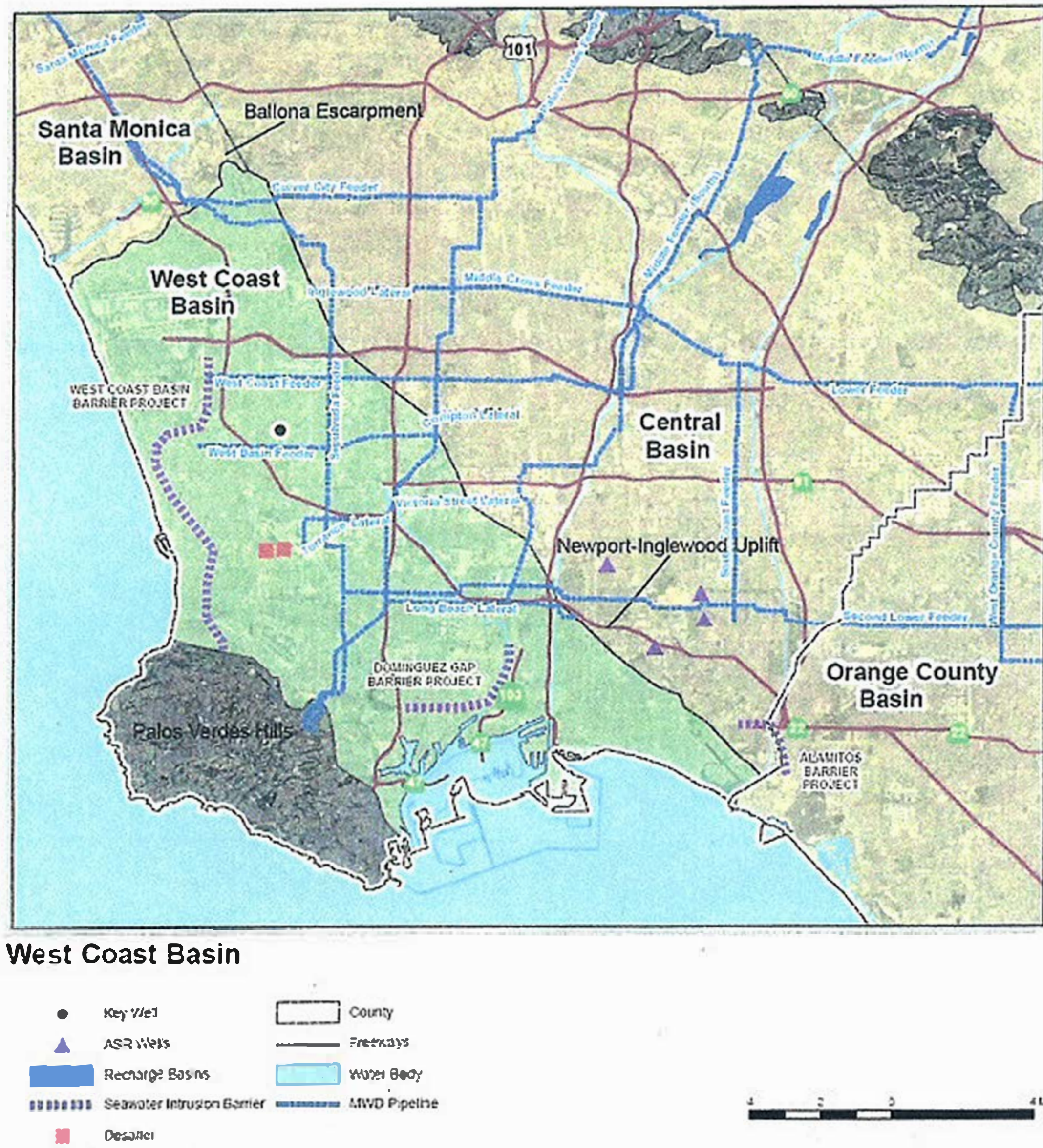


LOCATION OF SOIL BORINGS, MONITORING WELLS AND FORMER RECOVERY WELLS
FORMER CHEMOIL REFINERY
SIGNAL HILL, CALIFORNIA

Testa Environmental Corporation

Earth Sciences & Environmental Specialists

PROJECT NO:	94-11-1008	FILE:	.74	FIGURE NO:	
DATE:	June 2011	DRAWN BY:	SMT		3-1



NOTE: Source: Water Replenishment District of Southern California, 2007).

SITE LOCATION RELATIVE TO THE NEWPORT-INGLEWOOD STRUCTURAL ZONE
FORMER CHEMOIL REFINERY
SIGNAL HILL, CALIFORNIA

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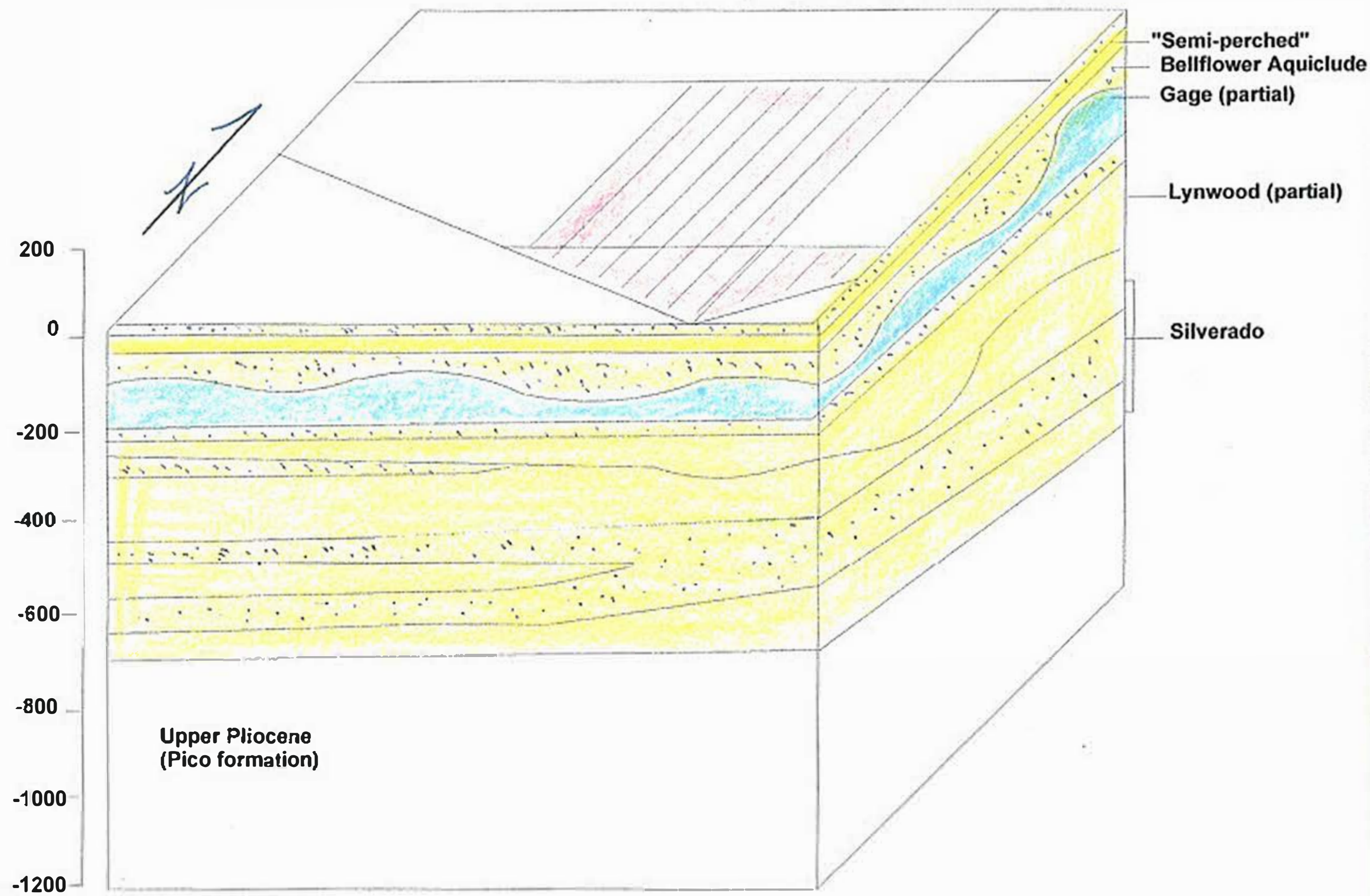
Earth Sciences & Environmental Specialists

PROJECT NO: 94-11-1008	FILE: .74	FIGURE NO: 4-1
DATE: June 2011	DRAWN BY: SMT	



EXPLANATION:

- Erosional unconformity (inferred)
- Aquicludes and deeper undifferentiated formations.
- Aquifers in recent alluvium ("Semi-Perched aquifer")
- Aquifers in Lakewood formation (Upper Pleistocene) (includes Gage "200-foot sand" Aquifer)
- Aquifers in San Pedro formation (Lower Pleistocene) (includes Lynwood "400-foot gravel" and Silverado Aquifer).

Scale 0 25 50 feet

NOTES:

1. Subsurface data from California Department of Water Resources Bulletin No. 104, L.A. County Flood Control District Dominquez Gap Geologic Investigation, and USGS Water Supply Paper 1471 .
2. Subsurface data projected 0.25 miles northwest into block diagram section.

SCHEMATIC SHOWING BLOCK DIAGRAM OF SUBSURFACE HYDROGEOLOGIC CONDITIONS FORMER CHEMOIL REFINERY SIGNAL HILL, CALIFORNIA

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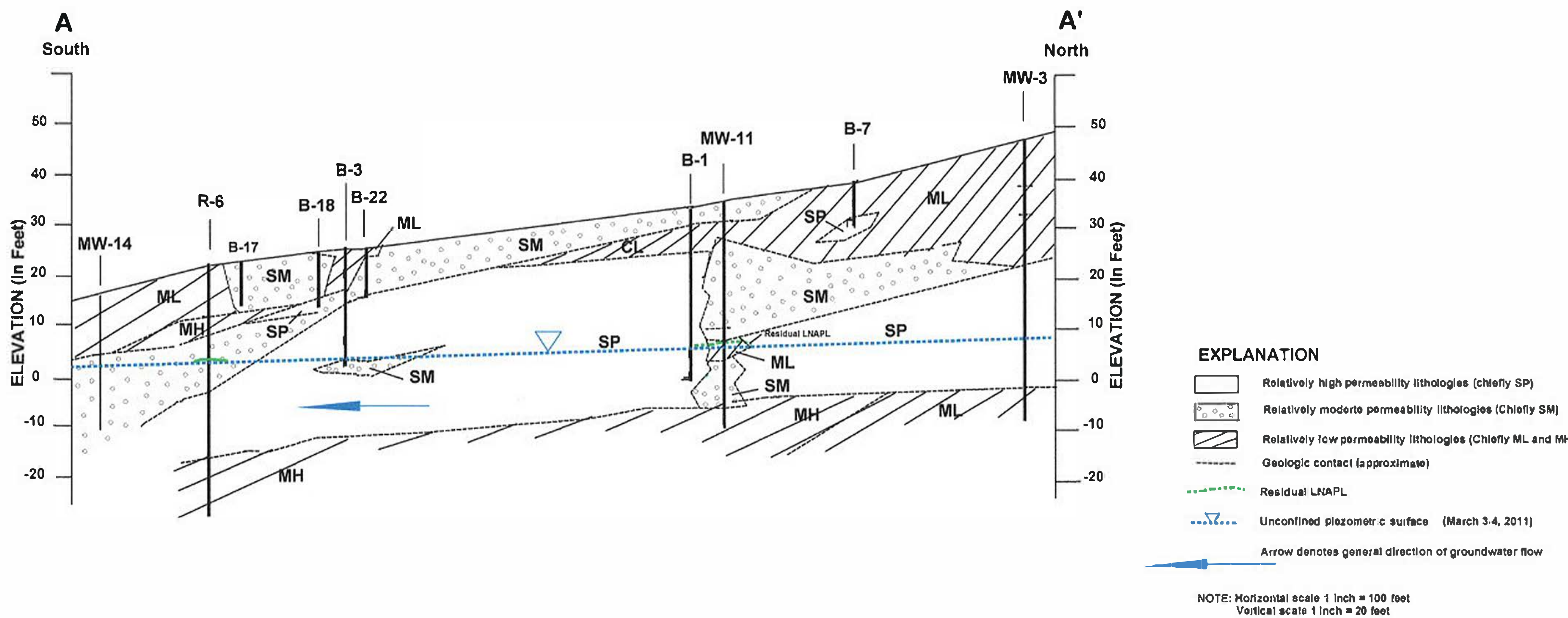
PROJECT NO: 94-11-1008	FILE: .74	FIGURE NO: 4-2
DATE: June 2011	DRAWN BY: SMT	



HYDROGEOLOGIC CROSS-SECTION A - A'
WESTERN PARCEL
FORMER CHEMOIL REFINERY
SIGNAL HILL, CALIFORNIA

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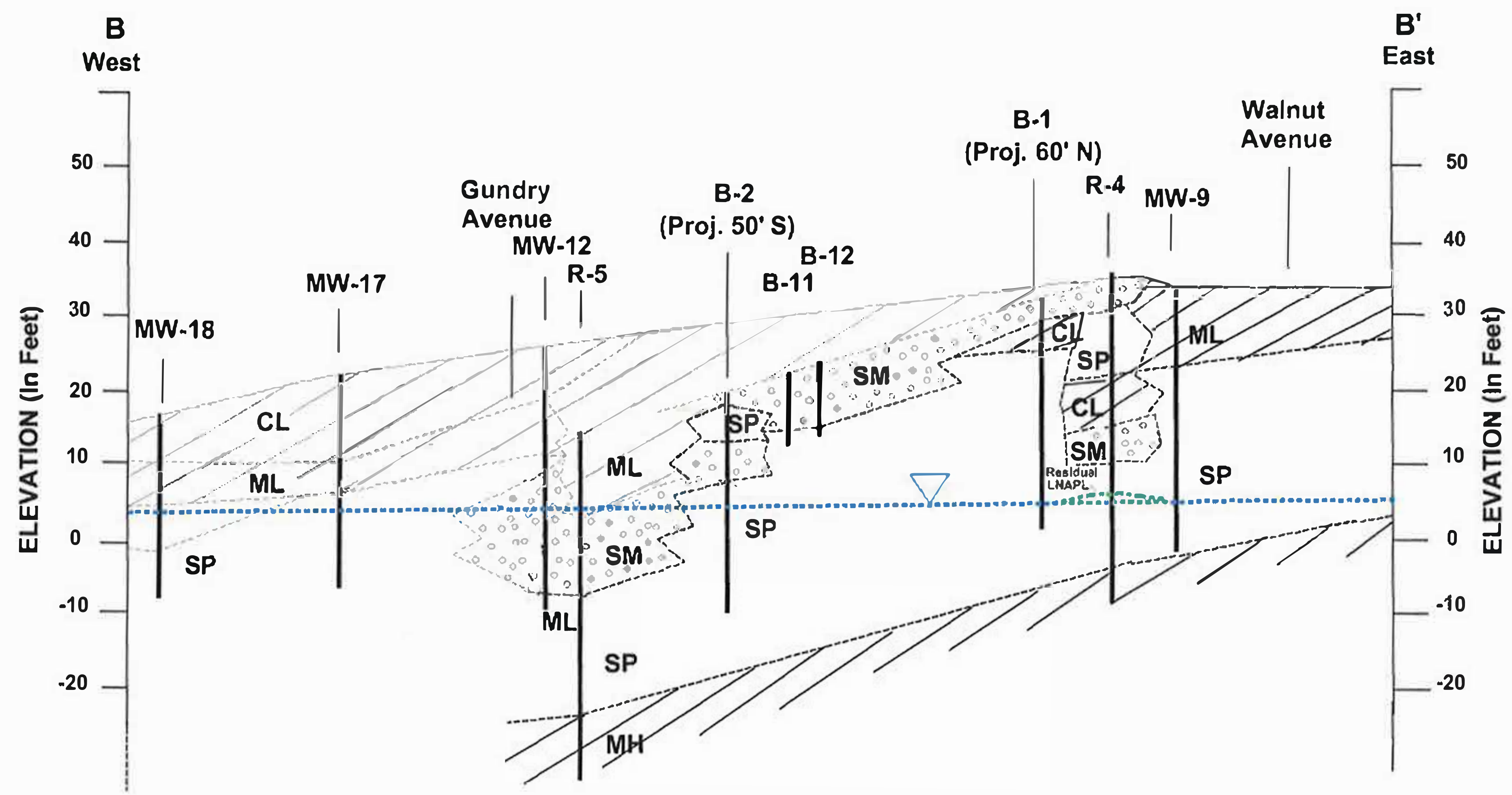
PROJECT NO: 94-11-1008	FILE: .74	FIGURE NO:
DATE: June 2011	DRAWN BY: SMT	4-3



EXPLANATION

- Relatively high permeability lithologies (Chiefly SP)
- Relatively moderate permeability lithologies (Chiefly SM)
- Relatively low permeability lithologies (Chiefly ML and MH)
- Geologic contact (approximate)
- Unconfined piezomatric surface (March 3-4, 2011)
- Residual LNAPL

NOTE: Horizontal scale 1 inch = 100 feet
Vertical scale 1 inch = 20 feet

HYDROGEOLOGIC CROSS-SECTION B-B'
WESTERN PARCEL
FORMER CHEMOIL REFINERY
SIGNAL HILL, CALIFORNIA

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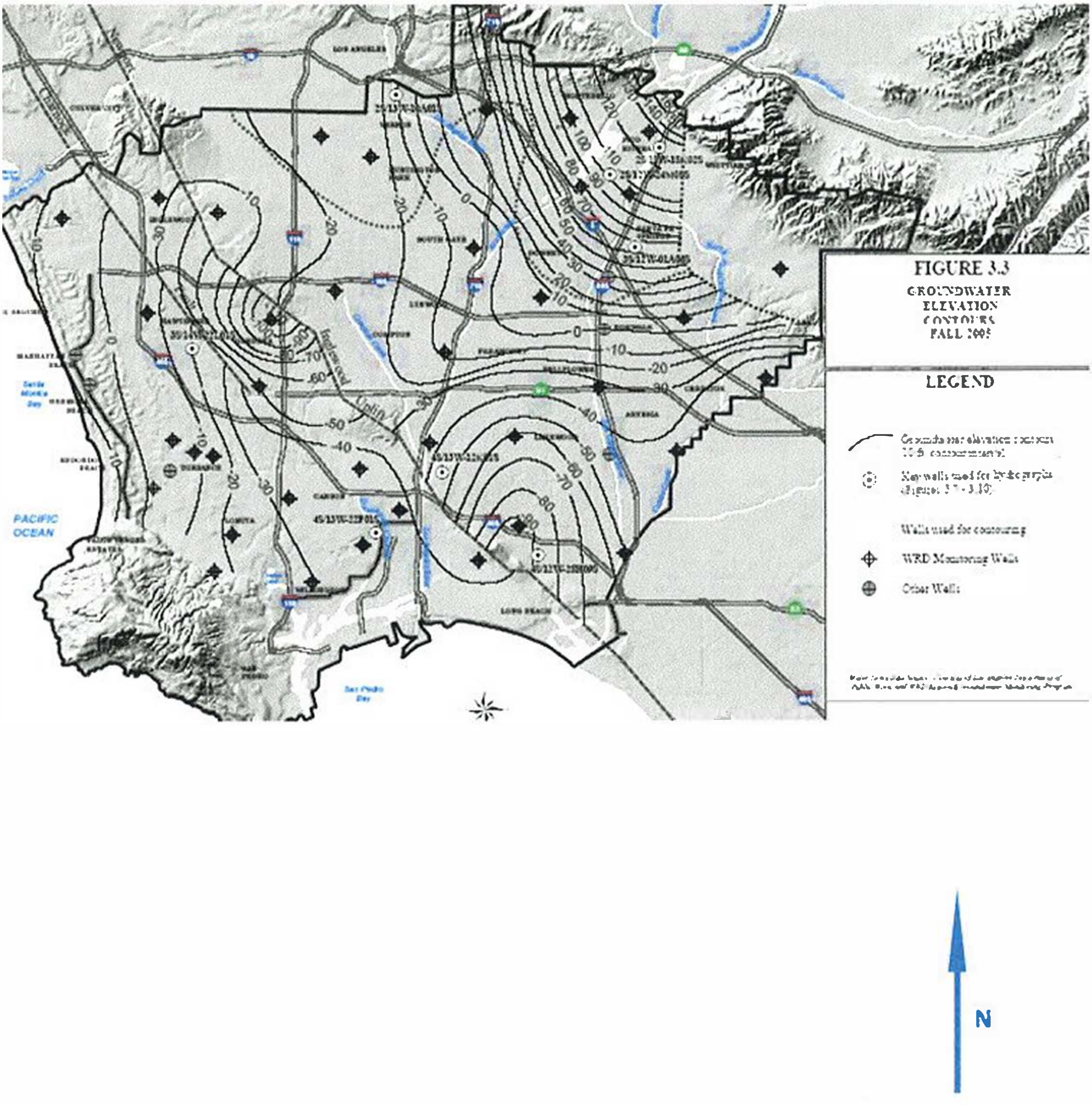
PROJECT NO:	FILE:	FIGURE NO:
94-11-1008	.74	4-4
DATE: June 2011	DRAWN BY: SMT	



NOTE: Groundwater data from Fall 2005 (Water Replenishment District of Southern California, 2007).

NEWPORT-INGLEWOOD STRUCTURAL ZONE IMPACT ON REGIONAL GROUNDWATER
FORMER CHEMOIL REFINERY
SIGNAL HILL, CALIFORNIA

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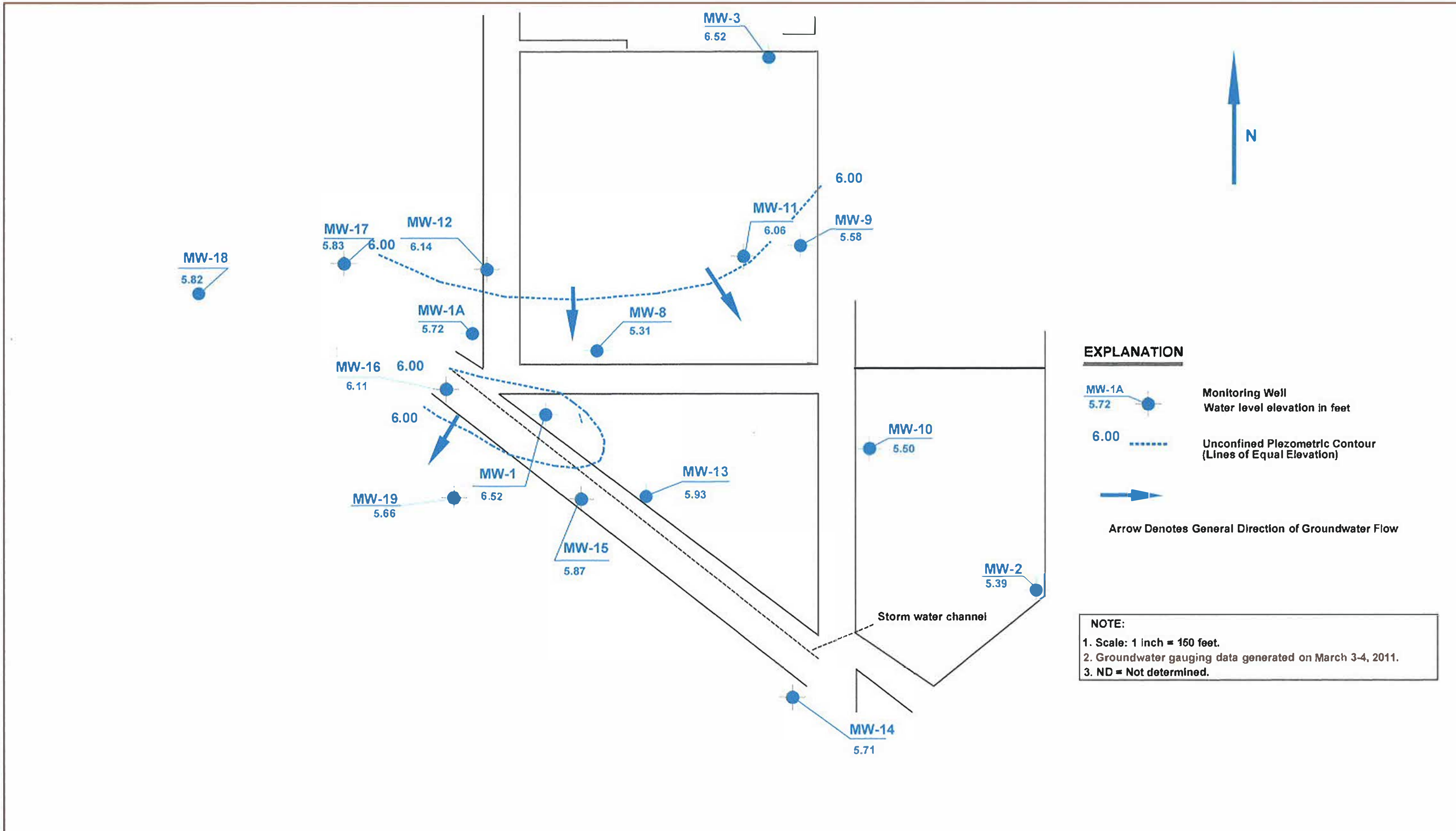
PROJECT NO: 94-11-1008	FILE: .74	FIGURE NO: 4-5
DATE: June 2011	DRAWN BY: SMT	



UNCONFINED PIEZOMETRIC CONTOUR MAP
FORMER CHEMOIL REFINERY
SIGNAL HILL, CALIFORNIA

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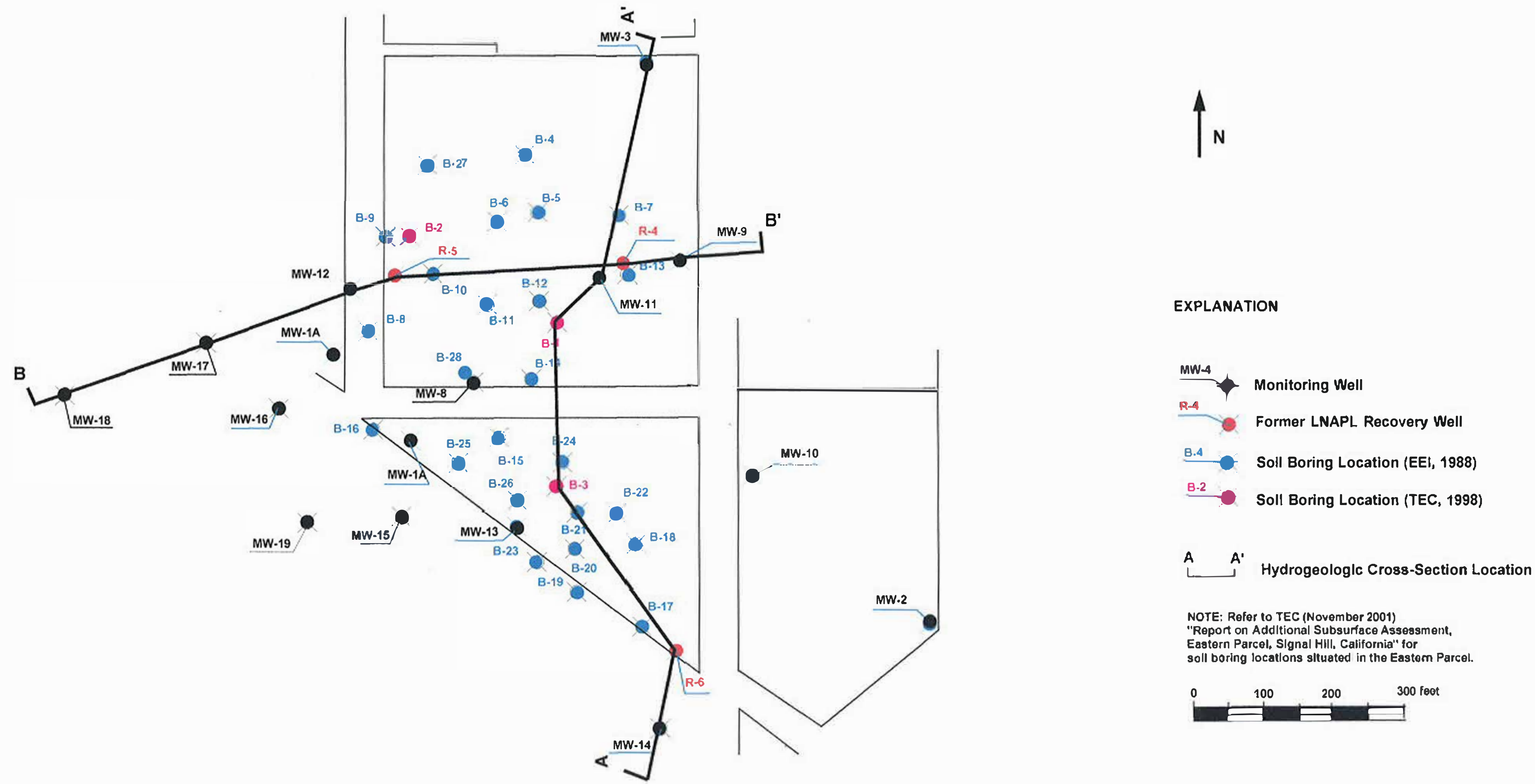
PROJECT NO: 94-11-1008	FILE: .74	FIGURE NO: 4-6
DATE: June 2011	DRAWN BY: SMT	



LOCATION OF SOIL BORINGS
FORMER CHEMOIL REFINERY
SIGNAL HILL, CALIFORNIA

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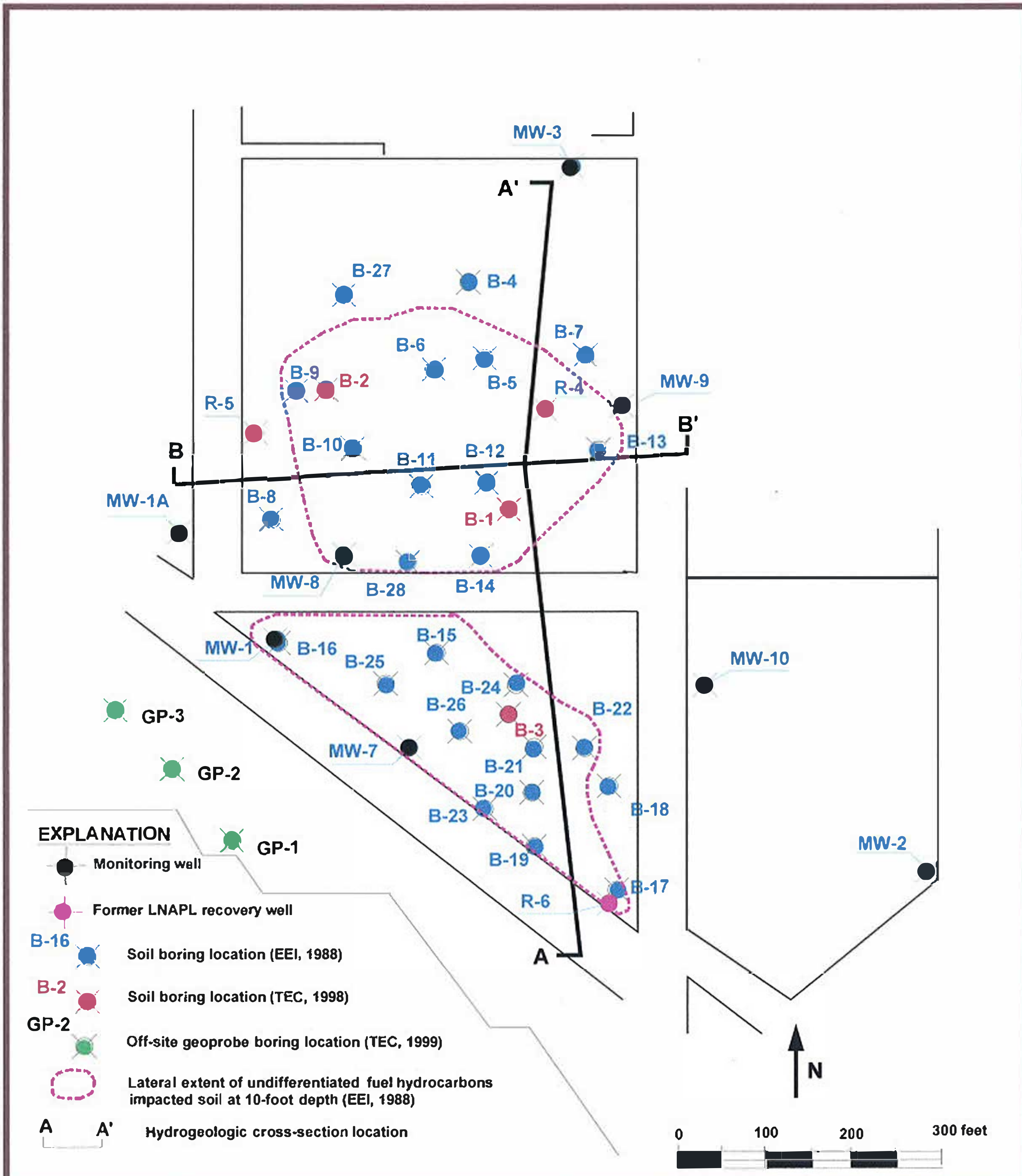
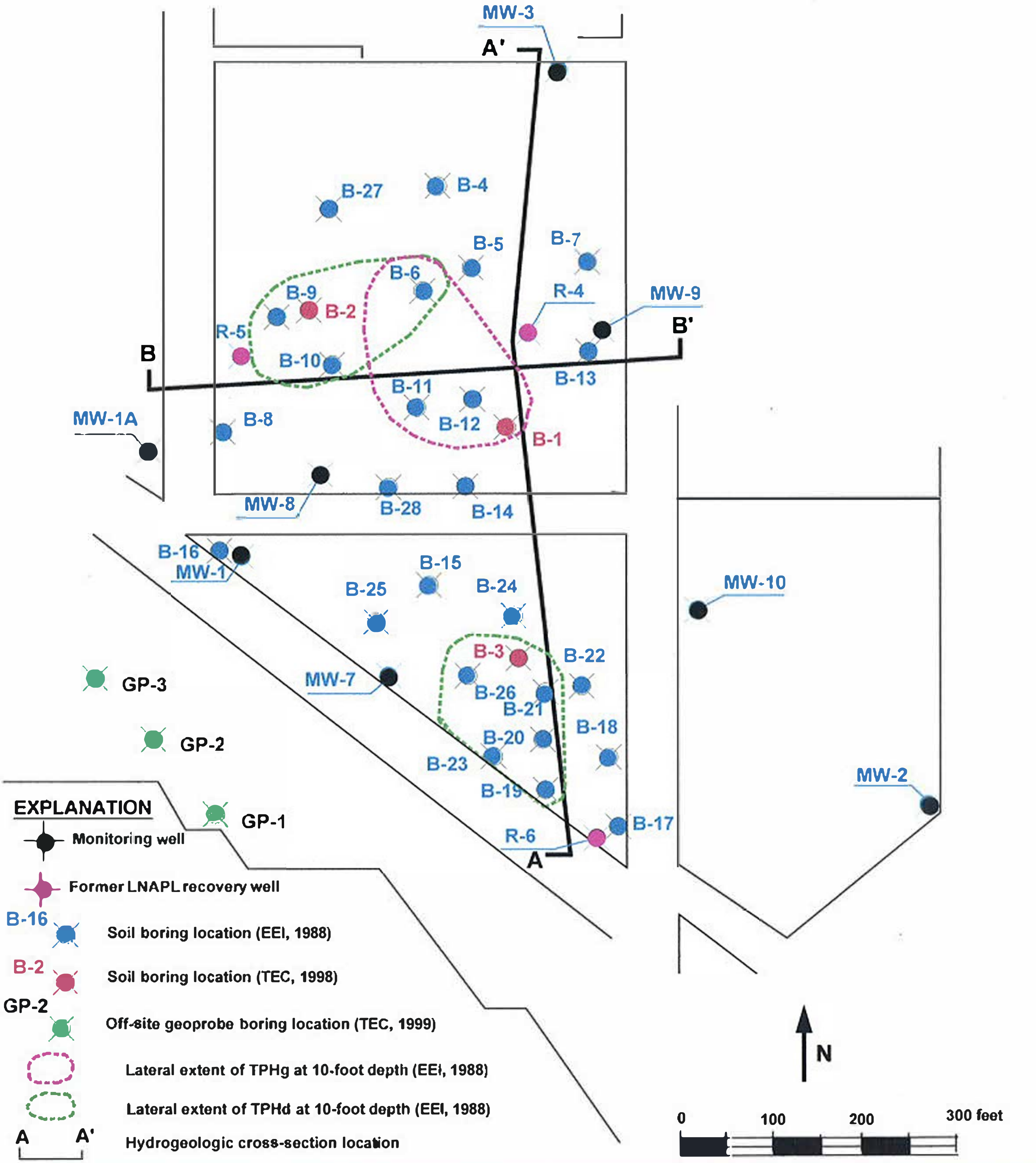
Earth Sciences & Environmental Specialists

PROJECT NO: 94-11-1008	FILE: .74	FIGURE NO: 5-1
DATE: June 2011	DRAWN BY: SMT	



LATERAL EXTENT OF FUEL HYDROCARBONS IMPACTED SOIL AT 10-FOOT DEPTH WESTERN PARCEL FORMER CHEMOIL REFINERY SIGNAL HILL, CALIFORNIA	**Testa Environmental Corporation** *Earth Sciences & Environmental Specialists*

PROJECT NO.	FILE:	FIGURE NO.
94-11-1008	.74	5-2
DATE: June 2011	DRAWN BY: SMT	

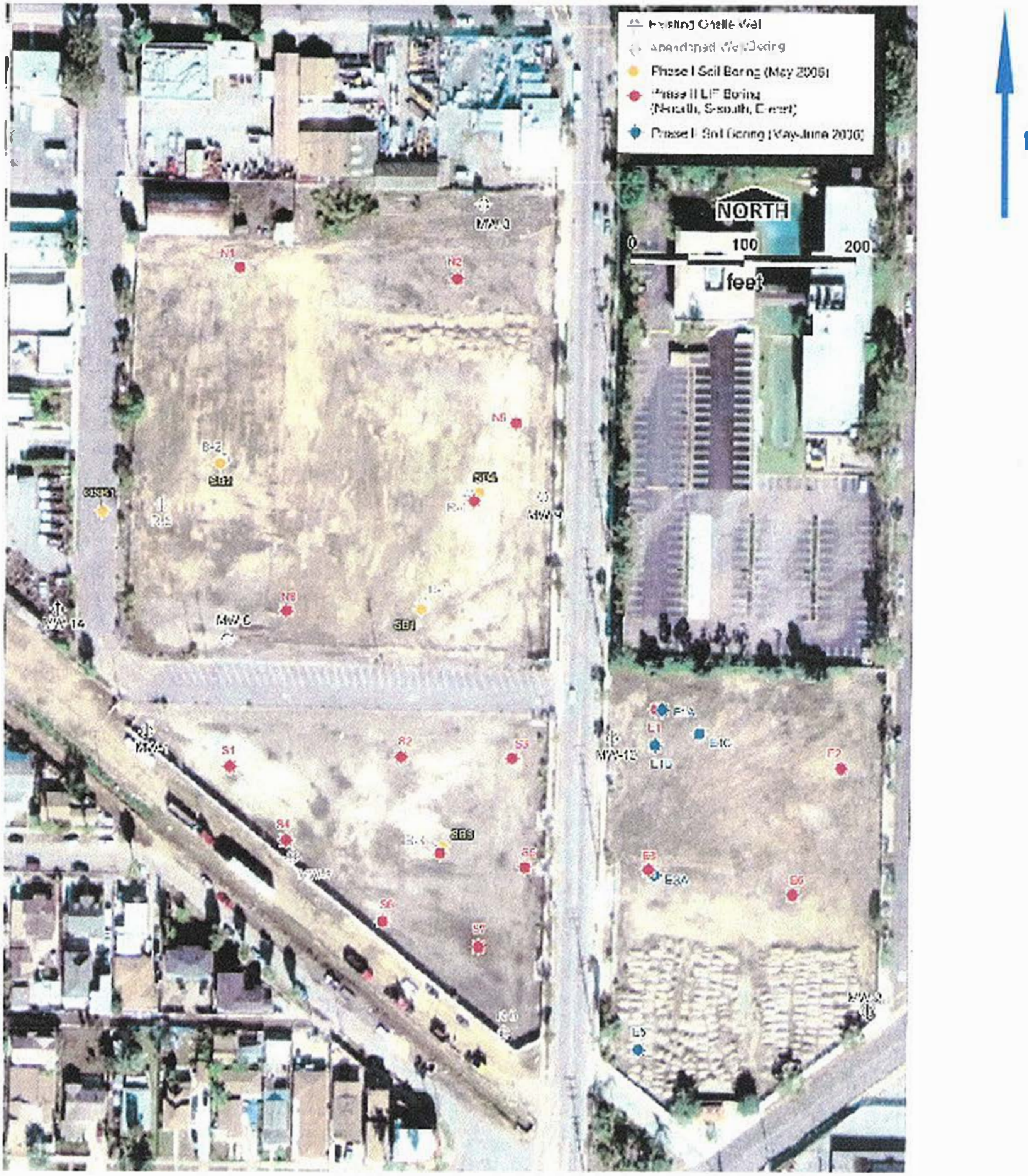


LATERAL EXTENT OF TPHg AND TPHd IMPACTED SOIL AT 10-FOOT DEPTH
WESTERN PARCEL
FORMER CHEMOIL REFINERY
SIGNAL HILL, CALIFORNIA

Testa Environmental Corporation

Earth Sciences & Environmental Specialists

PROJECT NO: 94-11-1008	FILE: .74	FIGURE NO:
DATE: June 2011	DRAWN BY: SMT	5-3



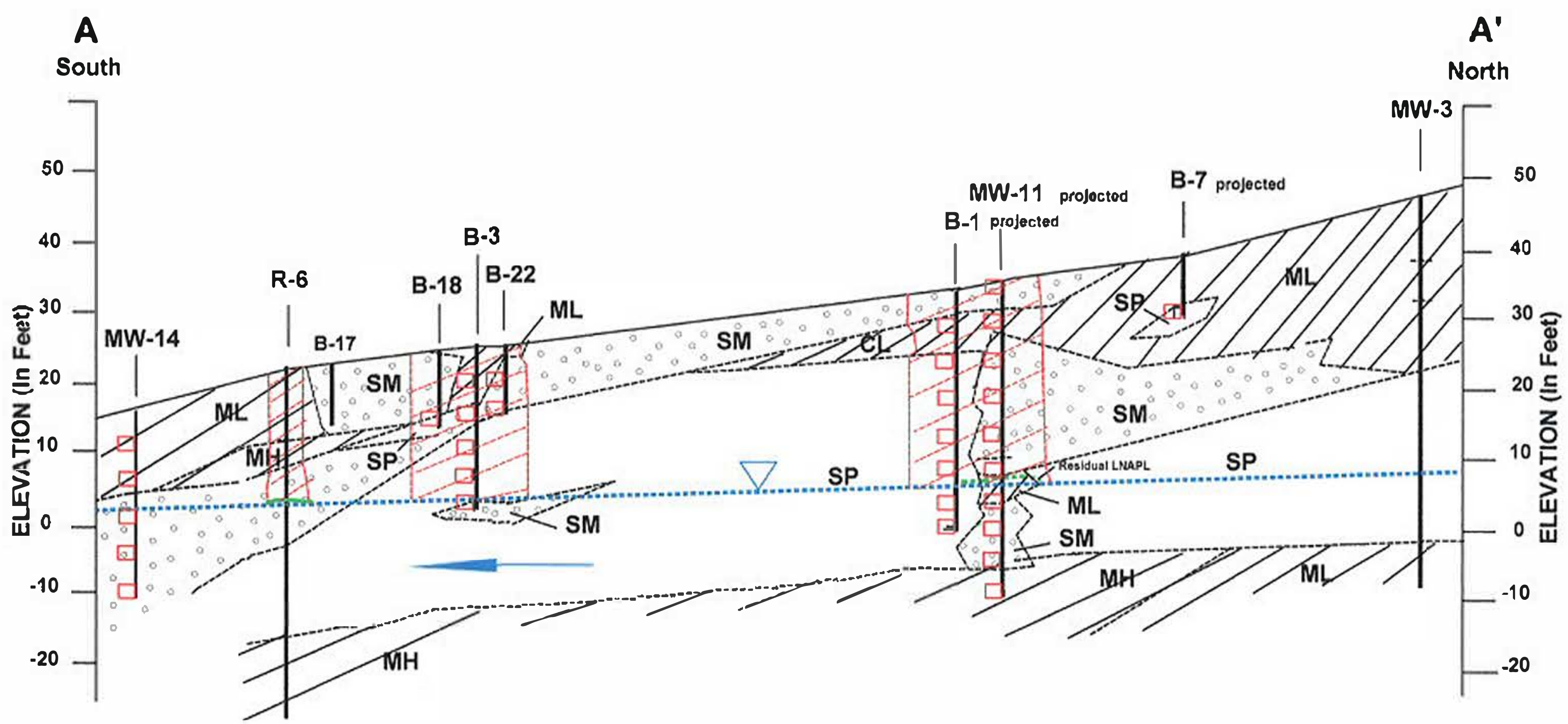
BORING AND PROBE LOCATIONS,
TETRA TECH, INC. (2006)

FORMER CHEMOIL REFINERY
SIGNAL HILL, CALIFORNIA

Testa Environmental Corporation

Earth Sciences & Environmental Specialists

PROJECT NO: 94-11-1008	FILE: .74	FIGURE NO:
DATE: June 2011	DRAWN BY: SMT	5-4



EXPLANATION

- Relatively high permeability lithologies (chiefly SP)
- Relatively moderte permeability lithologies (Chiefly SM)
- Relatively low permeability lithologies (Chiefly ML and MH)
- Geologic contact (approximate)
- Soil sample location
- Unconfined piezometric surface (March 3-4, 2011)
- Arrow denotes general direction of groundwater flow

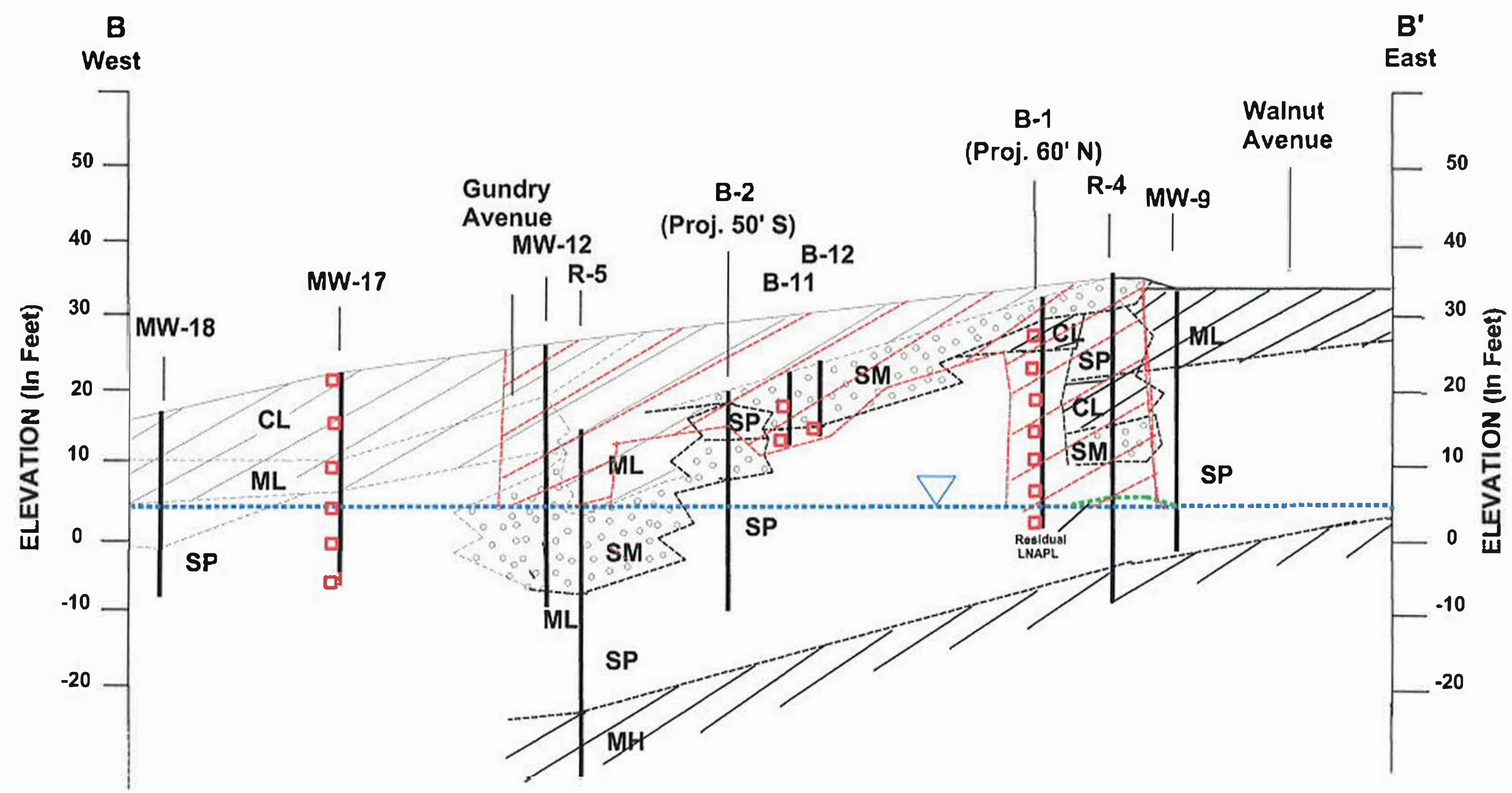
NOTE: Horizontal scale 1 inch = 100 feet
Vertical scale 1 inch = 20 feet

HYDROGEOLOGIC CROSS-SECTION A - A'
WESTERN PARCEL
FORMER CHEMOIL REFINERY
SIGNAL HILL, CALIFORNIA

Testa Environmental Corporation

Earth Sciences & Environmental Specialists

PROJECT NO:	FILE:	FIGURE NO:
94-11-1008	.74	5-5
DATE: June 2011	DRAWN BY: SMT	



EXPLANATION

- Relatively high permeability lithologies (Chiefly SP)
- Relatively moderate permeability lithologies (Chiefly SM)
- Relatively low permeability lithologies (Chiefly ML and MH)
- Geologic contact (approximate)
- Unconfined piezomatric surface (March 3-4, 2011)

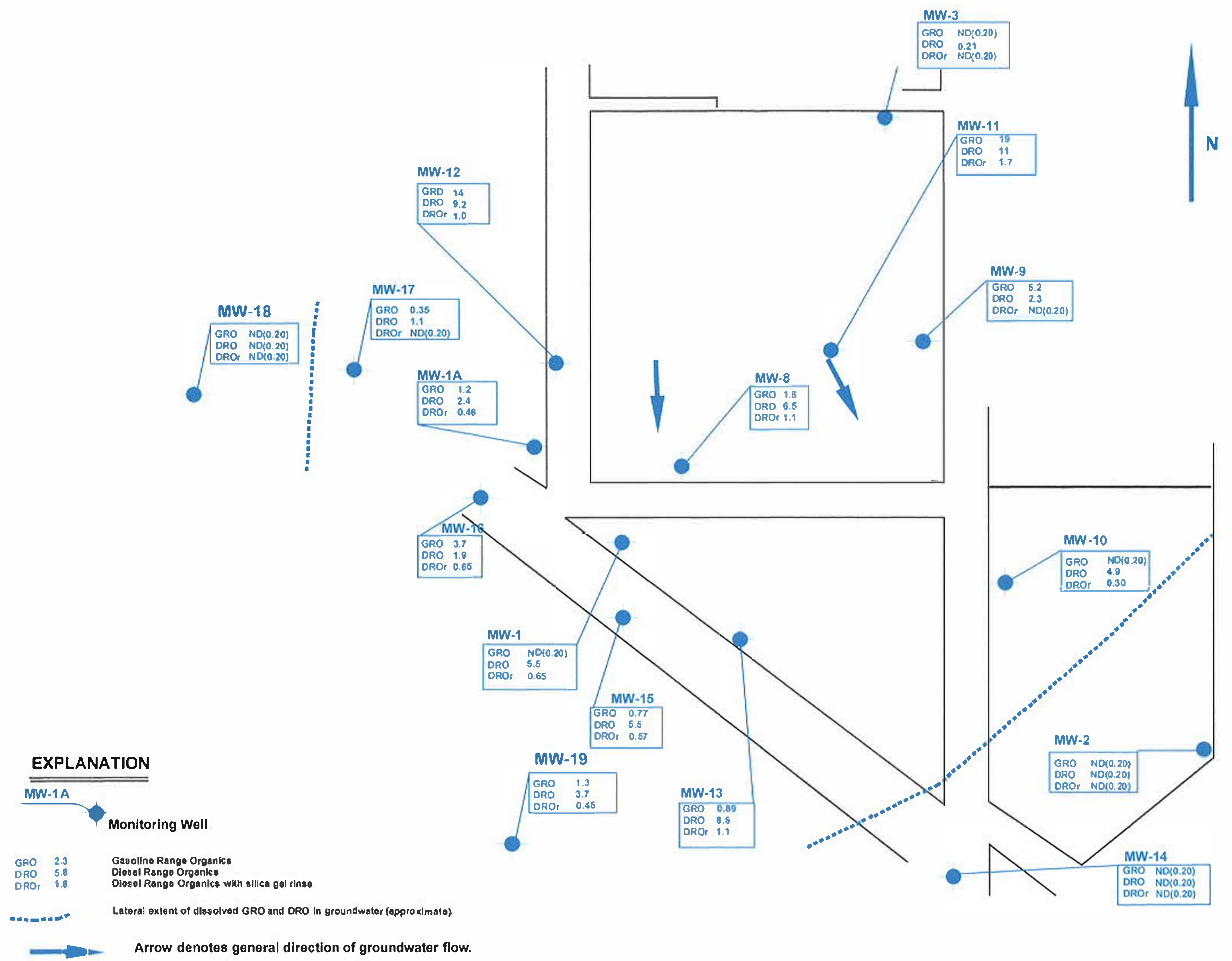
NOTE: Horizontal scale 1 inch = 100 feet
Vertical scale 1 inch = 20 feet

HYDROGEOLOGIC CROSS-SECTION B-B'
WESTERN PARCEL
FORMER CHEMOIL REFINERY
SIGNAL HILL, CALIFORNIA

Testa Environmental Corporation

Earth Sciences & Environmental Specialists

PROJECT NO: 94-11-1008	FILE: .74	FIGURE NO: 5-6
DATE: June 2011	DRAWN BY: SMT	



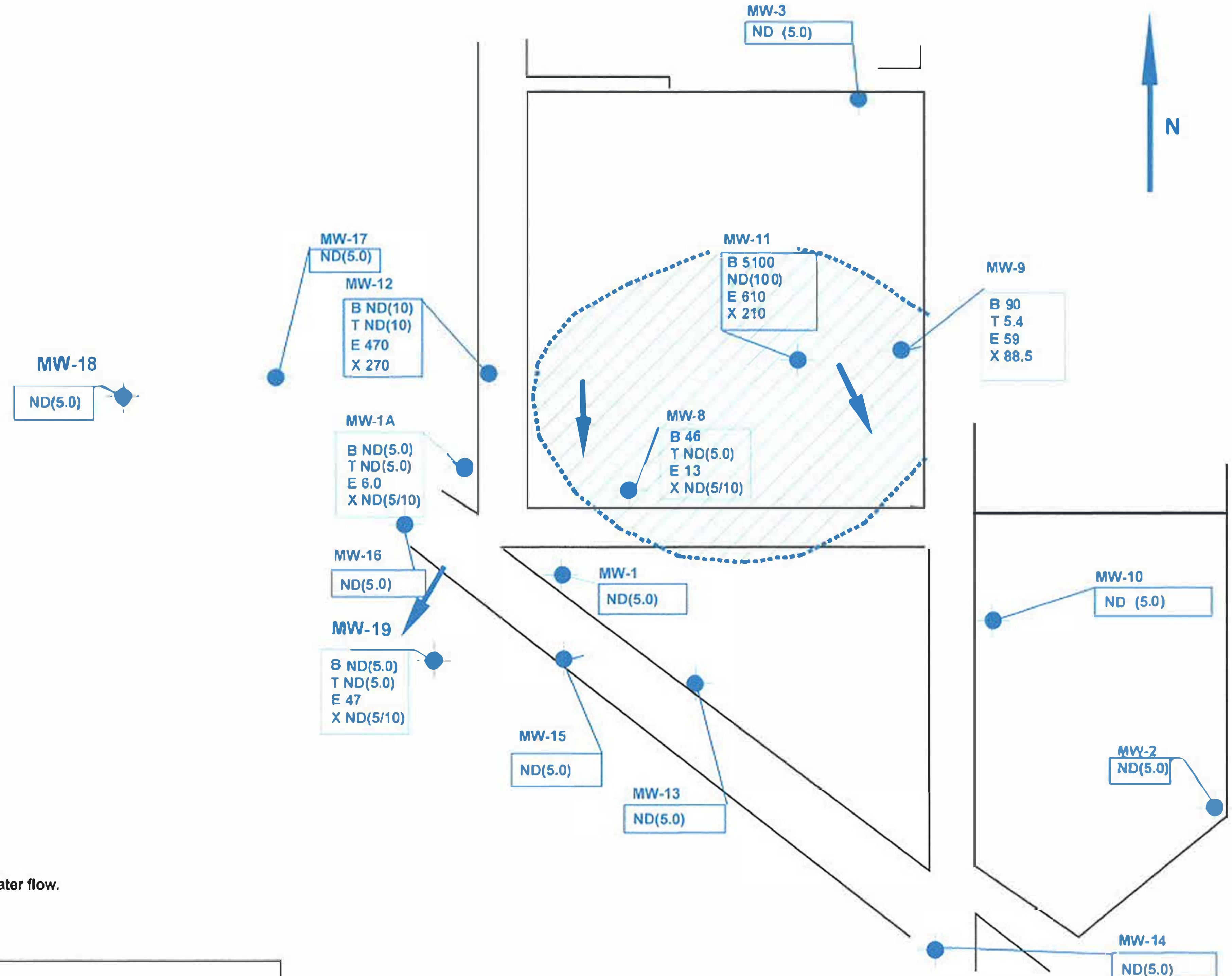
NOTE:
1. Scale: 1 inch = 150 feet.
2. Groundwater samples retrieved on March 3-4, 2011.
3. NO = Not operable.
4. ND = Not detected; all units in mg/L; analytical reporting limit shown in parens.

LATERAL EXTENT OF DISSOLVED GRO AND DRO IN GROUNDWATER
FORMER CHEMOIL REFINERY
SIGNAL HILL, CALIFORNIA

Testa Environmental Corporation

Earth Sciences & Environmental Specialists

PROJECT NO: 94-11-1008	FILE: .74	FIGURE NO:
DATE: June 2011	DRAWN BY: SMT	6-1



EXPLANATION

MW-1A — Monitoring Well

Lateral extent of dissolved Benzene plume.

Arrow denotes general direction of groundwater flow.

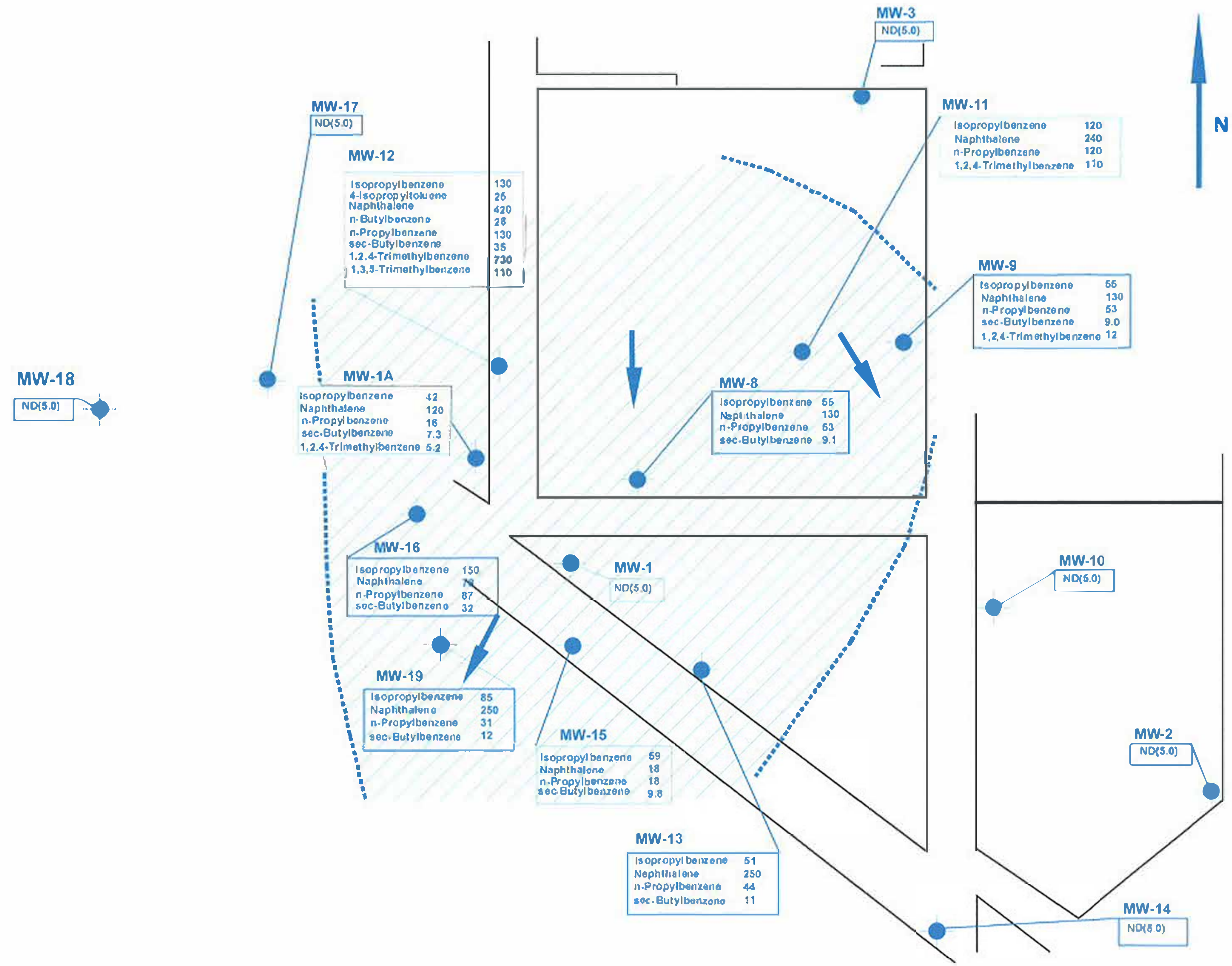
NOTE:
1. Scale: 1 inch = 160 feet.
2. Groundwater samples retrieved on March 3-4, 2011.
3. NO = Not operable.
4. ND = Not detected; all units in ug/L; analytical reporting limits in parens.

LATERAL EXTENT OF DISSOLVED
BTEX IN GROUNDWATER
FORMER CHEMOIL REFINERY
SIGNAL HILL, CALIFORNIA

Testa Environmental Corporation

Earth Sciences & Environmental Specialists

PROJECT NO: 94-11-1008	FILE: .74	FIGURE NO:
DATE: June 2011	DRAWN BY: SMT	6-2



EXPLANATION

MW-1A — Monitoring Well

Arrow denotes general direction of groundwater flow.

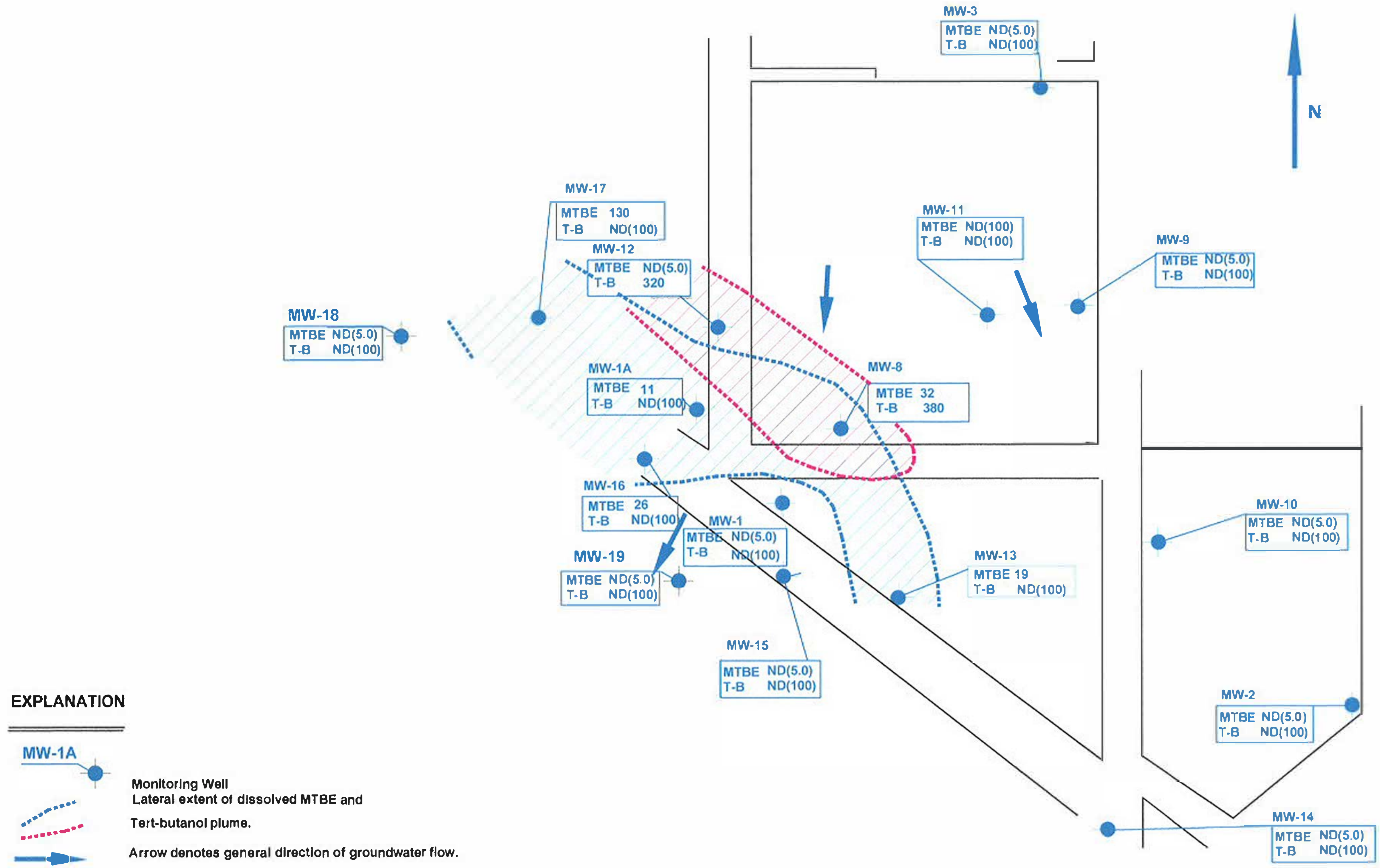
NOTE:
1. Scale: 1 inch = 150 feet.
2. Groundwater samples retrieved on March 3-4, 2011.
3. NO = Not operable.
4. ND = Not detected; all units in ug/L; analytical reporting limit shown in parens.

LATERAL EXTENT OF DISSOLVED VOLATILE AND SEMI-VOLATILE ORGANIC COMPOUNDS
FORMER CHEMOIL REFINERY
SIGNAL HILL, CALIFORNIA

Testa Environmental Corporation

Earth Sciences & Environmental Specialists

PROJECT NO: 94-11-1008	FILE: .74	FIGURE NO: 6-3
DATE: June 2011	DRAWN BY: SMT	



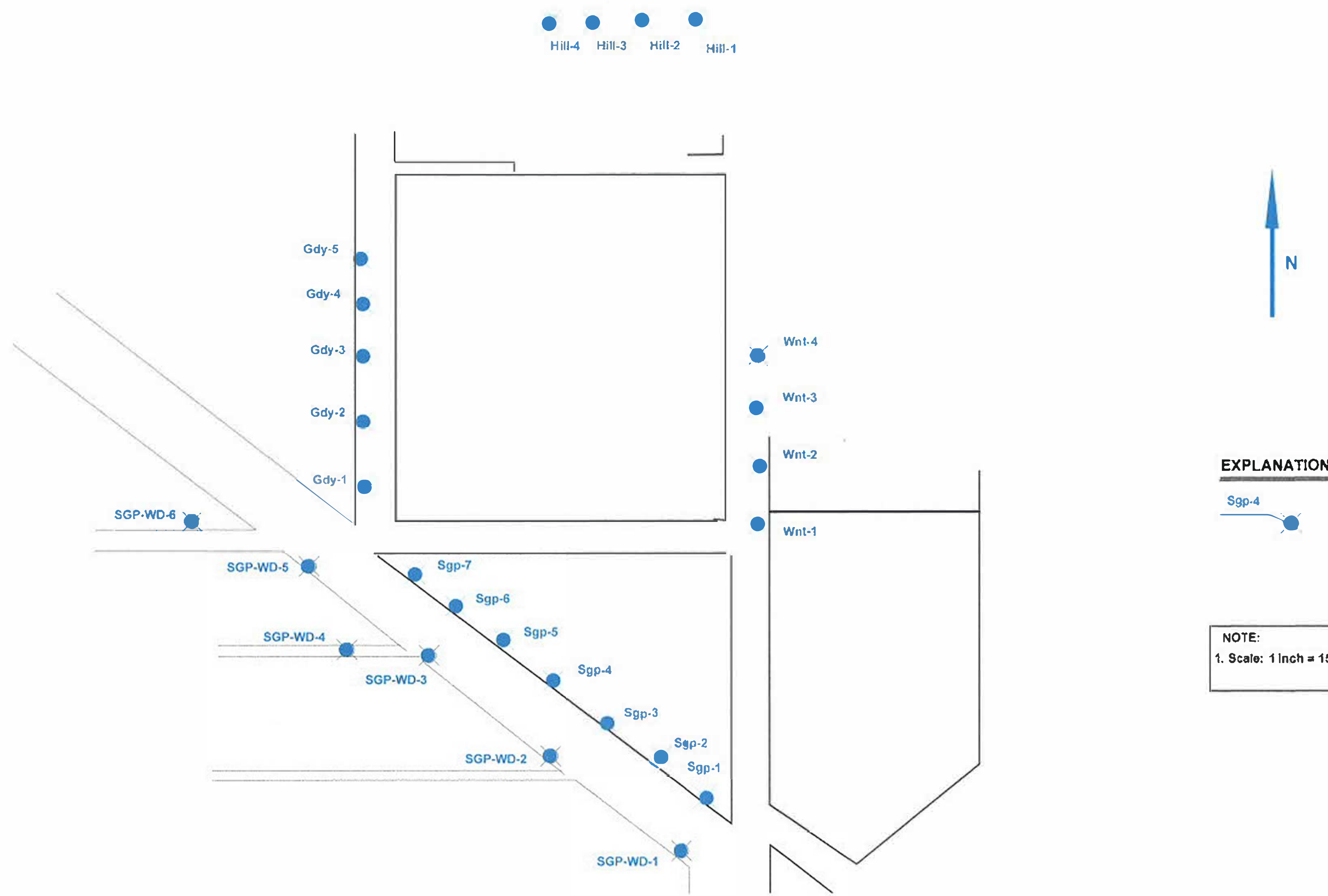
NOTE:
1. Scale: 1 inch = 150 feet.
2. Groundwater samples retrieved on March 3-4, 2011.
3. NO = Not operable.
4. ND = Not detected; all units in ug/L; analytical reporing limits shown in parens.

LATERAL EXTENT OF DISSOLVED OXYGENATES IN GROUNDWATER
FORMER CHEMOIL REFINERY
SIGNAL HILL, CALIFORNIA

Testa Environmental Corporation

Earth Sciences & Environmental Specialists

PROJECT NO: 94-11-1008	FILE: .74	FIGURE NO:
DATE: June 2011	DRAWN BY: SMT	6-4



NOTE:
1. Scale: 1 inch = 150 feet.

LOCATION OF SOIL GAS SURVEY PROBES
FORMER CHEMOIL REFINERY
SIGNAL HILL, CALIFORNIA

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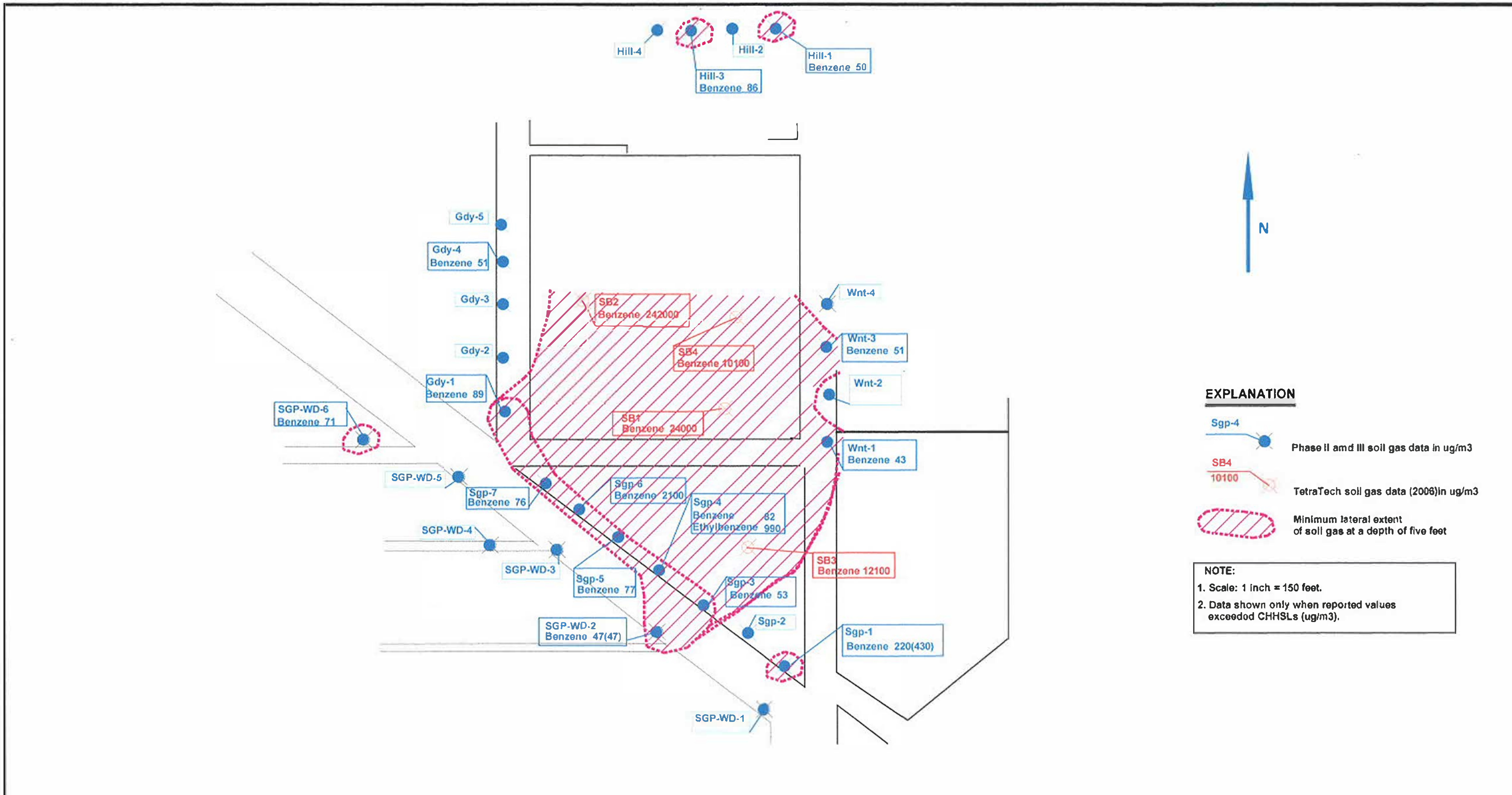
PROJECT NO: 94-11-1008	FILE: .74	FIGURE NO:
DATE: June 2011	DRAWN BY: SMT	7-1

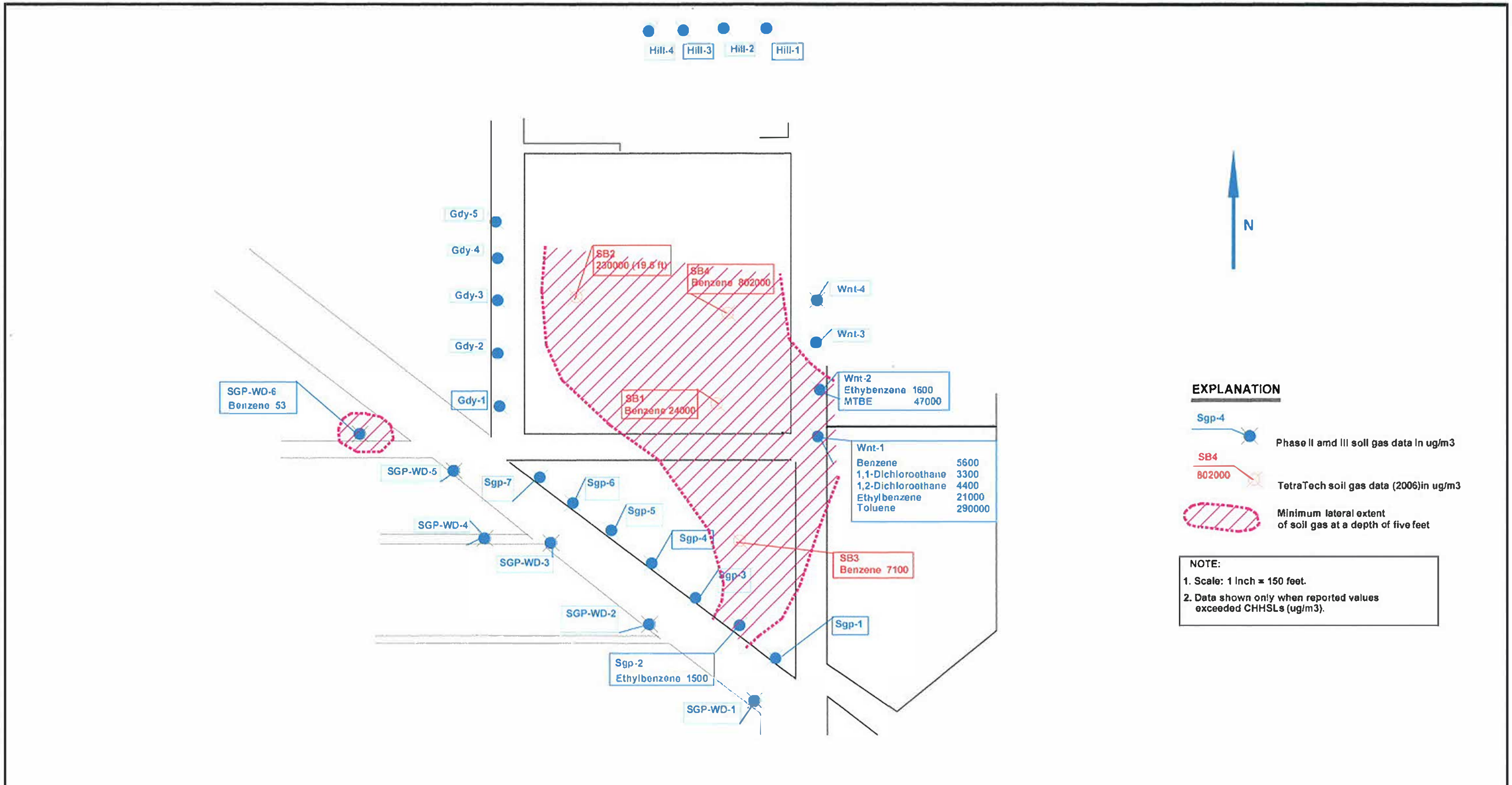


SOIL GAS PRESENCE AT 5-FEET DEPTH
FORMER CHEMOIL REFINERY
SIGNAL HILL, CALIFORNIA

Testa Environmental Corporation

Earth Sciences & Environmental Specialists

PROJECT NO: 94-11-1008	FILE: .74	FIGURE NO: 7-2
DATE: June 2011	DRAWN BY: SMT	

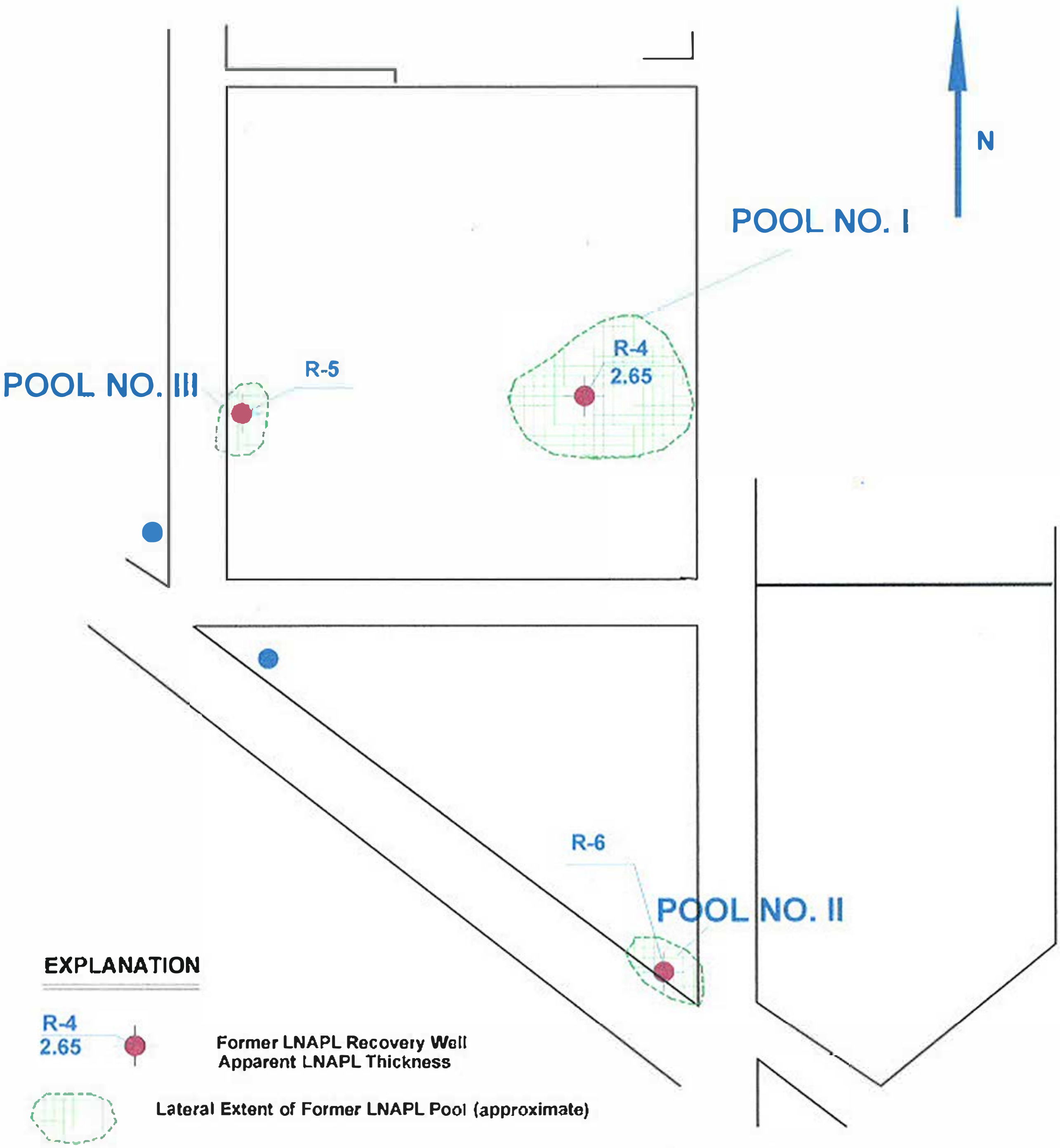


SOIL GAS PRESENCE AT 10 - 15 FEET DEPTH
FORMER CHEMOIL REFINERY
SIGNAL HILL, CALIFORNIA

Testa Environmental Corporation

Earth Sciences & Environmental Specialists

PROJECT NO: 94-11-1008	FILE: .74	FIGURE NO:
DATE: June 2011	DRAWN BY: SMT	7-3



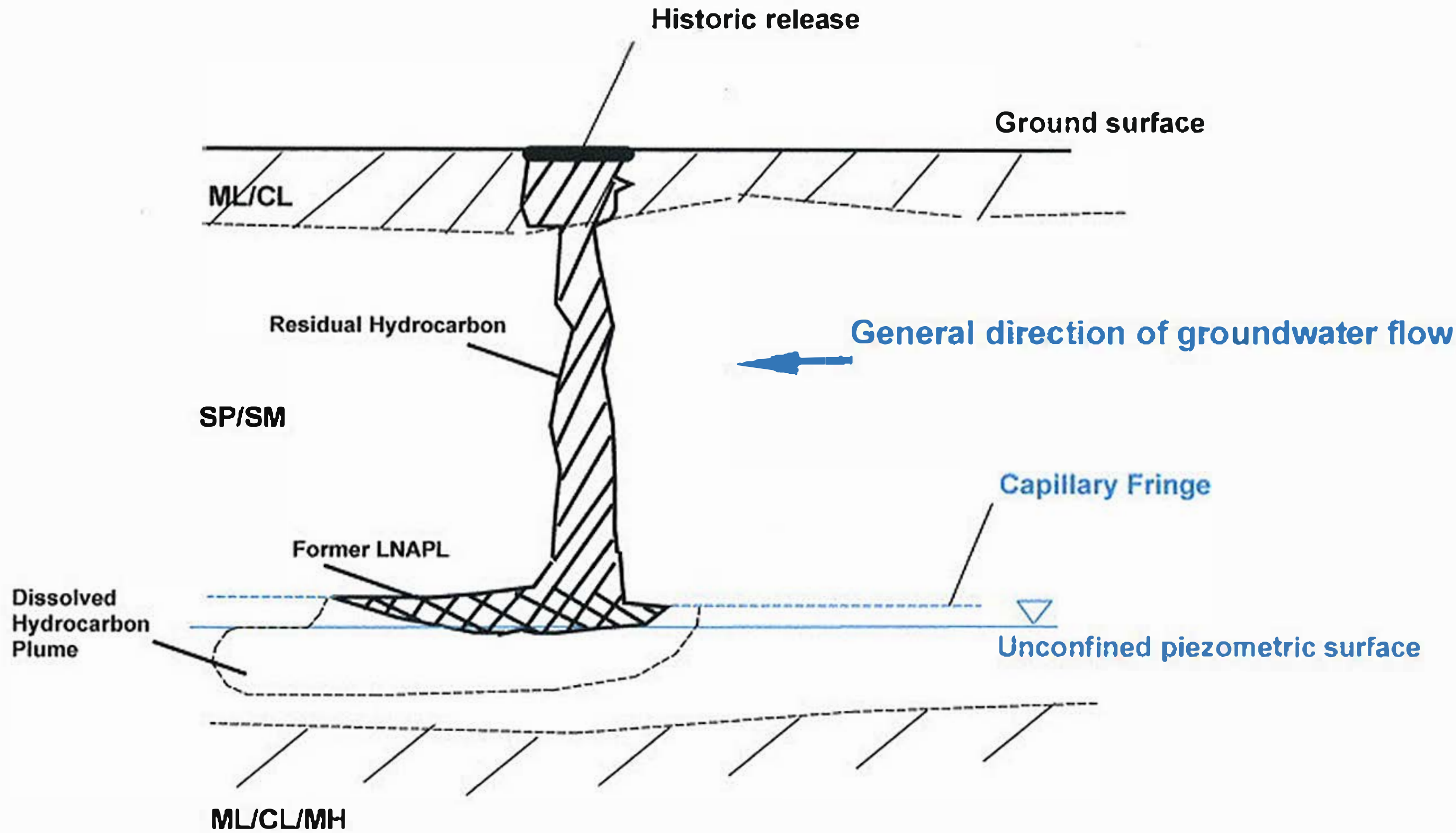
NOTE:
1. Scale: 1 inch = 150 feet.
2. Apparent thickness of LNAPL in R-4 measured on December 4, 2002.

LATERAL EXTENT OF FORMER LNAPL POOLS
FORMER CHEMOIL REFINERY
SIGNAL HILL, CALIFORNIA

Testa Environmental Corporation

Earth Sciences & Environmental Specialists

PROJECT NO:	94-11-1008	FILE:	.74	FIGURE NO:	8-1
DATE:	June 2011	DRAWN BY:	SMT		

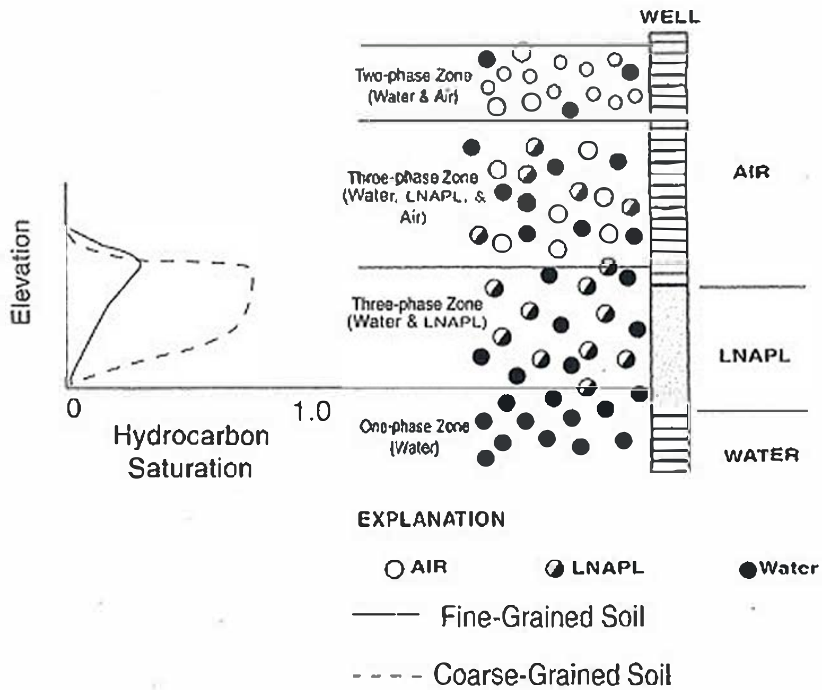


SCHEMATIC SHOWING MIGRATION OF
HYDROCARBONS IN THE SUBSURFACE
FORMER CHEMOIL REFINERY
SIGNAL HILL, CALIFORNIA

Testa Environmental Corporation

Earth Sciences & Environmental Specialists

PROJECT NO: 94-11-1008	FILE: .74	FIGURE NO:
DATE: June 2011	DRAWN BY: SMT	11-1



NOTE: The "smear" zone is actually where two-and three-phase zones (i.., air LNAPL or hydrocarbons, and water), exists.
Fluctuations in the unconfined piezometric surface will impact th thickness of the"smear zone."
Hydrocarbons are typicaly trapped and biograde via natural attenuation with time once the recoverable LNAPL is removed.

SCHEMATIC OF SOIL-PIEZOMETRIC "SMEAR" ZONE
FORMER CHEMOIL REFINERY
SIGNAL HILL, CALIFORNIA

Testa Environmental Corporation

Earth Sciences & Environmental Specialists

PROJECT NO: 94-11-1008	FILE: .74	FIGURE NO: 11-2
DATE: June 2011	DRAWN BY: SMT	