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REVISED MASTER WORK PLAN

CENCO REFINING COMPANY
SANTA FE SPRINGS, CALIFORNIA

Prepared for:

CENCO REFINING COMPANY
12345 Lakeland Road
Santa Fe Springs, CA 90670

Prepared by:

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Versar Project No. 3917-014

January 28, 2000

2026-00/3917-014/JAN28'00

CERTIFICATION

REVISED MASTER WORK PLAN
CENCO REFINING COMPANY
12345 LAKELAND ROAD
SANTE FE SPRINGS, CALIFORNIA

This plan has been prepared by the staff of Versar, Inc. and has been reviewed and approved by the professionals whose signatures appear below.

The findings, recommendations, specifications or professional opinions are presented, within the limits prescribed by the client, after being prepared in accordance with generally accepted geological and engineering practice in California ~~at the time~~ this plan was prepared. No other warranty is either expressed or implied.

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1.0 INTRODUCTION

The Revised Master Work Plan was prepared for the CENCO Refining Company (CENCO) (formally the Powerine Oil Company [Powerine]) by Versar, Inc. (Versar) pursuant to Cleanup and Abatement Order (CAO) 97-118 issued by the California Regional Water Quality Control Board (RWQCB) - Los Angeles Region. CAO 97-118 requires that Powerine (now CENCO) address petroleum hydrocarbons and associated constituents in soil and groundwater at the CENCO refinery located at 12345 Lakeland Road in Sante Fe Springs, California (Figure 1). In correspondence dated October 27, 1999, the RWQCB provided comments on the June 9, 1998 version of the Master Work Plan (Versar, 1998a). The Master Work Plan has been revised based on these comments.

When the Master Work Plan was first issued by Powerine in June, 1998, the future use of the property had not been determined. In August 1998 CENCO purchased the assets and liabilities of the Powerine Oil Company, including the refinery and adjacent properties in Sante Fe Springs, California. CENCO plans to operate the refinery once facility improvements have been completed.

Since June 1998 CENCO has performed additional soil and groundwater characterization activities based on the activities proposed in the June 1998 version of the Master Work Plan. These activities included:

- Installation of three soil borings in Operational Areas 2 and 3;
- Well abandonment and replacement, and;
- Semi-annual groundwater monitoring.

The results of these activities have been incorporated into the Revised Master Work Plan.

1.1 PURPOSE

The purpose of the Revised Master Work Plan is to present the strategy developed by CENCO for complying with CAO 97-118. This strategy includes the following activities:

- Evaluation of previous soil and groundwater investigation results to provide a framework for future investigations and remediation activities.

- Additional investigation activities to characterize further subsurface conditions and to develop a remedial strategy for soil and groundwater.

- Development of an approach to evaluating the risk to human health and the environment.

- Preliminary remedial strategy development.

- Development of an approach to update the Refinery Source Identification and Reduction Plan.

- Development of a strategy for investigating conveyance pipelines to and from the Long Beach Marine Terminal to the refinery.

- Preparation of a schedule for implementing the activities outlined in the Revised Master Work Plan, including additional investigation and feasibility study (FS) and remedial action plan (RAP) preparation.

1.2 RELEVANCE TO CAO 97-118 REQUIREMENTS

CAO 97-118 requires that remedial investigation and other activities will be conducted in two phases: 1) preparation of the Master Work Plan, and 2) submittal of semi-annual progress reports. Specific requirements of CAO 97-118 for the Master Work Plan are summarized in the table below, which indicates where each item is discussed in more detail in the text of this document.

REQUIREMENTS FOR MASTER WORK PLAN		LOCATION IN WORK PLAN
Order Item No.	Description	
2.a	Update the refinery source identification and elimination plan including a plan and a time schedule within 90 days of the approval of the plan by the Executive Officer. Detect leakage from aboveground storage tanks (ASTs) and piping, identify free-phase hydrocarbons in the vadose zone, and remediate petroleum hydrocarbons in soil and groundwater as required to protect water quality and human health and the environment in a timely manner.	Section 7.0
2.b.1	Fully delineate the extent of free-phase and dissolved-phase petroleum hydrocarbons and associated constituents in groundwater in the upper and lower saturated zones. Coordinate with other off-site investigations. Characterize all known on-site areas where the vadose zone has been impacted. Characterize and evaluate petroleum hydrocarbon fate and transport and the potential impact to water quality.	Section 4.0 Section 5.0 Section 6.1 Section 6.2 Section 6.3
2.b.2	Develop specific aquifer characteristics, such as hydraulic conductivity, for the uppermost saturated zone and any underlying aquifers impacted by petroleum hydrocarbons.	Section 3.0 Section 6.3

REQUIREMENTS FOR MASTER WORK PLAN		LOCATION IN WORK PLAN
Order Item No.	Description	
2.b.3	Assess the saturated zone hydraulic characteristics and conductivity (i.e., evaluate the connection between saturated units or aquitards underlying areas where soil or groundwater have been impacted by petroleum hydrocarbons).	Section 6.2 Section 6.3
2.c	Develop a cleanup strategy for petroleum hydrocarbons in groundwater that addresses on-site and off-site free-phase and dissolved-phase petroleum hydrocarbons in groundwater.	Section 6.1 Section 6.2
2.d	Develop a schedule for initiating cleanup of all known impacted groundwater (i.e., implementation of the Revised Master Work Plan).	Section 8.0
2.e	Develop a schedule for initiating cleanup of on-site vadose zone areas impacted by petroleum hydrocarbons. Cleanup levels shall be approved in Waste Discharge Requirements (WDRs) issued by the RWQCB.	Section 8.0

1.3 REPORT ORGANIZATION

This Revised Master Work Plan addresses the requirements for remedial investigations and other activities at the CENCO Site as specified in CAO 97-118. The Revised Master Work Plan consists of the following sections:

- Section 1.0 Presents introductory information including the purpose and contents of the Revised Master Work Plan;
- Section 2.0 Presents background information including descriptions of historical Site operations;
- Section 3.0 Presents a discussion of the geology and hydrogeology at the CENCO Site and its vicinity;
- Section 4.0 Presents a summary of previous site investigations including subsurface soil and groundwater conditions;
- Section 5.0 Presents a summary of previous regional groundwater investigations, including descriptions of potential contributors of halogenated volatile organic compounds (HVOCs) detected in groundwater on a regional scale;

- Section 6.0 Presents the proposed strategy for soil and groundwater cleanup and additional investigation activities;
- Section 7.0 Presents an outline for the updated refinery Source Identification and Reduction Plan;
- Section 8.0 Presents a proposed schedule for implementing the Revised Master Work Plan; and
- Section 9.0 Presents a list of references.

In addition to the above described sections, supporting tables and figures are included following the text and are referenced as appropriate in each section.

2.0 BACKGROUND

2.1 SITE DESCRIPTION

The CENCO Refining Company (CENCO) facility is located at 12345 Lakeland Road in Santa Fe Springs, Los Angeles County, California (Site). The Site is bounded by Florence Avenue to the north, Santa Fe Rail Road to the east, and Lakeland Road to the south, and industrial facilities and Norwalk Boulevard to the west. The Site is located in an industrial/commercial area, which is surrounded by a residential neighborhood. A Site location map is shown on Figure 1.

The Site occupies approximately 74 acres and consists of three main areas: 1) Bloomfield Property, 2) the former Lakeland Property, which was the former location of the refinery offices and truck-loading facilities, 3) the former aboveground storage tank (AST) area (South Tank Area) - Walker Property. The former Lakeland Property has been sold and the property redeveloped as a warehouse storage and distribution center. In addition, the former Powerine Oil Company operated a crude oil transfer pipeline interconnecting the Marine Terminal in Long Beach, and its refinery in Santa Fe Springs, California. Figure 2 shows the CENCO Site layout and Operational Area locations. The following sections provide brief descriptions of these areas.

2.1.1 Bloomfield Property

The Bloomfield Property is located directly to the east of the refinery and on the east side of Bloomfield Avenue. The property consists of five ASTs, which have been used primarily for bulk petroleum products, and a coke storage facility. An active oil production well is present in the northwestern corner of the Bloomfield Property. For the purposes of this Master Work Plan, the Bloomfield Property will be designated as Operational Area 1 (Figure 2).

2.1.2 Refinery

The refinery is bordered by Florence Avenue to the north, Bloomfield Avenue to the east, Lakeland Road to the south, and an industrial area to the west. The refinery consists of three main areas including the East Tank Farm Area, the West Tank Farm Area, and the Processing Area. For the purposes of this Master Work Plan, the East Tank Farm Area, Processing Area, and West Tank Farm Area will be designated as Operational Areas 2, 3 and 4, respectively.

As shown on Figure 2, the East Tank Farm Area encompasses the southeastern portion of the refinery and includes several ASTs, which were used to store various petroleum products including crude oil, gasoline, propane, isobutane, and butane. The West Tank Farm Area is located along the western boundary of the refinery; and includes several ASTs, which were used to store wastewater, vacuum residuum, gas oil, and other fuel products. The Processing Area is located within the central and northern portions of the refinery, and consists of the following: an administration building that houses an operations office, a maintenance office, and a laboratory; and processing equipment, including crude units, a fluid catalytic cracking unit (FCCU), an

alkylation unit, a coker unit, a sulfur plant, a hydrogen plant, a hydrocracker, and a gasoline blending facility.

2.1.3 Former Lakeland Property

The former Lakeland Property is located directly south of the refinery and on the south side of the Lakeland Road (Figure 2). For the purposes of this Revised Master Work Plan, the former Lakeland Property will be designated as Operational Area 5. The property was used to house office buildings for the former Powerine Oil Company, a warehouse, a firehouse, a waste storage area, an employee parking, a storage yard, and several gasoline ASTs with loading racks. The facility was demolished and soil was remediated in 1997. Subsequently, the RWQCB issued a "No Further Action" determination to Powerine (now CENCO) with regards to the soil at this property. The former Lakeland Property was sold in 1997 and has been redeveloped as a warehouse facility. Since the soil at Former Lakeland Property requires "no further action" as warranted by the RWQCB, soil conditions will not be discussed further in this document. Discussion pertaining to the former Lakeland Property will be limited to the groundwater conditions beneath the Site and its vicinity as discussed in Sections 4.2 and 5.0.

2.1.4 Former AST Area - Walker Property

The former AST area (South Tank Area), located in the southwestern portion of the Walker Property and to the east of the Metropolitan State Hospital (Figure 2), consisted of two 80,000-barrel ASTs that were removed in 1990. For the purposes of this Master Work Plan, the former AST area at the Walker Property will be designated at Operational Area 6. CENCO leased the area with the two ASTs from Walker Property between 1968 and 1986. Prior to 1968, the Getty Oil Company (the successor in interest is Texaco) owned and operated the property between the 1920s and 1964 as a storage facility for crude oil and disposal of off-site-derived oil-well drilling mud. Getty sold the property to the Walker Property in 1979. The ASTs were interconnected to the refinery via underground pipelines. During the leasing period, CENCO used the ASTs to store fuel oil and jet fuel, which were transported via underground pipelines from the refinery and to the Norwalk Defense Fuel Supply Center (DFSC) facility. The fuels may also have been loaded on railcars at the Walker Property. The facility was also used to receive butane and propane for consumption at the refinery. From 1968 to 1986, the former AST area was used to store only virgin fuel products, and was not used to generate, store, treat, or dispose of any waste material.

2.1.5 Pipeline

The former Powerine Oil Company, as well as numerous other refineries, operated a number of product conveyance pipelines (Line Nos. 1 through 4, and Line Nos. 9 through 11, and Line Nos. 13 through 15). CENCO is not operating these pipelines due its suspension of refinery operations. These pipelines interconnected the refinery to the Marine Terminal in Long Beach, California, the Southern Pacific Pipeline Station, and the DFSC in Norwalk, California as follows:

- Line No. 1 conveyed crude oil and gasoline between the refinery and the Marine Terminal between 1969 and 1991.

- Line No. 2 conveyed diesel fuel, and Jet A fuel from the refinery to the Southern Pacific Pipeline Station in Norwalk, California between 1966 and 1995.

- Line Nos. 3 and 4 conveyed crude oil between the refinery and the Marine Terminal; these pipelines are connected to other pipelines operated by other refineries (i.e., G.A.T.X., Edgington Oil Company, and Paramount Oil Company).

- Line No. 9 was used to transfer jet fuels from the refinery to the DFSC in Norwalk, California between 1969 and 1982.

- Line No. 10 was used to transfer crude oil between the refinery and the Golden West refinery.

- Line No. 11 was used to transfer gas oil from the west side to the east side of the refinery.

- Line No. 13 was used to transfer crude oil from the ARCO Terminal to the former Powerine Marine Terminal in Long Beach, California.

- Line Nos. 14 and 15 were used to transfer crude oil from the former Powerine Marine Terminal to Topko & Thums refinery in Long Beach, California.

2.2 HISTORICAL SITE OPERATIONS

The CENCO Site had been used as a refinery since the 1930s. Prior to the construction of the refinery, the CENCO Site was an oil field consisting of crude oil production wells and unlined sumps. In 1936 the Rothschild Oil Company purchased the refinery from the Bell View Oil Syndicate. The Rothschild family owned and operated the Powerine Oil Company at the site from 1936 to 1984, when Powerine went into bankruptcy and ceased operations at the refinery. In 1986 the refinery emerged from bankruptcy with a new owner, Mr. Oscar Schmidt. The refinery was restarted and operated until 1992, when it ran into financial problems and shut down. In 1993 the Castle Energy Corporation bought Powerine and operated the facility until 1995, at which time operations were temporarily suspended. In 1996 Energy Merchant Corporation purchased Powerine. In August 1998 the CENCO Refining Company purchased the assets and liabilities of the Powerine Oil Company.

The Powerine refinery processed crude oil to produce petroleum products; primarily transportation fuels, including gasoline, Jet A fuel, high and low sulfur diesel, and petroleum coke. The refinery also produced refinery gas and hydrogen, which were consumed internally. In addition, the refinery also produced revenue generating, non-fuel by-products such as sulfur

and carbon dioxide. Gasoline, jet fuel, diesel and fuel oils were transported via common carrier pipelines to Southland terminals for distribution. The remaining products were shipped off-site by trucks.

3.0 GEOLOGY AND HYDROGEOLOGY

3.1 REGIONAL GEOLOGY

The CENCO Site is located on the Santa Fe Springs Plain Subgeomorphic Province of the Los Angeles Coastal Plain at an elevation of 130 to 145 feet mean sea level (msl). This plain is a slightly rolling topographic feature sloping gently to the northeast in the vicinity of the Site due to the northwest trending Santa Fe Springs-Coyote Hills anticlinal system. Petroleum accumulation associated with this anticlinal structure has resulted in substantial oil production in the Santa Fe Springs area north of the site. Prominent features include the Puente and Coyote Hills to the northeast, east, and southeast; and the San Gabriel River to the west. The Coastal Plain area is a large structural basin that has accumulated thousands of feet of sediments since Miocene time and has been tectonically active. The Coastal Plain area generally consists of alluvial materials deposited by the Los Angeles, San Gabriel, and Santa Ana rivers.

3.2 LOCAL GEOLOGY

In the vicinity of the CENCO Site, the Santa Fe Springs Plain consists of the late Pleistocene alluvium of the Lakewood Formation. The Lakewood Formation unconformably overlies the lower Pleistocene San Pedro Formation and the Pliocene Pico Formation. The Lakewood Formation consists of interbedded clays, silts, silty sands, and sands representative of stream-type alluvial and flood-plain deposits.

Information obtained from previous soil boring logs indicates that the shallow near surface soil consists mostly of mixtures of silty and sandy clay to a depth approximately of 12 feet below ground surface (bgs) (International Technology Corporation [IT], 1986). Interbedded layers and lenses of sandy silt and silty sand occurred at depths approximately between 5 and 15 feet bgs. An intermediate coarse-grained zone consisting of sand to silty sand materials was identified at depths between approximately 15 and 90 feet bgs. Figures 3 and 4 depict CENCO site-specific and regional geologic cross-sections, respectively.

3.3 REGIONAL HYDROGEOLOGY

Several regional water-bearing units have been identified within the Lakewood and San Pedro formations. Figure 4 presents a generalized geologic cross section for the CENCO Site vicinity. In the CENCO Site vicinity, the Lakewood Formation begins at ground surface, ranges from 100 to 180 feet thick, and is composed of three hydrostratigraphic units: 1) the Bellflower Aquiclude (upper unit), 2) the Exposition Aquifer, and 3) the Gage Aquifer. The Exposition and Gage aquifers consist predominantly of sands and fine gravels with discontinuous, thinly-bedded silts and clays. These aquifers have an approximate combined thickness of 100 to 150 feet, approximately half of which is saturated.

The major water-bearing unit of specific interest with respect to this Revised Master Work Plan is the Exposition Aquifer, the upper water-bearing unit of the Lakewood Formation. The

Exposition Aquifer is separated from the deeper water-bearing zones by an unnamed aquiclude. The Exposition Aquifer is described as consisting of interbedded deposits ranging in size from low permeability clays and silts to higher permeability deposits of silty sands and locally discontinuous deposits of gravel. Information for this area of the Santa Fe Springs Basin indicates that the depth to first-encountered groundwater within the Exposition Aquifer ranges from 75 to 90 feet bgs. The Gage Aquifer base also represents the base of the Lakewood Formation.

The San Pedro Formation underlies the Lakewood Formation. In the Site vicinity, the San Pedro Formation is approximately 750 feet thick and consists of stratified silt, silty sand, sand, and gravel. The uppermost aquifer in the San Pedro Formation is the Hollydale. Maximum thickness of the discontinuous Hollydale Aquifer in the Site vicinity is approximately 40 feet; the aquifer may extend from approximately 275 to 315 feet bgs. Deeper aquifers (including the Lynwood, and the underlying Silverado and Sunnyside) are the major water-producing zones in the area. These aquifers have all been affected, to some extent, by structural folding and faulting. Structural lows, created by faulting and synclinal folding, have formed groundwater reservoirs in these zones, which are separated by aquicludes. The aquifers range in thickness from less than 50 to 500 feet. Aquifer sediments generally consist of coarse-grained sands and gravels interbedded with lenses of silt and clay. Well yields range up to 4,700 gallons per minute (gpm), (California Department of Water Resources [CDWR], 1961).

3.4 LOCAL HYDROGEOLOGY

Depth to groundwater at the Site ranges from approximately 85 feet to 105 feet bgs. Slug and pump tests performed at the refinery by IT Corporation (IT, 1986) indicate a wide range of transmissivities. Transmissivities were estimated to be between 124 gallons/day/foot (g/d/f) and 13,613 g/d/f within first-encountered groundwater at the Site. IT interpreted the hydraulic test results as an indication of a highly heterogeneous water-bearing zone containing significant boundary effects. Review of these data indicates that wells used in the tests were screened within and across sediments of disparate hydraulic properties. The range of transmissivities estimated by IT can be correlated with a variety of sediments including a gravel layer (Wells MW-502, 503 and 504) and (Wells MW-103, 201 and 206), silt (Well MW-101) and transitional sediments between the two. The transmissivity value for MW-503 of 962 g/d/f appears to be an anemally. Review of the IT data and discussion suggests that MW-503 may not have been sufficiently developed prior to performing the test, and residual drilling mud cake may have influenced the test result.

Hydraulic gradients at the site range from 0.008 to 0.011 with groundwater flow directions to the south and southwest (IT, 1986; TRC, 1989; Environmental Resolutions, 1990; Aerovironment, 1992; HLA, 1993 & 1995; TriHydro, 1996a,b & 1997a,b,c,d; Versar, 1998a,b &1999a,b). Table 1 summarizes the historical groundwater elevations at the CENCO Site. Figure 5 shows the groundwater surface contour map for the July 1999 monitoring event.

4.0 PREVIOUS INVESTIGATION

Site investigations at the CENCO refinery have been conducted since 1985 in response to RWQCB CAO 85-17 and CAO No. 97-118. CAO 85-17 directed Powerine (now CENCO) and 14 other local refineries to conduct remedial investigations to: 1) define the nature and extent of free-phase petroleum hydrocarbons and hydrocarbon-impacted groundwater, 2) define the nature and extent of petroleum hydrocarbons in soil, and 3) evaluate subsurface geology and aquifer hydraulic properties. Since 1985 site investigations have included the collection and analysis of 80 surface soil samples, installation of more than 87 soil borings for soil sample collection, and installation of more than 30 groundwater monitoring wells. Figure 6 shows soil boring and groundwater monitoring well locations. Table 2 summarizes the construction details for on-site and off-site groundwater monitoring wells. Table 3 summarizes the historical soil sampling data, and Table 4 summarizes the historical groundwater quality data. Figures 7 through 10 present the concentrations of petroleum hydrocarbons and associated constituents detected in soil and groundwater at the CENCO Site.

Soil and groundwater samples have been analyzed for petroleum hydrocarbons using the following analytical methods:

- Total recoverable petroleum hydrocarbons (TRPH) using U.S. Environmental Protection Agency (EPA) Method 418.1 and American Society for Testing and Materials (ASTM) Method 2887;

- Oil and Grease using Standard Method 5520B (reported as TRPH in Table 3).

- Total purgeable petroleum hydrocarbons in the gasoline range (C_6 to C_{12}) (TPH-g) using EPA Modifed Method 8015; and

- Total extractable petroleum hydrocarbons (TPH) as jet fuel and diesel in the C_7 to C_{44} range using EPA Modified Method 8015. Total extractable petroleum hydrocarbons were also analyzed by EPA Modified Method 8015 using a simulated distillation to differentiate between specific carbon ranges (TriHydro, 1997).

Soil and groundwater samples have been analyzed for petroleum hydrocarbon constituents (e.g., benzene, toluene, ethylbenzene and total xylenes [BTEX]) and other constituents using the following methods:

- BTEX and methyl teriary butyl ether (MTBE) using EPA Methods 8020, 8240 and 8260;

- Volatile organic compounds (VOCs), including halogenated VOCs (HVOCs) and total HVOCs, using EPA Methods 8010, 8240 and 8260;

- Total organic halogens (TOX), which includes both volatile and nonvolatile organic halogens by Method 5320 or EPA Method 450.1;
- Semi-volatile organic compounds (SVOCs) using EPA Method 8270;
- Total metals (including lead) using EPA Method 6010; and
- Total soluble lead using California Waste Extraction Test (WET).

Figures 11 and 12 present the distribution of TPH-g and benzene in groundwater respectively, for the semiannual groundwater monitoring event performed in July 1999 (Versar, 1996b). Detailed descriptions of these investigations can be found in previously submitted reports listed in Section 9.0, References.

4.1 SOIL CONDITIONS

Previous soil investigations indicated that the subsurface soils are impacted by petroleum hydrocarbons, and to a lesser extent BTEX, at the areas of know releases. Other VOCs were detected sporadically in soil samples at low levels (less than 0.3 milligrams per kilogram [mg/kg]). Low concentrations of metals were detected throughout the Site suggesting background soil metal conditions with exception of areas adjacent to Tanks 10006 and 20092 in Operational Area 4 (Section 4.1.4). The following sections summarize past remedial investigations and soil conditions at each of the six Operational Areas.

4.1.1 Operational Area 1: Bloomfield Property

In 1985 a remedial investigation was conducted by IT at the Bloomfield Property in response to the CAO 85-17 (IT, 1985). Investigations at the Bloomfield Property were performed in two main areas: 1) South Tank Farm Area, and 2) North Coke Handling Area. In the area of the South Tank Farm, three soil borings, SB-20, 107, and 203, were drilled to maximum depths of 10, 70, and 88.5 feet bgs, respectively (Figure 7). Boring SB-20 was placed in the tank farm area. Soil Boring 107 was placed at the southeast corner of the property adjacent to the railspur; and Soil Boring 203 was placed at the southeast corner near the property boundary. Eight subsurface soil samples were collected at depths between 5 and 88.5 feet bgs from the three soil borings. Six of the eight samples, except two from SB-20, were analyzed for TRPH or TPH-g, BTEX, and other VOCs; the two samples collected from SB-20 were analyzed for TPH only. Upon completion of soil sample collection, soil borings 107 and 203 were converted into two 4-inch diameter monitoring wells.

In the North Coke Handling Area, five soil borings (106 and NCH-B1 through NCH-B4) were drilled in 1995 and 1997 by TriHydro Corporation (TriHydro) to maximum depths between 11 and 80 feet bgs (Figure 7). Soil Boring 106 was placed at the northern boundary of the property and to the east of an existing crude oil production well. NCH-B1 and NCH-B2 were installed near the clarifier. NCH-B3 was installed in the nonhazardous waste storage area. NCH-B4 was

installed in the area of the truck wash station. Eleven subsurface soil samples were collected at depths between 2 and 80 feet bgs from the five soil borings. All eight samples collected from soil borings NCH-B1 through NCH-B4 were analyzed for TRPH; additionally, the sample collected from Soil Boring NCH-B1 at 2 feet bgs was also analyzed for BTEX, halogenated VOCs (HVOCs), and metals. The three soil samples collected from Soil Boring 106 were analyzed for TRPH, TPH-g, BTEX, HVOCs, and lead. RWQCB has issued a "no further action" letter in regard to the soil conditions at the North Coke Handling Area.

Soil analytical results indicate that the subsurface underlying the Bloomfield Property is not impacted by petroleum hydrocarbons or VOCs. Petroleum hydrocarbons appear to be limited to surficial soils in the area near the clarifier and the nonhazardous waste storage area. Constituents of concern were detected in only four of 19 soil samples collected in this area. TPH was detected at a concentration of 640 mg/kg in the sample collected at 2 feet bgs from Soil Boring NCH-B2, and 150 mg/kg in the sample collected at 2 feet bgs from Soil Boring NCH-B3. Soil Boring 106 was the only location where TPH-g and BTEX were detected in the sample collected at 80 feet bgs at concentrations of 4.2, 0.018, 0.019, 0.011, and 0.1 mg/kg, respectively. Total xylenes were detected at 0.014 mg/kg in the sample collected at 10 feet bgs from Soil Boring 106. Cyanide was detected in one sample collected at 88.5 feet bgs from Soil Boring 203 at a concentration of 1.5 mg/kg. Shallower samples collected at 8.5 and 13.5 feet bgs contained no detectable concentrations of cyanide. TRPH, BTEX, and other VOCs were not detected at concentrations greater than laboratory reporting limits in the remainder of the 19 samples collected in the North Coke Handling Area.

4.1.2 Operational Area 2: East Tank Farm Area

In 1985 a subsurface investigation was conducted by IT at the East Tank Farm Area in response to CAO 85-17 (IT, 1985). During this investigation, 18 soil borings (SB-1 through SB-9, 103, 104, 202, 204, 303 through 305, 308, and 309) were drilled to maximum depths ranging from 5 to 88.5 feet bgs. Soil borings were located in areas of known releases (Figure 8). A total of 33 subsurface soil samples were collected at depths between 5 and 85 feet bgs from the 18 soil borings. Thirteen soil samples were collected from soil borings SB-1 through SB-9 and were analyzed for TRPH only. The remaining 20 soil samples were analyzed for TRPH, BTEX, total organic halogens (TOX) (which is a measure of volatile and nonvolatile halo-carbons), and HVOCs. Upon completion of soil sample collection, soil borings 103, 104, 202, and 204 were converted into 4-inch diameter monitoring wells, and soil borings 303 through 305, 308, and 309 were converted into vapor monitoring wells.

Impacted soils appear to be limited to three areas: 1) the area just west of the Impounding Basin, 2) the area north of the East Tank Farm and south of the Hydrogen/HydroCraker Unit, and 3) the central portion of the East Tank Farm. In the area west of the Impounding Basin at the southeast corner of the East Tank Farm Area (Figure 8), TRPH was detected at 26,500 mg/kg at 15 feet bgs in Soil Boring SB-5. TRPH was not detected at concentrations greater than the laboratory reporting limit (2 mg/kg) in the sample collected at 10 feet bgs. TRPH concentrations in soil samples from soil borings (SB-6 and 103) located approximately 120 feet downgradient of SB-5

were less than 100 mg/kg in all four soil samples collected at depths between 3.5 and 85 feet bgs. BTEX constituents were not detected in all three soil boring locations.

In the area north of the East Tank Farm (Figure 8), four soil borings were drilled to maximum depths between 5 and 40 feet bgs. TRPH was detected at a maximum concentration of 2,440 mg/kg at 40 feet bgs in Soil Boring SB-1; TRPH concentrations in soil samples collected in the other three soil borings (SB-2, SB-3 and 309) ranged from 4 to 118 mg/kg at depths between 5 and 38.5 feet bgs. BTEX constituents were not detected in any of the soil samples collected.

In the central portion of the East Tank Farm Area, nine soil borings were drilled to maximum depths between 4.5 and 68.5 feet bgs. Six of these soil borings were installed in the vicinity of known tank releases. TRPH was detected sporadically at concentrations ranging from 1 to 4,140 mg/kg (SB-8). Elevated TRPH concentrations in this area were detected at various depths and locations (Figure 8 and Table 3). BTEX constituents were not detected in any soil samples, with the exception of Soil Boring 204. In the sample collected at 4.5 feet bgs from Soil Boring 204, toluene, ethylbenzene, and total xylenes were detected at concentrations of 0.32, 0.32, and 4.4 mg/kg, respectively; benzene was not detected.

As proposed in the June 1998 version of the Master Work Plan, CENCO installed three soil borings (DB1 in Operational Area 3, and DB2 and DB3 in Operational Area 2) during March 1999. The RWQCB approved the addendum to the Master Work Plan for installation of these borings. As shown in Figure 8, DB2 is located just west of the Impounding Basin and DB3 is located in the southwest corner of Operational Area 2. Eight soil samples were collected from DB-1 and seven soil samples were collected from DB-2. (a total of 15 soil samples) at depths of 0.5, 5.5, 10.5, 20.5, 30.5, 40.5, 60.5, and 80.5 feet bgs. Samples were analyzed for TPH-g using EPA Method 8015M, and for BTEX and MTBE using EPA Method 8020. One grab groundwater sample was collected from boring DB2 using a Hydropunch™ II sampler and analyzed for TPH-g, BTEX, and MTBE using EPA Methods 8015M and 8020, respectively.

The analytical results for soil samples collected from DB2 indicate that vadose zone soils are impacted by gasoline-range petroleum hydrocarbons, BTEX, and MTBE from approximately 20 feet bgs to first encountered groundwater at about 80 feet bgs (Table 3 and Figure 8). Low levels (less than 10 mg/kg) of petroleum hydrocarbons, BTEX, and MTBE were detected in samples collected from DB2 at depths between the ground surface to 20 feet bgs. TPH-g, BTEX and MTBE were detected in the grab groundwater samples at concentrations of 402, 22.1, 5.0, 16.4, 35.0, and 294.0 mg/L respectively.

Soil Boring DB3 is located west of the Impounding Basin. TPH-g was detected at a concentration of 1.0 mg/kg in the sample collected from DB3 at 0.5 feet bgs. BTEX and MTBE were not detected in any of the samples collected from DB3 from depths ranging from 0.5 to 81 feet bgs. The analytical results for soil samples collected from DB3 indicate that vadose zone soils are not impacted by gasoline-range petroleum hydrocarbons, BTEX or MTBE at this location.

4.1.3 Operational Area 3: Processing Area

Subsurface investigations in the Processing Area were concentrated along the northern and southern portions of the CENCO Site boundary, and in the vicinity of the on-Site laboratory (Figure 8). Ten soil borings were drilled to maximum depths between 15 and 88.5 feet bgs. A total of 32 soil samples were collected. Fourteen soil samples were analyzed for TRPH; 13 of the 22 soil samples were also analyzed for VOCs, and 28 samples were analyzed for HVOCs. Sixteen samples were analyzed for lead. Eight soil samples were analyzed for TPH-g and MTBE. The soil data suggest soil impacted by petroleum hydrocarbons is limited to the areas of soil borings 102, 302, 402, and DB1, and the impact does not extend to groundwater at soil borings 302 and 402. Total HVOCs were not detected above a concentration of 0.23 mg/kg. Lead was not detected above a concentration of 12 mg/kg.

Three soil borings (104, 401, and 402) were drilled in the northern portion of the Processing Area to maximum depths ranging from 33.5 to 85 feet bgs (Figure 8). Soil Boring 104 was placed at the northeast portion of the Site, Soil Boring 401 was placed in the Sulfur Unit area, and Soil Boring 402 was placed south of the Lime Pond. A total of seven soil samples were collected from these borings and analyzed for TRPH and BTEX. TRPH was detected at concentrations ranging from 40 mg/kg at 18.5 feet bgs in Soil Boring 401 to 940 mg/kg at 8.5 feet bgs in Soil Boring 402. BTEX constituents were not detected in any of the seven samples analyzed.

In Soil Boring 102, located in the southwest corner of the Processing Area (Figure 8), TRPH was detected at 32,000 mg/kg at 8.5 feet bgs, 8,100 mg/kg at 13.5 feet bgs, and 1,500 mg/kg at 48.5 feet bgs. BTEX and HVOCs were detected sporadically at Soil Boring 102 at low levels (6.68 and 0.23 mg/kg, respectively). This soil boring was located adjacent to the underground pipeline that transported fuels from the CENCO refinery to the former AST area at the Walker Property. Soil Boring 302 was drilled to a depth of approximately 40 feet bgs, approximately 200 feet to the northeast of Soil Boring 102. The soil sample collected at 8.5 feet bgs indicated the presence of TRPH at a concentration of 5,060 mg/kg. TRPH was not detected in the sample collected at 38.5 feet bgs. HVOCs were not detected in soil samples from Soil Boring 302.

In 1996, in the area of the on-Site laboratory, a subsurface soil gas survey and soil sampling program was implemented. The program focused on whether previous handling of HVOC-containing materials, including carbon tetrachloride, 1,2-dichloroethane (1,2-DCA), propylene dichloride, and tetrachloroethene (PCE) in this area may have potentially contributed to the presence of HVOCs in groundwater beneath the Site. Thirteen soil gas points were installed and soil gas samples were collected and analyzed for HVOCs. In addition, three soil borings (LBS-5, LBS-10 and LBS-11) were drilled to maximum depths of 15, 20 and 21 feet bgs, respectively; two soil samples were collected from each of the three soil borings and analyzed for HVOCs. Analytical results showed no evidence of any HVOCs in any of the soil gas and soil samples collected.

On March 19, 1999, Soil Boring DB1 was drilled to a maximum depth of 81 feet bgs. A total of eight soil samples were collected at depths ranging from 0.5 to 80.5 feet bgs (Table 3 and Figure

8). TPH-g and BTEX were detected at maximum concentrations of 7,200, 58, 120, 75, and 392 mg/kg, respectively, at 60.5 to 61.0 feet bgs. MTBE was detected at a maximum concentration of 3.4 mg/kg at a depth of 80.5 feet bgs (at first-encountered groundwater). MTBE was not detected in vadose zone soils at elevated levels from 5.5 feet bgs to greater than 61 feet bgs.

4.1.4 Operational Area 4: West Tank Farm Area

In the West Tank Farm Area, 15 soil borings were drilled to maximum depths between 5 and 83.5 feet bgs (Figure 8). A total of 22 soil samples were collected and analyzed for TRPH; 13 of the 22 soil samples were also analyzed for VOCs and lead. Three soil samples were analyzed for TPH-g. The soil data suggests soils impacted by petroleum hydrocarbons is limited to the area of Soil Boring 201, and the impact does not extend to groundwater.

TRPH was detected at concentrations less than 100 mg/kg in all the samples collected with the exception of one sample collected from Soil Boring 201 and one sample collected from SB-13. TRPH was detected in Soil Boring 201 at a concentration of 11,000 mg/kg at 8.5 feet bgs. TRPH was detected in Soil Boring SB-13 at a concentration of 198 mg/kg at 5 feet bgs. Benzene was not detected in any of the samples located in the southeast corner of the West Tank Farm Area. Toluene, ethylbenzene, total xylenes, and other VOCs were detected sporadically at low concentrations in four soil samples collected from soil borings 105 and 201. Lead concentrations were below 10 mg/kg in the 13 samples analyzed. HVOCs were not detected in the ten samples analyzed.

4.1.5 Operational Area 5: Former Lakeland Property

The former Lakeland Property is located south of the refinery (Figure 9). As discussed previously, the RWQCB has issued a "No Further Action" letter with regard to the soil conditions at the former Lakeland Property. The RWQCB has determined that the residual levels of petroleum hydrocarbons in soil posed no unacceptable risks to human health and the environment. Discussion pertaining to the former Lakeland Property in the Master Work Plan is limited to groundwater conditions beneath CENCO Site and its vicinity.

4.1.6 Operational Area 6: Former AST Area at the Walker Property

The former Walker Property is located southeast of the refinery (Figure 2). In correspondence dated July 3, 1998, the RWQCB issued a "No Further Action" letter with regard to the soil conditions at the South Tank Area (Operational Area 6) of the former Walker Property. The RWQCB has determined that residual levels of petroleum hydrocarbons in soil in the former AST area on the Walker Property poses no significant threat to groundwater, and all significant petroleum sources have been removed. The RWQCB concluded that no further investigation or remedial action is likely to be required at the former AST area on the former Walker Property.

4.2 GROUNDWATER CONDITIONS

Groundwater beneath the CENCO Site has been impacted primarily by TPH-g and BTEX (Table 4, Figures 7 through 10). TPH-g has been detected at concentrations ranging from 0.024 to 12,000 milligrams per liter (mg/L). The detection of TPH-g at concentrations of 12,000 mg/L in a groundwater sample collected from Well MW-204 in December 1995 was an anomaly; TPH-g in this well has been historically detected at concentrations less than 14 mg/L. Generally, the highest TPH-g levels (greater than10 mg/L) were detected in groundwater monitoring wells located in the southern portion of the CENCO Site and northern portion of the Metropolitan State Hospital Property (Figure 11).

Benzene has been detected at concentrations ranging from 0.0006 to 150 mg/L. Benzene concentrations in groundwater samples are generally less than 1 mg/L, except those collected from wells MW-204 and MW-504 at the refinery, former Well MW-206, MW-501 and 501A, and MW-502, at the southern portion of the former Lakeland Property, and from former Wells MW-600 and MW-601 at the northern portion of the Metropolitan State Hospital Property. Toluene, ethylbenzene, and total xylenes have similar concentration trends as benzene in groundwater, and have been detected at concentrations ranging from 0.001 to 40 mg/L, 0.0011 to 130 mg/L, and 0.0013 to 101 mg/L, respectively. As shown on Figure 12, benzene levels in groundwater appear to be stable; the benzene plume is approximately 3,700 feet north to south by 3,400 feet east to west, with the groundwater flow direction primarily to the south-southwest in the vicinity of the CENCO Site (Figure 12).

Other VOCs, in particular HVOCs, have been detected sporadically at low concentrations in groundwater samples collected from the CENCO Site and in the area of the Metropolitan State Hospital. Based on the prevailing groundwater flow direction (south-southwesterly beneath the CENCO Site), the presence of numerous upgradient sources with documented usage and impacts to groundwater by HVOCs, and the lack of historical HVOC usage at the CENCO Site, it is likely that the presence of HVOCs is due to migration of the HVOCs onto the CENCO Site from off-site upgradient sources. Off-site, upgradient sources of HVOCs in groundwater are discussed in detail in Section 5.0. HVOCs detected in groundwater beneath the CENCO Site include cis-1,2-dichloroethene 1,2-DCE, 1,1- DCA, 1,2- DCA, 1,1-DCE, trans-1,2-DCE, PCE, trichloroethene (TCE), and vinyl chloride. HVOCs have not been detected in production well Nos. 7 and 8, located in Operational Areas 2 and 4, and at former production Well No. 6 at the former Lakeland Property. These three wells were screened from 450 to 690 feet bgs, and were analyzed for purgeable priority pollutants and petroleum hydrocarbons in 1985 (IT, 1986), and petroleum hydrocarbons and HVOCs in 1993 (Core Laboratories, 1993) and in 1997. A trace concentration of toluene (0.88 micrograms per liter [μg/L]) was detected in former Well No. 6 in April 1997.

4.3 FREE-PHASE PETROLEUM HYDROCARBONS

Free-phase petroleum hydrocarbons were first observed in Well MW-504 during the June 1988 monitoring event at an approximate thickness of 1.83 ft (Table 1). The maximum thickness of

free-phase product was observed at 2.75 feet during the March 1989 monitoring event, after which the free-phase product thickness decreased to an undetectable level after the December 1990 monitoring event. The decrease in product thickness in Well MW-504 is likely due to implementation of a product recovery program for the 2-year period between 1988 and 1990. The program was terminated as free-phase product was no longer detected in this well. Currently, only a trace of free product is observed sporadically in Well MW-504.

Free-phase product was also detected in Wells MW-501 and MW-502 at a maximum free-product thicknesses of 1.36 and 3.13 feet, respectively. Free-phase product was first detected in Well MW-501 in June 1988 and in Well MW-502 in June 1989. In 1990 free-product recovery was implemented in wells MW-501 and MW-502 and was discontinued in 1991 due to insufficient free product in these wells. Currently, there is no free product in these two wells.

In addition, two off-site monitoring wells, MW-600 and MW-601, have also had observable levels of free product. These wells are located near the northern boundary of the Metropolitan State Hospital Property and are directly down-gradient of wells MW-501 and MW-502. Free product was first detected in wells MW-600 and MW-601 in September 1990 at approximate thicknesses of 1.17 and 0.75 feet, respectively. In Well MW-600, recorded free-product thicknesses indicate a decreasing trend between September 1990 and December 1995; however, in the subsequent monitoring events between July 1996 and January 1998, free-product thickness were observed to increase in this well. In reviewing Well MW-600 construction details, CENCO concluded that the top of the well screen, at 78 feet bgs, is below the groundwater elevation of approximately 70 feet bgs recorded during monitoring events in December 1995, December 1996, and January 1998. Therefore, the measurements of free-product thicknesses were not representative of the actual thicknesses. In Well MW-601, free product has been observed sporadically since September 1990. Similar to Well MW-600, the top of the well screen of Well MW-601 at 85 feet bgs is also submersed below the groundwater table, which is at approximately 70 feet bgs. As recommended in the June 1998 version of the Master Work Plan and approved by the RWQCB, these wells have been replaced as discussed in Section 6.2 of this Master Work Plan.

Free product at trace levels has been observed sporadically in nine other wells during the monitoring events between September 1993 and September 1994 (Table 1). Free product has not been observed in these nine wells since December 1994.

4.4 INTRINSIC BIOREMEDIATION

The National Research Council (NRC) defines intrinsic bioremediation as a type of *in situ* bioremediation that uses the innate capabilities of naturally occurring microorganisms to degrade chemicals without taking any engineering steps to enhance the process (NRC, 1993). To demonstrate that intrinsic bioremediation is occurring, the following lines of evidence are considered:

1) Decrease in concentrations of chemicals of concern over time, and
2) Appropriate trends in other intrinsic bioremediation parameter measurements.

For an analysis of bioremediation potential to be meaningful, it should include at least one upgradient well, one downgradient well and one well in the center of the plume (Chevron Research and Technology Company [CRTC], 1995). At the CENCO facility, two upgradient wells (MW-104 and MW-205), two downgradient wells (MW-605 and MW-606), one crossgradient well (EW-1) and one well in the center of the benzene plume (MW-502) were selected for intrinsic bioremediation monitoring.

Groundwater samples collected from upgradient wells MW-104A and MW-205, on-Site well MW-502, downgradient wells MW-605 and MW-606, and cross-gradient well EW-1 are analyzed during each semiannual groundwater monitoring event for the following parameters:

- Ferrous iron by EPA Method 3500FED,
- Nitrate as NO_3 by EPA Method 353.2,
- Methane (monitored in wells MW-205, MW-502 and MW-505)
- Sulfate as SO_4 by EPA Method 375.4,
- Alkalinity by EPA Method 310.2,
- Total heterotrophic bacteria by Standard Method 9213, and
- *Psuedomonas* bacteria by Standard Method 9215.

The results of the intrinsic bioremediation investigation confirm the potential for intrinsic bioremediation to occur in groundwater beneath the Site. Specifically, the results of analyses performed for nitrate, sulfate, ferrous iron, alkalinity, and dissolved oxygen (DO) indicate that the potential for intrinsic bioremediation exists in the vicinity of the Site. TPH-g and associated constituent concentrations have generally decreased since groundwater monitoring was initiated at the Site. Intrinsic bioremediation parameter monitoring results are summarized in Table 5.

5.0 REGIONAL GROUNDWATER INVESTIGATION

Groundwater quality at the CENCO Site has been impacted from a variety of sources. Catastrophic releases from ruptures of ASTs that have been documented during refinery gasoline tank farm fires in the 1950s and 1960s have resulted in releases of petroleum constituents to groundwater. Additionally, several non-petroleum related chemicals are present in groundwater beneath the CENCO Site as a result of releases from other commercial and industrial properties within the Santa Fe Springs area and upgradient of the CENCO site. Recent and historic groundwater quality data indicate that groundwater beneath the CENCO refinery has been impacted with several HVOCs that do not originate from the CENCO Site.

CENCO has conducted extensive research into the regional groundwater quality in the Santa Fe Springs area. Several sites have been identified as major contributors to the groundwater conditions in this area. The potentially responsible parties (PRPs) identified by CENCO have been grouped into two Tiers (A and B) based on the likelihood that a Site has contributed to the presence of HVOCs in groundwater, and the relative magnitude of that contribution. Sites that have had major contributions to the existing groundwater quality (Tier A PRPs) are described briefly in alphabetical order below.

5.1 ANGELES CHEMICAL COMPANY

Angeles Chemical Company is located at 891 Sorenson Avenue in Santa Fe Springs, approximately 0.7 miles north (upgradient) of the CENCO Site. The site has operated at its current location since 1976 as a repackaging and distribution facility for bulk organic chemicals. The California Environmental Protection Agency, Department of Toxics Substance Control (DTSC) is currently the lead regulatory agency for the Angeles Chemical Company site.

Groundwater at the Angeles Chemical Company site has been heavily impacted with a variety of HVOCs. Specific contaminants include acetone (191,000 micrograms per liter [μg/L]), 1,1-DCA (3,880 μg/L), 1,2-DCA (1,140 μg/L), 1,1-DCE (6,500 μg/L), 1,1,1-trichloroethane (1,1,1-TCA) (189,000 μg/L), benzene (848 μg/L), TCE (14,300 μg/L), toluene (17,200 μg/L), total xylenes (9,310 μg/L), and PCE (7,980 μg/L) (Harding Lawson Associates [HLA], 1996).

5.2 ASHLAND CHEMICAL COMPANY

The Ashland Chemical Company operates a facility at 10505 South Painter Avenue in Santa Fe Springs, located approximately 0.4 miles northeast (upgradient) from the CENCO Site. This facility has operated as a repackaging and distribution center for bulk organic chemicals and remains operational today. The site is currently under the jurisdiction of both the DTSC and the RWQCB.

Site assessment activities have been conducted at the Site since 1984, and indicate the presence of elevated levels of HVOCs in groundwater beneath the site. Although groundwater remediation has been conducted within the source area, several HVOCs have migrated off-site

and appear to have impacted the CENCO Site. Specific chemicals in groundwater detected in monitoring wells downgradient of the Ashland facility include TCE (120 μg/L), total 1,2-DCE (790 μg/L), 1,1-DCA (580 μg/L), 1,2-DCA (160 μg/L), vinyl chloride (730 μg/L) and benzene (67 μg/L) (GTI, 1995).

5.3 MCKESSON CHEMICAL COMPANY

The McKesson Chemical Company is located at 9005 Sorenson Avenue in Santa Fe Springs, approximately 0.7 miles north (upgradient) of the CENCO Site. The McKesson Site is located adjacent to the Angeles Chemical Company facility at 8915 Sorenson Avenue. The McKesson Site was operated as a bulk chemical repackaging facility from 1976 until 1986. Approximately 44 ASTs and 23 underground storage tanks (USTs) were operated at the facility. The McKesson facility is currently under the jurisdiction of the DTSC.

Groundwater beneath the McKesson facility has been heavily impacted with VOCs released from the site and the adjacent Angeles Chemical Company site. Specific groundwater contaminants include: acetone (681,000 μg/L), 1,2-DCA (4,360 μg/L), cis-1,2-DCE (12,800 μg/L), 1,1-DCE (22,000 μg/L), 1,1,1-TCA (110,000 μg/L), 1,1-DCA (4,360 μg/L), PCE (45,000 μg/L), TCE (15,300 μg/L) and benzene (120 μg/L) (HLA, 1996).

5.4 MOBILE OIL/JALK FEE LEASE

The Mobil Oil/Jalk Fee Lease consists of approximately 8.8 acres of currently undeveloped land located at 10607 Norwalk Boulevard in Santa Fe Springs, approximately 0.3 miles northwest of the CENCO Site. The site has been used in connection with oil field development since the 1920s. A large, underground, degreasing tank was present on the property. The site is currently under the jurisdiction of the RWQCB.

Groundwater contaminants at the Mobil Oil/Jalk Fee Lease site include long-chain petroleum hydrocarbons, PCE (1,100 μg/L) and TCE (88 μg/L) (Alton, 1997). PCE from the Mobil Oil site appears to have impacted groundwater in the western portions of the CENCO Site and the Metropolitan State Hospital. Groundwater beneath the Mobil Oil/ Jalk Fee site appears to have been impacted by contaminants from the adjacent Continental Heat and Treat Facility.

5.5 PHIBRO-TECH, INC.

Phibro-Tech Inc. operates a facility located at 8851 South Dice Road in Santa Fe Springs, approximately 1 mile north (upgradient) from the CENCO Site. The site has operated since 1958 under various names (e.g. Southern California Chemical, and CP Chemicals, Inc.) as a metals recovery facility. The Phibro-Tech facility remains in operation and has been cited on numerous occasions for poor waste handling and housekeeping. The lead regulatory agency on the Phibro-Tech site is currently the DTSC.

Groundwater beneath the Phibro-Tech facility has been impacted with a mixture of VOCs and metals. Specific contaminants include: chromium (25,700 μg/L), ethylbenzene (4,300 μg/L), toluene (520 μg/L), xylenes (6,100 μg/L) and TCE (620 μg/L).

5.6 PILOT CHEMICAL COMPANY

The Pilot Chemical Company operates a chemical manufacturing facility at 11756 Burke Street in Santa Fe Springs, approximately 1 mile north of the CENCO Site. The facility has been used primarily for the manufacture of detergents. The RWQCB currently has lead regulatory status on the Pilot Chemical Company site. Groundwater at the Pilot Chemical Company facility has been impacted primarily with BTEX compounds. Detected concentrations of these compounds include 52 μg/L of benzene, 180,000 μg/L of toluene, 23,000 μg/L of ethylbenzene, and 110,000 μg/L of total xylenes (McLaren/Hart, 1997).

5.7 PRODUCTOL CHEMICAL DIVISION (PMC INC.)

The Productol Chemical Division of the Ferro Corporation operated a facility at 10051 Romandel Avenue in Santa Fe Springs from as early as 1947 until 1990. The site is located approximately 0.4 miles northeast (upgradient) from the CENCO Site. Prior to Productol's tenancy, the site was operated as a petroleum refinery from 1938 until 1947. Productol used the site for manufacturing napthenic acid, cresylic acid, alkylated phenols and chemical intermediates.

During tank removal activities at the Productol site in 1990, it was discovered that a benzene leak had occurred which impacted groundwater. Analytical data indicate that groundwater beneath the Productol facility has been impacted with up to 32,000 μg/L of benzene. The site is currently vacant. The regulatory status of Productol facility is unknown. The site is possibly an unregulated facility.

5.8 OMEGA RECOVERY SYSTEMS

Omega Recovery Systems operated a facility located at 12504 Whittier Boulevard in Whittier California, approximately 1.5 miles north (upgradient) of the CENCO Site. Omega Recovery Systems used the site as a solvent recovery facility until sometime after 1988. The facility has been frequently cited for poor housekeeping practices. The facility is currently closed and has been regulated by the RWQCB, the DTSC and most recently the U.S. Environmental Protection Agency (USEPA). The site has recently been placed on the National Priorities List (NPL).

Groundwater beneath the Omega Recovery Systems facility has been heavily impacted with several HVOCs including 1,1-DCE (1,080 μg/L), TCE (258 μg/L), trichlorofluoromethane (1,718 μg/L), 1,1,1-TCA (2,200 μg/L), PCE (1,030), and methylene chloride (650 μg/L) (Kaman Tempo, 1988). Additional investigative work has been performed at the Omega Recovery Systems site but was not available for review.

5.9 ADDITIONAL POTENTIALLY RESPONSIBLE PARTIES (Tier B PRPs)

Several additional properties have been identified as potential contributors to the regional groundwater contamination in the Santa Fe Springs area. These potential contributors are designated as Tier B PRBs. Regulatory agency files for these additional sites have not been reviewed at this time. Research conducted by CENCO suggests that there may be as many as 100 PRPs contributing to the presence of VOCs in groundwater on a regional scale.

6.0 REMEDIAL STRATEGY FOR SUBSURFACE SOIL AND GROUNDWATER

This section presents the remedial strategy to address soil and groundwater at the CENCO Site in Santa Fe Springs, California. Since the June 1998 version of the Master Work Plan (Versar, 1998a) was issued, CENCO purchased the refinery and adjacent properties from the former Powerine Oil Company and plans to continue operation of the refinery once facility improvements are completed. The remedial strategy presented in the June 1998 version of the Master Work Plan has been revised to reflect continued use of the property as a refinery.

Since June 1998 CENCO proceeded with several of the investigation activities proposed in the June 1998 version of the Master Work Plan with approval from the RWQCB. Activities completed to date are noted in this sections and the results presented in previous sections of the Revised Master Work Plan.

6.1 REMEDIAL CLEANUP STRATEGY FOR SOIL

As presented in Section 4.0, CENCO has performed extensive soil and groundwater investigation to characterize subsurface conditions beneath the refinery and adjacent properties. Based on the investigation results, sufficient data are available to evaluate the potential for petroleum hydrocarbons in vadose zone soil to impact groundwater quality. The vertical extent of petroleum-impacted soil, the concentrations of petroleum hydrocarbons and associated constituents (BTEX, MTBE and polycyclic aromatic hydrocarbons [PAHs]), and the age of the release will be considered in evaluating whether petroleum hydrocarbons in vadose zone soil will attenuate before reaching the groundwater table. Simple analytical models, and if required more complex computer simulations, will be used in this evaluation. If the model results indicate that a continuing source of petroleum hydrocarbons to groundwater is present in the vadose zone soil, these results will be used as input for the continuing source term in groundwater modeling efforts.

In areas where subsurface soil conditions are determined to have the potential to impact groundwater quality, source reduction/removal alternatives will be evaluated in the feasibility study (FS/remedial action plan [RAP]). Source removal/reduction alternatives that may be considered include: soil vapor extraction (SVE), bioventing, and excavation with *ex situ* bioremediation (e.g., on-Site land farming).

Since CENCO plans to continue operation of the refinery, extensive investigation and remediation of surface (0 to 0.5 feet bgs) and near surface (0.5 to 5 feet bgs) soil is not warranted with the exception of the area adjacent to Tanks 10006 and 20092 located in the West Tank Farm Area (Operational Area 4), and in Operational Area 2 adjacent to an AST formerly used to store MTBE. Previous soil sampling results for these areas are discussed in Section 4.1.4. Additional investigation activities proposed for these areas are presented in Section 6.3.2. The Human Health Risk Assessment Work Plan (Appendix D) presents the approach to developing risk-based soil cleanup criteria for these areas. These criteria will be protective of refinery workers (industrial scenario) and will be developed based on dermal, incidental ingestion and inhalation exposure pathways.

6.2 GROUNDWATER CLEANUP STRATEGY

CAO 97-118 requires that CENCO address the impacts to groundwater quality and to human health and the environment due to impacted groundwater originating from the refinery. Groundwater quality data collected at the CENCO Site and the surrounding area indicate that groundwater has been impacted with a mixture of petroleum and nonpetroleum-related constituents (i.e., HVOCs that originate from sources upgradient of the refinery). Groundwater remediation using pump-and-treat is not feasible for the CENCO Site due to the potential to enhance further downgradient migration of nonpetroleum-related constituents. Additionally, the cost of pump-and-treat would increase as a result of HVOCs in extracted groundwater. Finally CENCO could potentially become liable for enhancing migration of nonpetroleum-related constituents.

To reduce the potential liability and increase the effectiveness of groundwater remediation for the CENCO Site and surrounding groundwater, Powerine (now CENCO) proposed that a cooperative Regional Groundwater Investigation (RGI) be conducted to address HVOCs that are present in groundwater on a regional scale, including in the vicinity of the CENCO Site. This approach was presented to the RWQCB, which has begun the process of addressing regional groundwater issues in the Sante Fe Springs area. To date, two meetings have been held at the RWQCB offices (in August and December 1998) with PRP, DTSC and EPA representatives.

The purpose of the proposed RGI is to collect accurate and comparable data from sites within the Santa Fe Springs area so that a regional feasibility study may be conducted. The data will be incorporated into a database and used to develop groundwater surface elevation maps and isoconcentration maps showing the distribution of HVOCs, and to identify contributing source areas for sites within the Santa Fe Springs region. These data could then be used in a feasibility study to develop remedial strategies to manage impacted groundwater within the Santa Fe Springs area.

CENCO believes that a coordinated effort will allow facilities in the Santa Fe Springs area with documented groundwater issues to develop remedial strategies to address the presence of HVOCs without enhancing migration and incurring additional liabilities. CENCO hopes that a cooperative agreement can be forged in which all responsible parties will work together to ensure that groundwater resources are managed effectively. The success of this coordinated effort relies on effective regulatory guidance and leadership of the RWQCB and other regulatory agencies.

CENCO believes that the regional groundwater issues within the Santa Fe Springs area are best addressed through a cooperative approach involving all PRPs. It is important to note that the current list of Tier A PRPs identified through CENCO's research efforts does not constitute all of the contributors to the observed regional groundwater conditions, but rather, constitutes the sites identified by CENCO as having contributed significantly to HVOCs in groundwater.
The proposed RGI would be conducted under the direction of a technical committee consisting of representatives from all of the Tier A PRPs, the RWQCB, and other regulatory agencies. The objectives of the technical committee would be to:

1) Identify Additional PRPs: The technical committee would identify additional PRPs by conducting research at regulatory agencies. The technical committee will rely on the Santa Fe Springs Fire Department to provide notice of any accidental releases, emergency response actions, or UST removals that occur in the Santa Fe Springs area. Additional PRPs are likely to be added by the Tier A PRPs once they are notified.

2) Prioritize Investigative and Remedial Actions: The technical committee will rely on the guidance of the RWQCB to set priorities for any investigative and remedial actions performed under the RGI. Members of the committee will identify data gaps that will need to be filled for the purposes of characterizing groundwater flow and chemical transport.

3) Develop Remedial Strategies: The technical committee will use historical data and data collected under the RGI to determine the most technically feasible options for managing groundwater in different areas within the Santa Fe Springs area. It is anticipated that several remedial options will be employed to address the variety of chemicals present in Santa Fe Springs Area.

4) Community Relations: Representatives of the technical committee will make periodic status reports to the public. Reporting to the public will involve the distribution of fact sheets, attendance at City meetings, and updates regarding issues of significant public health concern.

5) Obtain Closure: The ultimate goal of the technical committee will be to facilitate the closure of facilities that either do not contribute to groundwater contamination on a regional scale, have implemented appropriate remedial actions, and/or have addressed their contributions to regional groundwater contamination through participation in a coordinated effort.

It is important to note that participation in the RGI will not preclude PRPs from individual requirements to conduct investigative or remedial activities outside the scope of the coordinated effort. Such activities may include tank removal, source removal, and additional site characterization as required by the RWQCB and other regulatory agencies for facility closures, and soil and groundwater cleanup on-site and off-site due to chemicals migrating from their facility. The RGI is intended to address only regional groundwater issues and not localized contamination that cannot be attributed to other PRPs.

6.3 ADDITIONAL REMEDIAL INVESTIGATION

Additional remedial investigations and other activities will be conducted in four phases:

- Phase 1: Regional groundwater investigation;
- Phase 2: Additional soil and groundwater investigation;
- Phase 3: Fate transport and risk assessment; and
- Phase 4: Feasibility study and remedial action plan preparation.

The proposed scopes of work for each phase are discussed below.

6.3.1 Phase 1 - Regional Groundwater Investigation

CENCO recommends that the RWQCB continue efforts begun in August and December 1998 to address regional groundwater issues in the Sante Fe Springs area. Some initial tasks are presented below. It is CENCO's position that refinery operations did not contribute to the presence of HVOCs in groundwater on a regional scale. CENCO does agree to assist the RWQCB in their efforts by providing groundwater monitoring data and other information useful in developing a thorough understanding of subsurface conditions in the Santa Fe Springs area.

Task 1.1: Development of a Comprehensive Site Conceptual Model (SCM)

The purpose of developing of a comprehensive SCM is to guide all future site investigations, interim remedial measures, and final remedial actions to ensure that these activities are efficient and take into account regional conditions that may impact the Site. Prior to developing final remedial measures, it will be necessary to develop a site conceptual model for the CENCO Site. It will be important to understand the site geology and hydrogeology prior to identifying, evaluating, and selecting of remedial measures.

Using previously collected data regarding the CENCO Site and adjacent sites, a preliminary SCM will be prepared. This model will provide a framework for evaluating the historical use of the CENCO Site and surrounding area, site geology and hydrogeology, existing chemical data in soil and groundwater, and the environmental fate and transport of these chemicals, including intrinsic bioremediation potential. Once the preliminary SCM is developed, data gaps will be identified and addressed. The data may include collection of additional geologic and hydrogeologic information, and further defining the lateral and vertical extent of the petroleum impacted groundwater.

Task 1.2: PRP Research

The scope of work of Task 1.2 will consist of the following:

1. Compilation of environmental database information on surrounding sites that may have contributed to regional groundwater issues; prioritization of listed sites for completion of RWQCB and DTSC file reviews; and completion of file reviews and related PRP research.

2. Review appropriate environmental documents to assess the potential for contamination both on-site and off-site, as well as identify other environmental issues that may be indicated in the documents that could impact the selection and subsequent design of the remedial system.

3. Review historical records of land ownership and activity, including aerial photographs in five-year increments for the previous 50 years (if available) and Sanborn Fire Insurance maps, to assess the potential for historical contamination of the Site and surrounding area.

4. Conduct interviews with appropriate persons who have knowledge related to the history and development of the Site and surrounding area. The interviews are intended to identify potential environmental contamination which may have resulted from previous land uses.

5. Perform Site reconnaissance of adjacent properties that pose a potential for adverse environmental impact to the Site. Special emphasis will be placed on identifying and evaluating surrounding land uses that may have contributed to the benzene plumes and HVOC plumes.

Task 1.3: Compilation of an Environmental Database of All Existing Data for CENCO and the Surrounding Properties

Existing available data for the CENCO Site and the surrounding sites will be compiled and evaluated. A key step in the evaluation of the existing data is the determination of its quality and usability. Existing data does not have to be of sufficient quality to make final decisions but will be helpful in developing a conceptual understanding of site dynamics. Evaluating existing data is necessary to avoid duplication of previous activities. In addition, this activity helps to determine any data gaps. The following activities will be conducted:

1. Acquire and Organize Site Data Gathered During Prior Investigations: Available previous investigation reports will be reviewed and a detailed bibliography will be created. Additionally, geologic and hydrogeologic data that has been collected for the site will be identified. A Geographic Information System (GIS) will be developed for the site; sampling locations will be placed on AutoCad maps that are linked to data that have been collected from the site.

2. Acquire and Organize Off-Site Data: The reports obtained during completion of Task 1.2 will be placed in an offsite bibliography and relevant geologic, hydrogeologic, and water quality data will be identified and added to the GIS to be developed for the site.

3. Collect Regional Geologic and Hydrogeologic Data: Background information about regional geology and hydrogeology will be reviewed and summarized. The purpose of the regional evaluation is to characterize the regional influences on groundwater and the interaction between groundwater and surface water.

4. Conduct Potential-Conduit Survey: A potential-conduit survey will be conducted to locate water wells within ½-mile of the CENCO Site. This will include a review of well logs and water quality, as well as field confirmation of the well locations. The purpose of this survey will be to better identify whether the area of impacted groundwater has affected or has the potential to come in contact with human receptors.

Task 1.4: Evaluation of Lateral Continuity of Aquifer and Other Geologic Units

Geologic cross-sections will be developed utilizing the geologic logs from existing wells. A minimum of six cross-sections will be developed. The cross-sections will be developed both along the groundwater gradient and perpendicular to the groundwater gradient, if possible. The thickness of the aquifer and other geologic units will be identified on isopach maps. Plume maps illustrating the extent of the groundwater contamination plume and free product at reasonable time intervals will be compiled. Groundwater contour maps will be compiled to illustrate the groundwater table and inferred directions of groundwater flow for reasonable time intervals. Graphs illustrating the change in water levels and plume chemistry through time will be created to evaluate the seasonal variability in water level and plume conditions.

6.3.2 Phase 2 - Additional Soil and Groundwater Investigation

Surficial and near-surface soil investigation for lead have been conducted adjacent to Tanks 10006 and 20092 located in Operational Area 4.

Task 2.1: Additional Soil Investigation

The focus of the soil investigation program is to identify areas that have the potential to impact human health and/or water quality. To evaluate the horizontal and vertical extent of petroleum-impacted soil at the CENCO Site, the historic soil sampling data were reviewed for the each of the six Operational Areas shown on Figure 2. As recommended in the June 1998 version of the Master Work Plan and approved by the RWQCB, three soil borings were installed and samples collected for TPH-g, BTEX and MTBE analysis in areas where elevated levels of petroleum hydrocarbons and/or BTEX were previously identified.

Operational Area 1: Bloomfield

Soil samples have been collected from eight locations at the Bloomfield Property. Low levels of petroleum hydrocarbons and BTEX have been detected in this area. The maximum TPH concentration detected in soil was 640 mg/kg. Free-phase petroleum hydrocarbons have not been observed in the groundwater in this area. Based on the most recent groundwater sampling results, TPH-g and benzene were detected at maximum concentrations of 0.89 and 0.038 mg/L, (July 1999) respectively. No significant releases have occurred in this area, and therefore, no further characterization of the soil is warranted.

Operational Area 2: East Tank Farm Area

Eighteen soil borings have been installed and soil samples collected for analysis of various constituents within the East Tank Farm Area. Three potentially impacted areas have been identified including: 1) the area west of the Impounding Basin, 2) the area north of the East Tank Farm and south of the Hydrogen/Hydro Cracker Unit, and 3) the central portion of the East Tank Farm.

- Area West of the Impounding Basin: TRPH (26,500 mg/kg) was detected in Soil Boring SB-5 at 15 feet bgs. Since the vertical distribution of the petroleum hydrocarbons in this area had not been defined, one additional boring (DB3) was installed adjacent to this location. Eight samples were collected at 0.5, 5.5, 10.0, 20.0, 30.5, 40.5, 60.5, and 80.5 feet bgs. Soil screening was performed using a (PID) and recorded on the boring log. Samples were be analyzed for TPH-g, BTEX, and MTBE using EPA Methods 8015M and 8020, respectively. The analytical results for soil in this area indicate that vadose zone soils are not impacted by petroleum hydrocarbons and associated constituents, and therefore, no additional investigation is warranted.

- Area north of the East Tank Farm and south of the Hydrogen/Hydro Cracker Unit: Four locations were sampled within the northeast portion of the East Tank Farm. Elevated levels (2,440 mg/kg) of TRPH were detected at only one location (SB-1). The nearest soil boring, SB-2, located to the east of SB-1, contained low levels of TRPH at 118 mg/kg at 15 feet bgs. Impacted soil in this area appears to be surficial and does not extend to depth. Further characterization of this area is not warranted at this time.

- Central Portion of the East Tank Farm Area: Nine locations were sampled within the central portion of the East Tank Farm Area. Elevated levels of TRPH in soil were detected at three locations: soil borings SB-8, SB-9, and SB-7. At SB-8 and SB-9 impacted soil was detected at shallow depths (10 and 5 feet, respectively). Samples collected from the same borings below these depths decreased to nondetectable levels indicating that only shallow soil less than 10 to 15 feet bgs is impacted. At SB-7, the vertical extent of petroleum-impacted soil is limited to the upper 25 feet bgs, no additional soil sampling is warranted in this area.

Operational Area 3: Processing Area

Elevated levels of TRPH (32,000 mg/kg) were detected in the Southwest Corner of the East Tank Farm in Soil Boring MW-102 at 8.5 feet bgs and decreased with depth to 1,500 mg/kg at 48.5 feet bgs. TPRH concentrations in Soil Boring B-302, installed a short distance to the east-northeast of Soil Borings 102, were limited to 5,060 mg/kg TRPH at 8.5 feet bgs, underlain by no detected concentration of TRPH at 38.5 feet bgs. As recommended in the June 1998 version of the Master Work Plan and approved by the RWQCB, soil borings DB1 and DB2 were installed and samples were collected at 0.5, 5.5, 10, 20.5, 30.5, 40.5, 60.5, and 80.5 feet bgs. Samples were analyzed for TPH-g, BTEX, and MTBE using EPA Method 8015M and 8020, respectively. As presented in Section 4.1.2, analytical results for soil samples collected from DB2 indicate that vadose zone soil is impacted with gasoline-range petroleum hydrocarbons BTEX and MTBE. In situ remediation techniques such as soil vapor extraction (SVE) and bioventing will be evaluated for this area.

Northern Portion and the Laboratory Areas: Several sampling events have been performed within the northern portion and the laboratory areas of Operational Area 3 over the past decade, targeting various processing and chemical use areas. To date, only one sample, collected from SB-402 has contained greater than 100 mg/kg of TRPH. The soil sample collected at 8.5 feet bgs contained TRPH at 940 mg/kg. The sample collected from the same boring at 33.5 feet bgs contained no detectable levels of hydrocarbons indicating that the vertical extent is limited. Based on the low levels of petroleum hydrocarbons detected to date, this area does not have the potential to impact groundwater quality at the CENCO Site, and therefore, no additional soil sampling is warranted.

Operational Area 4: West Tank Farm Area

Fifteen locations have been sampled within Operational Area 4. Of the fifteen sample locations, TRPH was detected at only two sample locations (MW-201 and SB-13) at a concentration greater than 100 mg/kg. The sample collected at 8.5 feet in Soil Boring MW-201 contained 11,000 mg/kg of TRPH. The sample collected at 8.5 feet in Soil Boring SB-13 contained198 mg/kg of TRPH. Petroleum hydrocarbons in soil in this area appear to be limited to surficial soils and do not extend to depth.

In January 1998 the DTSC conducted an inspection of the CENCO refinery and collected two surficial soil samples (POC-6-128SA and PC-7-128A) at depths between 0 and 0.5 feet bgs (Figure 8). Sample POC-6-128A was analyzed for soluble lead using the California Waste Extraction Test (WET). Sample POC-7-128A was analyzed for total lead using EPA Method 6010 and for soluble lead using the WET method. CENCO collected two split soil samples (POC-6-128B and POC7-128B) and submitted these samples for total and soluble lead analyses. The analytical results are presented on Table 6.

The lead concentrations in all four samples were less that the Total Threshold Limit Concentration (TTLC) for lead of 1,000 mg/kg established in Title 22 of the California Code of Regulations (CCR) (22CCR). Soluble lead concentration in three of the four samples (POC-6-128A, POC-7-128A and POC-7-128B) were greater than the Soluble Threshold Limit Concentration (STLC) for lead of 5 mg/L (22CCR).

In October 1998 CENCO collected five additional surficial soil samples (Asphalt-1-006, Asphalt-2-046, Asphalt-3-091, Asphalt-4-045, and Asphalt -5-092) at depths of 0 to 0.7 feet bgs (Figure 8). All five samples were analyzed for total and soluble lead. The analytical results are presented on Table 6. Total lead concentrations were less than the TTLC for lead in all five samples. Soluble lead concentrations were greater than the STLC for lead in two of the five samples (Asphalt-1-006 and Asphalt-5-092).

On December 14, 1998 CENCO submitted a letter report to the DTSC summarizing the results for the samples collected during October 1998. CENCO believes that the presence of lead in surficial soil is from lead paint and is not petroleum related. CENCO proposes to collect 18 to 24 samples at six locations to define the vertical and lateral extent in soil around Tanks 10006 and 20092 total and soluble lead. The proposed sampling locations are shown on Figure 13.

Operational Area 5: Former Lakeland Property

The RWQCB has issued a No Further Action letter for the soils at the former Lakeland Property. Therefore, no additional investigation or remediation is required for vadose zone soil in this area.

Operational Area 6: Former AST Area At the Walker Property

In correspondence dated July 3, 1998, the RWQCB issued a "No Further Action" letter with regard to the soil conditions at the South Tank Area (Operational Area 6) of the former Walker Property. The RWQCB has determined that the residual levels of petroleum hydrocarbons in soil at the former AST area on the Walker Property poses no significant threat to groundwater, and all significant petroleum sources have been removed. The RWQCB concluded that no further soil or groundwater investigation or remedial action is likely to be required on the former Walker Property.

Task 2.2 Additional Groundwater Investigation

The purpose of further groundwater investigation is to obtain additional Site-specific data including hydrogeological conditions, aquifer characteristics, and subsurface bioavailability of petroleum hydrocarbons. This information will be used to evaluate remedial strategies for the groundwater at the CENCO Site. The groundwater investigation program will be conducted in a phased approach as outlined in the following tasks:

Task 2.2.1: Monitoring Well Replacement and Abandonment

Groundwater elevation measurements recorded during the last three monitoring events (Table 1) showed that elevations in some of monitoring wells have risen above the top of well screens. Therefore, measurements in these wells are not representative of the actual free-product thickness, if present. Four existing Wells (MW-104, MW-503, MW-600, and MW-601) were replaced with new 4-inch diameter wells with a screen interval between 65 and 100 feet bgs. In addition, Well MW-501 was replaced because it was damaged during redevelopment activities at the former Lakeland Property. The well was constructed with the same specifications as the other four replacement wells. A groundwater elevation measurement event was conducted upon completion of well installation. In addition, groundwater samples were collected, in the absence of free product, and analyzed for TPH-g, BTEX, and HVOCs.

The replaced wells were abandoned by destruction in accordance with the local and state regulations and guidelines. Upon completion of well replacement and abandonment activities, a summary report was prepared to document field activities, and sample results. If additional information is required for the assessment of the extent of free and dissolved-phase petroleum hydrocarbons in groundwater, additional monitoring wells will be installed as discussed in Task 2.2.2.

Well installations at the Site will be conducted using a hollow-stem auger, typically to a maximum depth of 100 feet bgs. Soil lithology will be logged according to the United Soil Classification System (USCS). No soil samples are scheduled to be collected. However, soil cuttings will be screened with a PID, if warranted, samples will be collected and analyzed. Each well will be constructed with a 4-inch diameter schedule 40 poly-vinyl chloride (PVC) casing and slotted screen. Upon completion of the well installation, the well will be developed and surveyed.

The Sampling and Analysis Plan (SAP) (Appendix B) has been prepared so that sample collection activities are conducted in accordance with technically acceptable protocols. The SAP consists of a Field Sampling Plan (FSP) and a Quality Assurance Project Plan (QAPP). The FSP describes data-gathering methods that will be used on the project and was written so that a field sampling team, would be able to gather the required information. The QAPP will describe the project objectives and quality assurance/quality control (QA/QC) protocols. In additional, a Site-specific Health and Safety Plan (HSP) has been be prepared to identify potentially hazardous operations and exposures and prescribe appropriate protective measures for on-Site workers, the surrounding community, and the environment.

Task 2.2.2: Monitoring Well Installation

As discussed above, previous investigations have delineated the plume of benzene-impacted groundwater. The plume is approximately 3,400 feet in the north-south direction and 3,000 feet in the east-west direction, with the groundwater flow direction primarily to the south-southwest in the vicinity of the CENCO Site. The furthest well to the south is Well MW-606, the furthest well to the southeast is Well MW-607, and the furthest well to the southwest is Well MW-605; these three wells are located on the Metropolitan State Hospital Property. TPH-g and BTEX were not detected in groundwater samples collected from wells MW-605 and MW-606. Low levels of HVOCs have been detected sporadically in Well MW-605, and HVOCs have not been detected in Well MW-606. Low concentrations of TPH-g and BTEX, and sporadic HVOCs have been detected in Well MW-607.

The closest up-gradient wells from MW-605, MW-606, and MW-607 are Well MW-600 and Well MW-601, which are located approximately 1,400 feet to 1,800 feet up-gradient. Free product has been observed in these two wells. However, as discussed in Section 4.3, the tops of the well screens in these two wells have been submerged below the groundwater table due to higher groundwater elevation. These wells have been recently replaced, and the groundwater plume will be re-evaluated after installation of the new wells.

If the replacement wells for Wells MW-600 and MW-601 show significant free product after several monitoring events, two additional groundwater monitoring wells will be installed between Wells MW-600 and MW-606 to characterize the southern boundary of the impacted groundwater plume and delineate the extent of free product. These wells will also be used to evaluate whether the benzene plume is stable or continuing to migrate downgradient. If the benzene plume is determined to be migrating remedial actions will be proposed in the context of

the regional groundwater program. Wells will be installed using the same protocols as outlined in Task 2.2.1.

Task 2.2.3: Groundwater Monitoring

As part of the semi-annual monitoring program (since July 1998), all wells are monitored for physical groundwater parameters including pH, dissolved oxygen, specific conductivity, oxidation/reduction(Redox) potential, and temperature, during well purging. Selected wells are also monitored for parameters indicative of the intrinsic bioremediation. The following additional activities have also been included in the monitoring program:

1. Following completion of the Phase 1 activities that include compiling monitoring data for surrounding properties/sites, an evaluation will be performed to determine if modifications to the semi-annual sampling program are warranted; including the collection of additional samples and/or analytical parameters to evaluate regional groundwater contamination issues that may have impacted CENCO or contributed to previously identified issues.

2. A statistical evaluation of all existing monitoring data to determine which wells could be monitored less frequently (annually or biannually), or if sufficient data exist to selectively reduce the types of analyses being analyzed (i.e., a reduction in the number of semi-volatile analyses being performed).

Task 2.2.4: Aquifer Testing

Aquifer testing will be conducted to characterize the hydraulic properties of the Exposition Aquifer. The data collected will be included in the CSM for use in modeling around water from and chemical fate and transport, assessing remedial alternatives, and in remedial design. Aquifer testing will comprise slug testing, and step drawdown and constant-rate discharge tests using an existing groundwater well; if the existing well is not feasible for use as the test well, a new groundwater well will be installed. The well to be used as the aquifer test well will be selected based on the following criteria:

- The well is located in an area with elevated benzene concentrations.
- The well screen is located in the appropriate transmissive zone
- Aquifer materials in the vicinity of the well are capable of yielding an adequate volume of groundwater
- The well was developed at a sufficiently high pumping rate to insure that testing activities do not disrupt the well screen.
- Well is of sufficient diameter to house a submersible pump capable of extracting water at an appropriate rate.
- There are adjacent wells for use as observation wells.

It is proposed that aquifer tests will be conducted on a selected aquifer test well. Aquifer tests to be conducted on the well will include: 1) a step drawdown test so that the flow rate can be estimated; 2) a 72-hour continuous aquifer test to assess aquifer parameters; and 3) a pilot test up to 30 days in length so that the capture zone for the well can be established.

During the constant-rate discharge test, a groundwater sample will be obtained after 24 hours from the aquifer test well and sampled for the following parameters:

a. General mineral quality by various methods
b. Total and soluble priority pollutant metals by EPA 6000 and 7000 series
c. Total petroleum hydrocarbons by EPA Method 8015 modified
d. Volatile organic compounds by EPA method 8260, and
e. Semi-volatile organic compounds by EPA method 8270.

To assess the extent of heterogeneity of hydraulic parameters within the Exposition Aquifer, slug tests will be performed at a number of wells located throughout the Site. One slug test will be performed on the well selected for the step-drawdown and constant-rate discharge tests for comparison with slug tests performed elsewhere in the Site and the Site vicinity. This information will be used in refining remedial measures across the Site and vicinity.

6.3.3 Phase 3 - Implement Human Health Risk Assessment Work Plan

A Risk-Based Corrective Action (RBCA) assessment will be performed to develop soil cleanup criteria for petroleum hydrocarbon and lead-impacted soil. The Human Health Risk Assessment Work Plan will utilize the RBCA decision-making process, which takes into account general, then specific, physical and chemical Site characteristics in a tiered approach to tailor assessment and remediation activities to Site-specific conditions. The RBCA process utilizes risk and exposure assessment practices developed by the EPA in their Risk Assessment Guidelines for Superfund (RAGS). The RBCA process was developed by the American Society for Testing and Materials (ASTM), and promulgated as ASTM Method PS-104. The RBCA assessment method has been recognized by the RWQCB as a viable decision-making approach to assess risks from contaminated sites to human health and the environment. Soil and groundwater cleanup criteria will be developed that are protective of refinery workers (industrial scenario) and consider dermal, incidental ingestion and inhalation exposure pathways.

6.3.4 Phase 4 - Feasibility Study/Remedial Action Plan Preparation

Task 4.1: Feasibility Study (FS)

A feasibility study (FS) will be conducted to develop a cost-effective remedial strategy that is protective of human health and the environment.

The FS will address the following soil and groundwater issues:

- Lead-impacted soil adjacent to Tanks 10006 and 20092 located in Operational Area 4. If necessary lead-impacted soil will be remediated to prevent exposure to levels greater than risk-based soil cleanup criteria. Remediation may include a combination of excavation and off-site disposal and capping. Since lead-impacted soil is limited to less than 5 feet bgs, potential impacts to groundwater quality need not be considered.

- Vadose zone-impacted soil in the vicinity of Soil Boring DB2. Remediation of petroleum-impacted soil may be required to reduce the potential to impact groundwater quality. Remediation technologies such as SVE and bioventing will be evaluated.

- If necessary, free-product recovery will be considered to reduce the total mass of petroleum hydrocarbons present beneath and downgradient of the refinery. At present, free product has not been observed at sufficient levels to warrant implementation of passive or active free-product recovery.

- Dissolved-phase petroleum hydrocarbons in groundwater. Natural attenuation (Intrinsic bioremediation) modeling will be performed to evaluate whether active remediation is required to address dissolved-phase petroleum hydrocarbon and associated constituents (BTEX and MTBE) in groundwater. If necessary, remedial alternatives such as enhanced bioremediation will be evaluated.

Task 4.2: Treatability Study (TS)

Treatability studies will be conducted for the selected remedial technologies and will include bench-scale testing and/or a field pilot testing to collect necessary parameters for a full scale system design. The evaluation will include consideration of hydraulic containment, soil vapor extraction, and in-situ bioremediation technologies. A pilot test work plan will be prepared and submitted to the lead regulatory agency for approval prior to field testing.

Task 4.3: Remedial Action Plan (RAP)

A RAP will be prepared in accordance with the RWQCB guidelines. The RAP may be combined with the FS to expedite the review and approval process and will discuss the Site history, regional and local hydrogeology, distribution of chemicals in soil and groundwater, results of interim remedial actions. The RAP will also summarize FS, present treatability study results, a final remedial action implementation plan, and present procedures for long-term management of soil groundwater issues.

6.4 PIPELINE INVESTIGATION

Numerous petroleum conveyance pipelines are located within and extending beyond the CENCO Site. The pipelines have been owned and operated by many parties concurrent with historical operations at the CENCO refinery. Various petroleum products were conveyed through the pipelines including: gasoline, Jet A fuel, diesel fuel, and crude oil. Given the extended period of use, multiple parties, and multiple products involved, a phased approach will be utilized for the investigation of possible releases from the pipelines at and extending off-Site.

The first phase will consist of the identification and mapping of existing and former line locations. Once the lines have been located, a records search will be performed to determine present and past ownership and operations of each line segment. The lines owned and/or operated by Powerine (now CENCO) will be identified. The pipeline owners and the operators identified will be contacted and asked to participate in future investigative activities. Additional investigations will be proposed based on the result of the record search. A work plan will be prepared and submitted to the RWQCB for approval.

7.0 REFINERY SOURCE IDENTIFICATION AND REDUCTION PLAN

As required by CAO 97-118, CENCO will prepare an updated "Refinery Source Identification and Reduction Plan". The plan will be updated and submitted to the RWQCB within 60 days of restarting refinery operations. The updated plan will provide detailed operational monitoring procedures to minimize and prevent unauthorized releases of petroleum hydrocarbons into the environment. The operational monitoring procedures will consist of a series of monitoring, visual inspection, and record-keeping efforts, designed to limit the occurrence of leaks and spills and to minimize any losses should there be any unanticipated leaks and spills. The plan will include the following:

- A description of the current and historical facilities that have existed on the Site.
- An inventory of all existing above and underground tanks including tank contents, year of operation and locations.
- A summary of the existing on-Site and off-Site pipelines that are currently operated by CENCO.
- A summary of the existing tank integrity testing program, and a proposed modified plan, if necessary.
- A summary of the existing pipeline monitoring program, and a proposed modified plan, if necessary.
- A description of the surrounding facilities that might have potentially impacted the Site, in the present or in the future.
- A description of the frequency with which each of the components of the plan will be conducted.

8.0 PROPOSED SCHEDULE

The proposed schedule necessary to implement the Master Work Plan is presented on Figure 14. It should be noted that implementation of the schedule will be subject to agency review and approval of work plans, regional groundwater investigation and coordination. Thus, the proposed schedule will be adjusted accordingly with the execution of the regional investigation and coordination issues.

9.0 LIST OF REFERENCES

American Petroleum Institute (API), 1989. *A Guide to the Assessment and Remediation of Underground Petroleum Releases.* API Publication 1628. Second edition, August.

Chevron Research and Technology Company (CRTC), 1995. *Protocol for Monitoring Intrinsic Bioremediation in Groundwater.* March.

CORE Laboratories. 1993. Analytical Report, Job Number 931767. Prepared for Powerine Oil Company. Dated August 30, 1993.

Blakely Environmental Investigations, Inc., 1997. *Bioremediation Monitoring Report for Powerine Oil Company 12354 Lakeland Road, Santa Fe Springs, California.* February 14.

Harding Lawson Associates (HLA), 1993. *Volume I Remedial Investigation/Feasibility Study Workplan Walker Property Site Santa Fe Springs, California.* April 23.

HLA, 1995. *Volume I Remedial Investigation Walker Property Site Santa Fe Springs, California.* August 25.

HLA, 1997. *Fate and Transport/Human Health Risk Assessment 12354 Lakeland Road Santa Fe Springs, California*, March 21.

IT, 1985. *Revised Plan for Investigation and Site Assessment for Potential Subsurface Pollution at Powerine Oil Company Refinery, Santa Fe Springs, California.* July.

IT, 1986a. *Investigation and Site Assessment for Subsurface Contamination.* January.

IT, 1986b. *Report Assessment of Surface Contamination and Remedial Alternatives Powerine Oil Company Refinery, Santa Fe Springs, California.* January.

IT, 1986. *Progress Report, Mitigation Investigation and Feasibility Study for Ground Water, Powerine Oil Refinery, Santa Fe Springs, California.* Prepared for Powerine Oil Company, August 28, 1986.

Micro Quick, 1998. *Records of Water Quality Control, The Mark Group.* Micro Quick No. 27643-1.

National Research Council (NRC), 1993. *In-Situ Bioremediation, When Does it Work?* Washington D.C.

Powerine Oil Company (Powerine), 1997. Fax Memo from Powerine to Keith Elliot, Associate Water Resource Control Engineer at the Los Angeles Regional Water Quality Control Board, regarding abandonment activities for well No. 6. Dated April 22, 1997.

Powerine Oil Company (Powerine), 1997. Letter from Powerine to Keith Elliot, Associate Water Resource Control Engineer at the Los Angeles Regional Water Quality Control Board, requesting No Further Action Letter by Tueday May 13, 1997 for Lakeland Property, 12354 Lakeland Road, Santa Fe Springs, California. May 12.

California Regional Water Quality Control Board - Los Angeles Region. 1998. Letter by J.E. Ross, Unit Chief regarding No Further Action status at the Powerine Oil Company - Former Powerine Lease on the Walker Property, 11240 Bloomfield Avenue (File No. 85-18). Dated July 3, 1999.

Santochi & Bravante LLC., 1998. Fax letter to Ms. June Christman containing laboratory analytical "results of the recent sampling near the southern tank area on the Walker Property." May 4.

TRC Environmental Consultants, Inc. (TRC), 1990a. *Environmental Investigations of Walker-Turner Property Bloomfield Avenue and Lakeland Road Santa Fe Springs, California.* January 19.

TRC, 1990b. Letter from TRC to Susan Drummy, Controller for the Turner Development Corporation, presenting results of additional Environmental Studies - 10 Soil Borings Walker-Turner Property, Santa Fe Springs, California. March 8.

TRC, 1990c. Letter from TRC to Susan Drummy, Controller for the Turner Development Corporation, presenting results of additional Drilling Activities - 5 Soil Borings Walker-Turner Property, Santa Fe Springs, California. March 9.

TRC, 1990d. *Summary of Groundwater Monitoring at Walker-Turner Property Bloomfield Avenue and Lakeland Road Santa Fe Springs, California.* June 1.

Trihydro Corporation (Trihydro), 1993. *Attorney-Client Privileged Ground-Water Records Search Powerine Refinery and Vicinity.* October 15.

Trihydro, 1996a. *Offsite Subsurface Investigation Powerine Refinery Santa Fe Springs, California.* February 19.

Trihydro, 1996b. *Soils Investigation Administrative Building/Lakeland Property 12354 Lakeland Road Santa Fe Springs, California.* December 17.

Trihydro, 1997a. *Halogenated Volatile Organic Compounds (HVOC) Soil Investigation Powerine Refinery 12345* [sic.] *Lakeland Road Santa Fe Springs, California.* January 3.

Trihydro, 1997b. *Final Soils Investigation Administrative Building/Lakeland Property 12354 Lakeland Road Santa Fe Springs, California.* February 7.

Trihydro, 1997c. *Semi-annual Groundwater Monitoring Report, Powerine Oil Company, Santa Fe Springs, California (July 1996-December 1996).* February 26.

Trihydro, 1997d. *Soils Investigation North Coke Handling Property 10820 Bloomfield Avenue Santa Fe Springs, California.* January 3.

Versar, Inc.(Versar), 1997. *Interim Remedial Measures Workplan for the Lakeland Property Powerine Oil Company, 12354 Lakeland Road Santa Fe Springs, California 90670.* December 30.

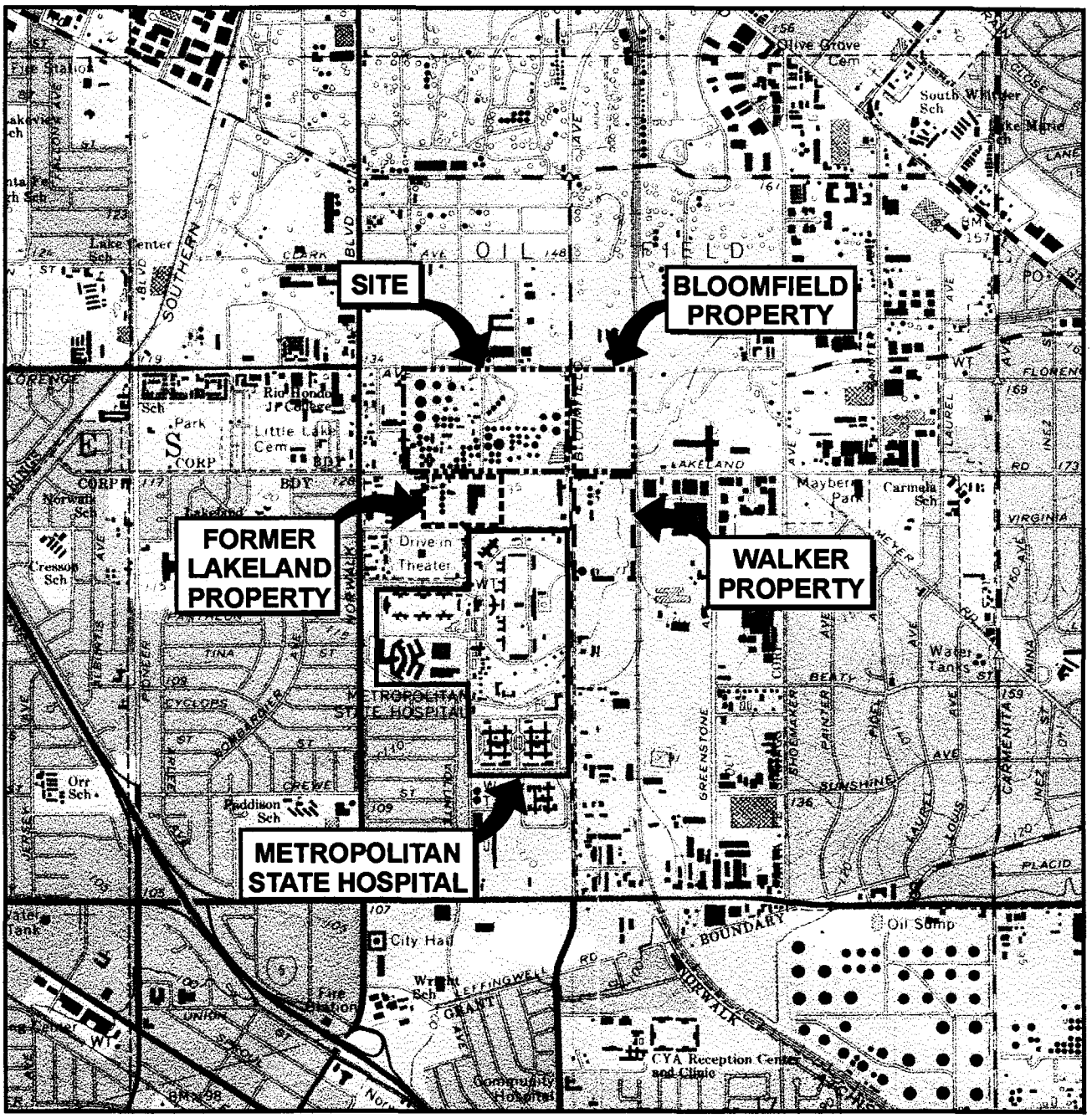
Versar, 1998a. *Master Workplan, Powerine Oil Company, 12354 Lakeland Road , Santa Fe Springs, California 90670.* Prepared for Powerine Oil Company. June 9, 1998.

Versar, 1998b. *Semi-Annual Groundwater Monitoring Report, CENCO Refining Company (Formerly Powerine Oil Company), Santa Fe Springs, California, August 1998 Monitoring Event.* Prepared for CENCO Refining Company. November 10, 1998.

Versar, 1999a. *Semi-Annual Groundwater Monitoring Report, CENCO Refining Company (Formerly Powerine Oil Company), Santa Fe Springs, California, January 1999 Monitoring Event.* Prepared for CENCO Refining Company. April 14, 1999.

Versar, 1999b. *Semi-Annual Groundwater Monitoring Report, CENCO Refining Company (Formerly Powerine Oil Company), Santa Fe Springs, California July 1999 Monitoring Event, .* Prepared for CENCO Refining Company. September 3, 1999.

FIGURES

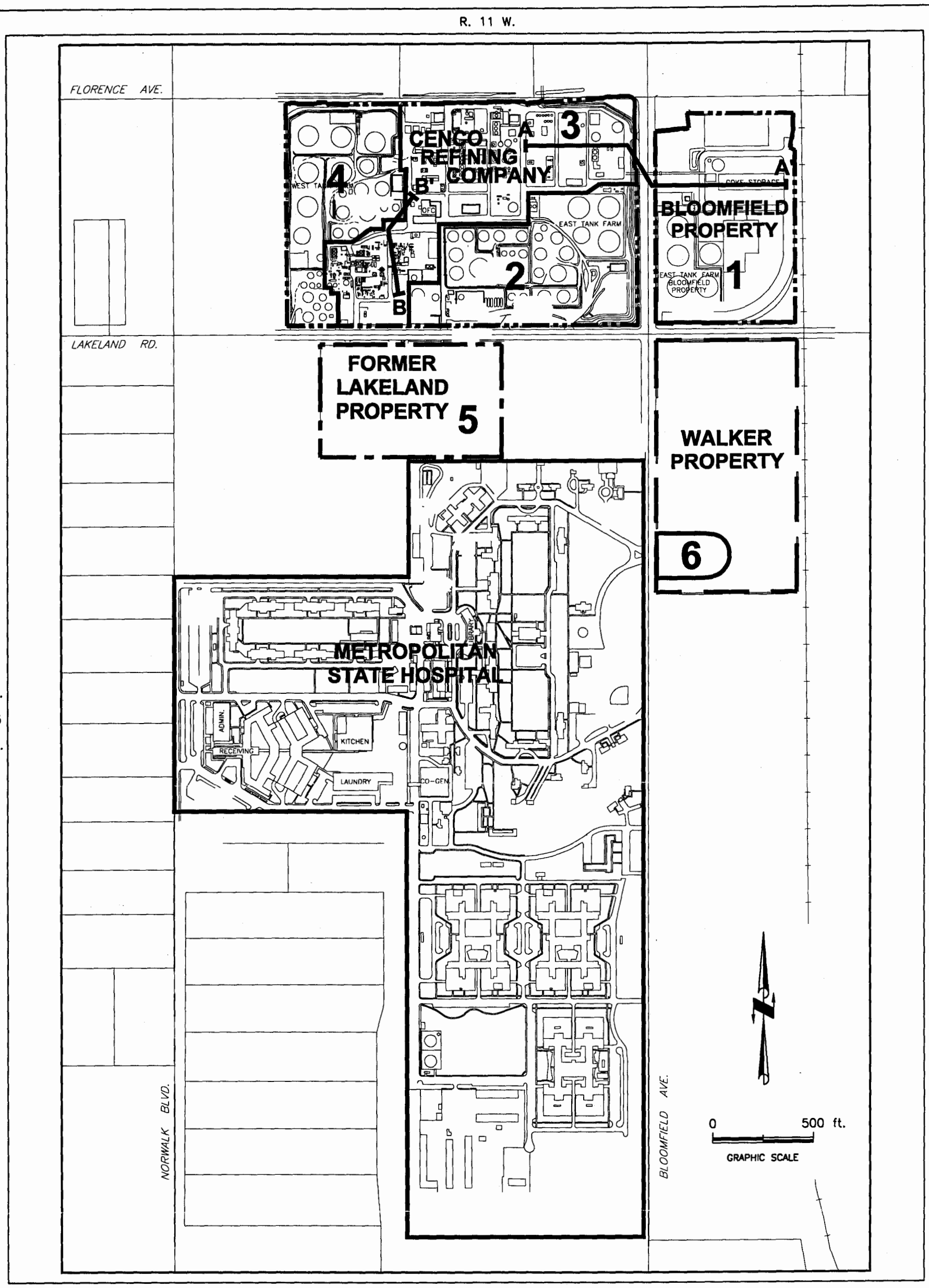


Source: USGS 7.5 Minute Series Whittier, California Quadrangle, 1965 Photorevised 1981.

0' SCALE 2000'

Dr. By: DKT	**Versar** INC 7844 Madison Avenue Suite 167 Fair Oaks, CA 95628 (916) 962-1612	**SITE LOCATION MAP** **Cenco Refining Company** **Santa Fe Springs, California**
Date: 11/23/99		**Figure 1**
Versar Project No.: 3917-014		

Path/File: P/Cenco/Masterwp/RevMWP/Cad/111599f1.cdr



LEGEND

OPERATIONAL AREAS

1. BLOOMFIELD PROPERTY
2. EAST TANK FARM AREA
3. PROCESSING AREA
4. WEST TANK FARM AREA
5. FORMER LAKELAND PROPERTY
6. FORMER AST AREA – WALKER PROPERTY

CENCO PROPERTY BOUNDARY

WALKER PROPERTY BOUNDARY

FORMER LAKELAND PROPERTY

METROPOLITAN STATE HOSPITAL

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VERSAR JOB NO.: 3917-014

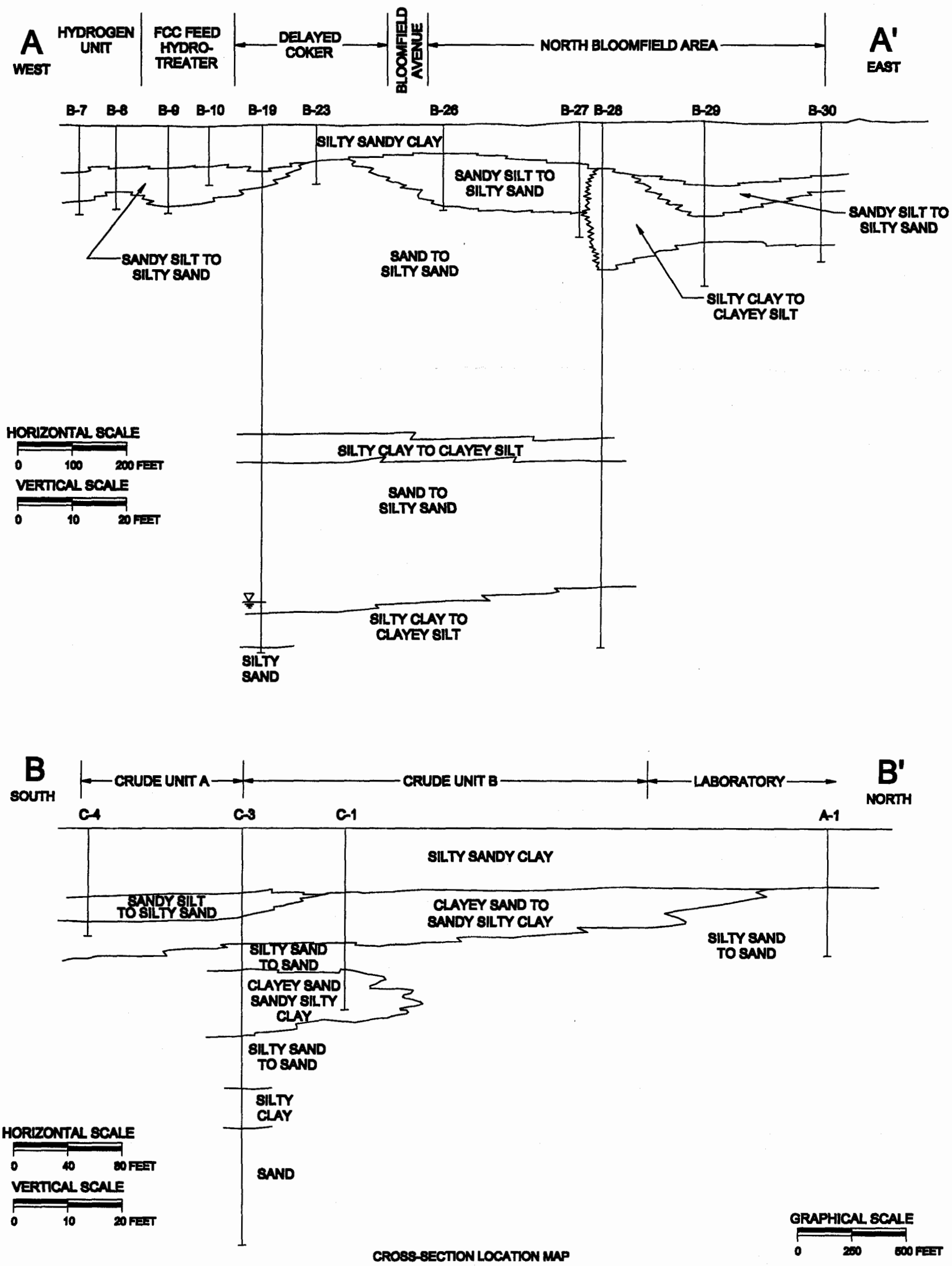
DRAWN / APPROVED: DKT / SRT

FILE: P/CENCO/MASTERWP/REVMWP/CAD/111599f2.DWG

SITE LAYOUT AND OPERATIONAL AREA LOCATIONS

CENCO REFINING COMPANY
SANTA FE SPRINGS, CALIFORNIA

FIGURE 2



SOURCE: IT "REVISED PLAN FOR INVESTIGATION AND SITE ASSESSMENT," JULY 1985.

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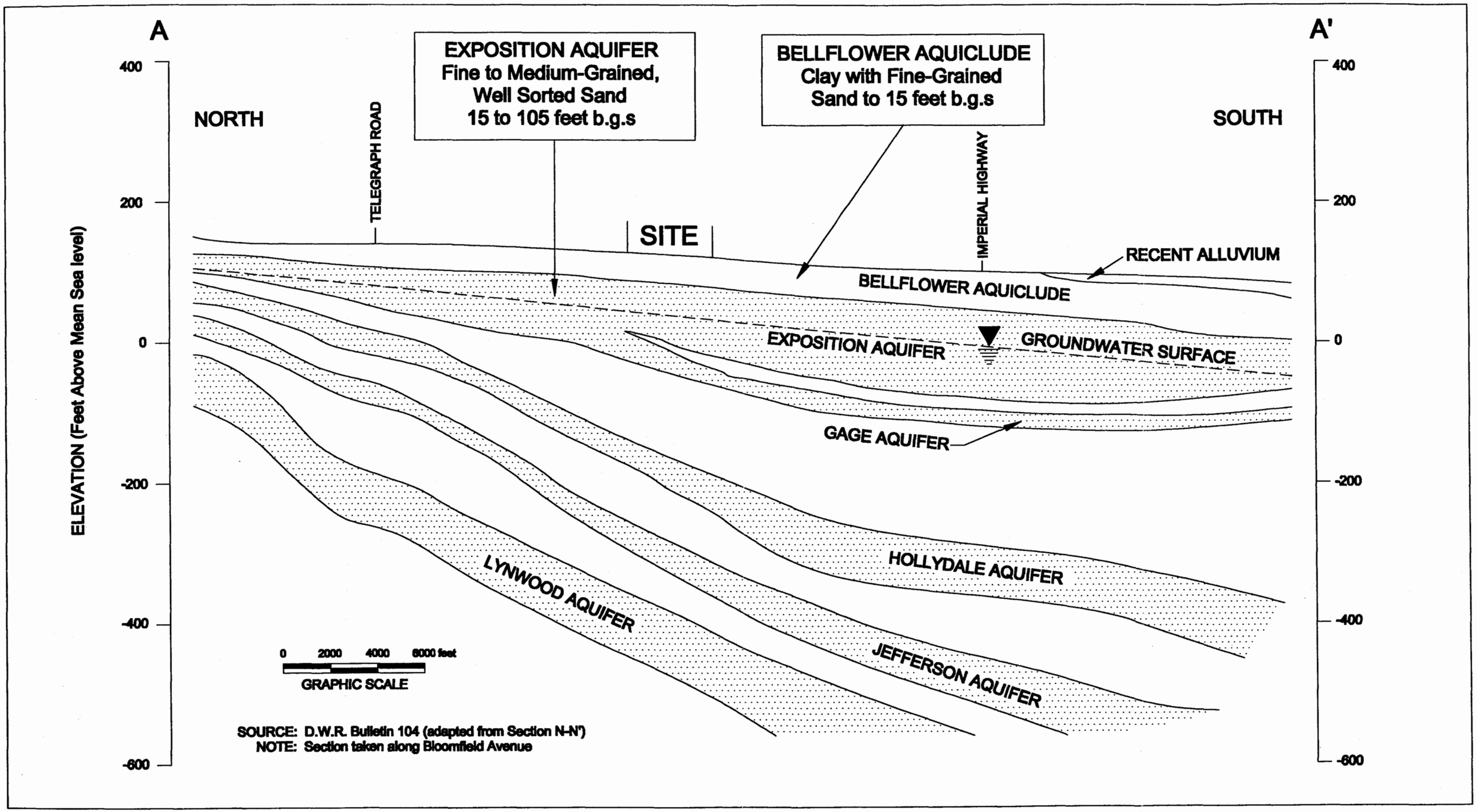
FILE: P/CENCO/MASTERWP/REVMWP/CAD/11159913.DWG

GEOLOGIC CROSS SECTIONS

CENCO REFINING COMPANY
SANTA FE SPRINGS, CALIFORNIA

FIGURE 3



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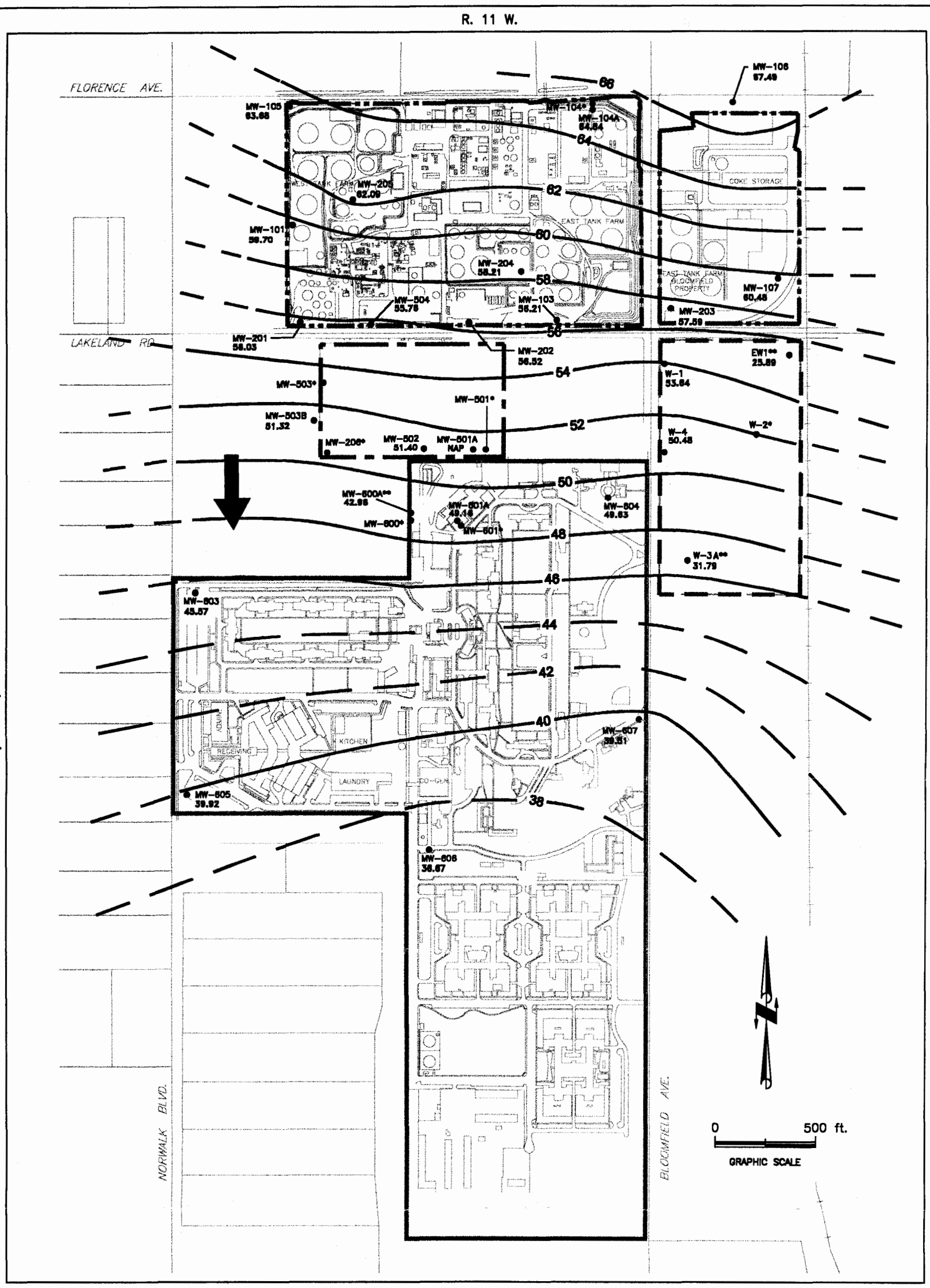
CENCO REFINING COMPANY
SANTA FE SPRINGS, CALIFORNIA

GEOLOGIC CROSS SECTION FOR THE CENCO REFINERY SITE VICINITY

FIGURE
4



LEGEND

● MW-203 57.59	MONITORING WELL LOCATION AND GROUNDWATER ELEVATION (FEET MSL)
36	GROUNDWATER ELEVATION CONTOUR JULY 1999 (FEET MSL, DASHED WHERE INFERRED)
(*)	WELL ABANDONED
(**)	GROUNDWATER ELEVATION WAS NOT USED FOR CONTOURING
NAP	NOT APPLICABLE, WELL NOT SURVEYED
MSL	MEAN SEA LEVEL
	CENCO PROPERTY BOUNDARY
	WALKER PROPERTY BOUNDARY
	FORMER LAKELAND PROPERTY
	METROPOLITAN STATE HOSPITAL
	GROUNDWATER GRADIENT DIRECTION

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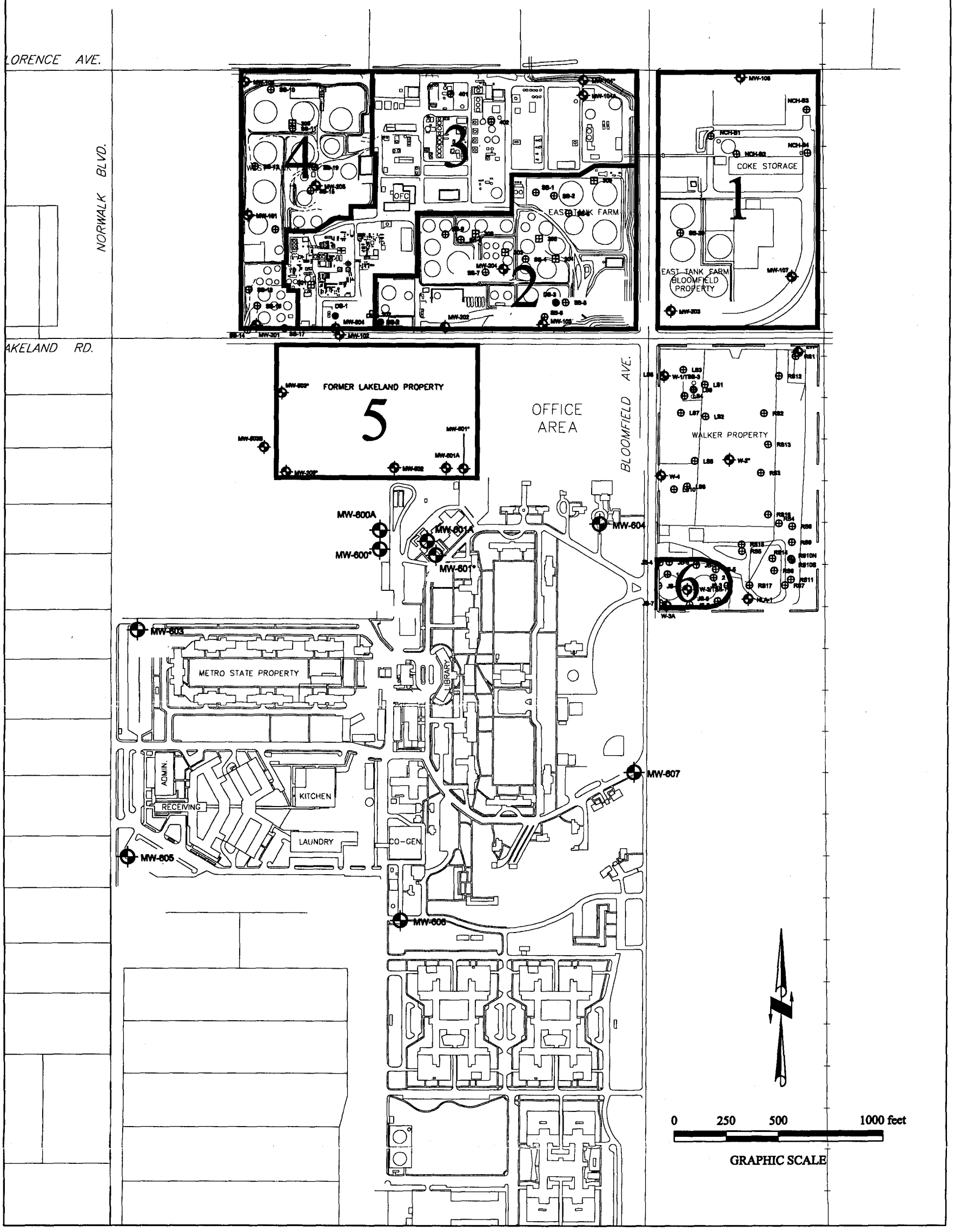
FILE: P/CENCO/MASTERWP/REVMWP/CAD/11159F5.DWG

GROUNDWATER SURFACE ELEVATIONS
JULY 1999
CENCO REFINING COMPANY
SANTA FE SPRINGS, CALIFORNIA

FIGURE 5



LEGEND

OPERATIONAL AREAS

1. BLOOMFIELD PROPERTY
2. EAST TANK FARM AREA
3. PROCESSING AREA
4. WEST TANK FARM AREA
5. FORMER LAKELAND PROPERTY
6. FORMER AST AREA – WALKER PROPERTY

SB-20 SOIL BORING LOCATION

MW-107 MONITORING WELL LOCATION

302 VAPOR MONITORING POINT/ SOIL BORING LOCATION

DB1 SOIL BORING LOCATION, 3/19/99

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FILE: P/CENCO/MASTERWP/REVMWP/CAD/111599f6.DWG

SOIL BORING AND MONITORING WELL LOCATIONS

CENCO REFINING COMPANY

SANTA FE SPRINGS, CALIFORNIA

FIGURE 6

	Depth (ft)	TPH-g	B	T	E	X
MW-106	10	< 1	< 0.005	< 0.005	< 0.005	0.014
	60	< 1	< 0.005	< 0.005	< 0.005	< 0.005
	80	4.2	0.018	0.019	0.011	0.1

	Depth (ft)	TPH (a)	B	T	E	X
NCH-B1	2	< 10	< 0.005	< 0.005	< 0.005	< 0.005
	20	< 10	-	-	-	-

	Depth (ft)	TPH (s)
NCH-B2	2	640
	14-16	< 10

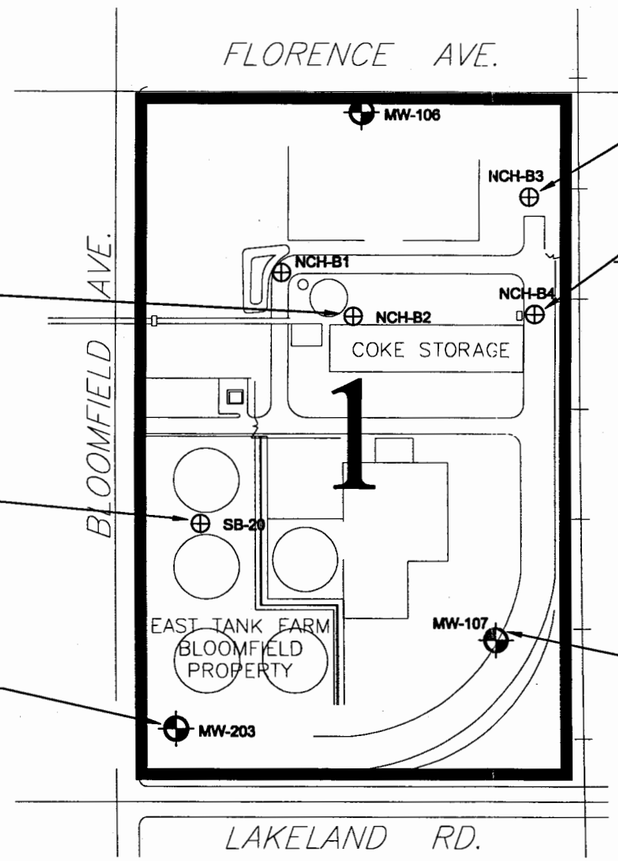
	Depth (ft)	TPH (s)
SB-20	5	< 2
	10	< 2

	Depth (ft)	TRPH (c)	B	T	E	X
203	8.5	< 20	< 0.005	< 0.005	< 0.005	< 0.005
	13.5	TR < 20	< 0.005	< 0.005	< 0.005	< 0.005
	88.5	TR < 20	< 0.005	< 0.005	< 0.005	< 0.005

	Depth (ft)	TPH (s)
NCH-B3	2	150
	11	< 10

	Depth (ft)	TPH (s)
NCH-B4	2	< 10
	15	< 10

	Depth (ft)	TRPH (a)	TPH-g	B	T	E	X
MW-107	10	< 10	< 1	< 0.005	< 0.005	< 0.005	< 0.005
	30	< 10	< 1	< 0.005	< 0.005	< 0.005	< 0.005
	70	< 10	< 1	< 0.005	< 0.005	< 0.005	< 0.005



LEGEND

⊕ SB-20	SOIL BORING LOCATION
MW-107	MONITORING WELL LOCATION
TRPH	TOTAL RECOVERABLE PETROLEUM HYDROCARBONS
(a)	ASTM M2887
(c)	AS OIL AND GREASE
TPH (s)	EPA 8015M WITH SIMULATED DISTILLATION
TPH-g	TOTAL PETROLEUM HYDROCARBONS - GASOLINE RANGE
B	BENZENE
T	TOLUENE
E	ETHYL BENZENE
X	TOTAL XYLENES

CONCENTRATIONS LISTED IN MILLIGRAMS PER KILOGRAM (MG/KG)

NOTE: SEE TABLE 2 FOR SAMPLE DATE.

0 125 250 500 feet

GRAPHIC SCALE

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CENCO REFINING COMPANY

SANTA FE SPRINGS, CALIFORNIA

TOTAL PETROLEUM HYDROCARBONS AND BTEX CONCENTRATIONS IN SOIL

OPERATIONAL AREA 1 - BLOOMFIELD PROPERTY

FIGURE 7

	Depth (ft)	TRPH (c)	B	T	E	X
	8.5	20	<0.005	<0.005	<0.005	308.005
	38.5	5.3	<0.005	<0.005	<0.005	<0.005

	Depth (ft)	TRPH (c)
SB-10	5	<2

	Depth (ft)	TRPH (a)	TPH-g	B	T	E	X
MW-105	10	<10	<1	<0.005	0.0055	<0.005	0.034
	60	<10	<1	<0.005	<0.005	<0.005	0.017
	70	<10	<1	<0.005	<0.005	<0.005	0.022

	Depth (ft)	TRPH (c)
SB-11	5	<2

	Depth (ft)	TRPH (c)
SB-19	5	<2

	Depth (ft)	TRPH (c)	B	T	E	X
205	8.5	20	<0.005	<0.005	<0.005	<0.005
	14	36	<0.005	<0.005	<0.005	<0.005
	68.5	35	<0.005	<0.005	<0.005	<0.005

	Depth (ft)	TRPH (c)
SB-12	5	<2

	Depth (ft)	TRPH (c)
SB-15	5	4

	Depth (ft)	TRPH (c)	B	T	E	X
101	9	60	<0.005	<0.005	<0.005	<0.005
	13.5	71	<0.005	<0.005	<0.005	<0.005
	78.5	82	<0.005	<0.005	<0.005	<0.005

	Depth (ft)	TRPH (c)
SB-13	5	198

	Depth (ft)	TRPH (c)	B	T	E	X
301	8.5	14	<0.005	<0.005	<0.005	<0.005
	28.5	36	<0.13	<0.13	<0.13	TR<1
	38.5	12	<0.025	<0.025	TR<0.17	TR<0.19

	Depth (ft)	TRPH (c)
SB-18	5	<2

	Depth (ft)	TRPH (c)
SB-16	5	4

	Depth (ft)	TRPH (c)	B	T	E	X
201	8.5	11000	<0.005	0.26	TR 0.011	0.067
	83.5	<20	<0.005	<0.005	<0.005	<0.005

	Depth (ft)	TRPH (c)
SB-14	5	29

	Depth (ft)	TRPH (c)
SB-17	10	<2

	Depth (ft)	TRPH (c)	B	T	E	X
102	8.5	32000	0.39	1.4	0.39	TR 0.049
	13.5	8100	0.25	0.1	0.22	TR 0.028
	18.5	-	0.23	0.51	0.29	1.2
	28.5	-	<0.063	TR 0.43	1.5	4.1
	43.5	-	<0.005	<0.005	<0.005	TR 0.012
	48.5	1500	0.078	3.2	1.1	2.3
	58.5	-	<0.005	<0.005	<0.005	<0.005
	73.5	-	<0.005	<0.005	<0.005	<0.005
	83.5	-	<0.005	<0.005	<0.005	TR 0.023
	88.5	-	<0.005	<0.005	<0.005	<0.005

	Depth (ft)	TPH-g	B	T	E	X	MTBE
DB1	0.5-1.0	<0.5	<0.005	<0.005	0.32	<0.010	<0.025
	5.5-6.0	<0.5	<0.005	<0.005	<0.005	<0.010	0.029
	10.0-10.5	<0.5	<0.005	<0.005	<0.005	<0.010	<0.025
	20.5-21.0	110	0.5	0.8	1.0	3.8	<0.6
	30.5-31.0	<0.5	<0.005	<0.005	<0.005	<0.010	<0.025
	40.5-41.0	550	1.0	5.6	5.5	30.8	<2.5
	60.5-61.0	7,200	58	120	75	392	<12
	80.5-81.0	1,200	8.0	6.3	8.7	31.5	3.4

	Depth (ft)	TRPH (c)	B	T	E	X
302	8.5	5060	<0.005	<0.005	<0.005	<0.005
	38.5	<1	<0.005	<0.005	<0.005	<0.005

	Depth (ft)	TRPH (a)
SB-7	25	3100
	35	<2

	Depth (ft)	TRPH (a)
SB-8	10	4140
	15	<2

	Depth (ft)	TPH-g	B	T	E	X	MTBE
DB3*	0.5-1.0	1.0	<0.005	<0.005	<0.005	<0.010	<0.025
	80.5-81.0	<0.5	0.074	<0.005	<0.005	<0.010	<0.025

	Depth (ft)	TRPH (c)	B	T	E	X
204	4.5	<20	<0.025	0.32	0.32	4.4
	68.5	TR<20	<0.005	<0.005	<0.005	<0.005

	Depth (ft)	TPH-g	B	T	E	X	MTBE
DB2	0.5-1.0	1.1	<0.005	<0.005	<0.005	<0.010	1.50
	5.5-6.0	4.2	0.053	<0.005	0.012	0.016	4.0
	10.5-11.0	8.4	0.018	0.027	<0.005	0.046	13.3
	20.5-21.0	5,050	11.3	179	48.7	288	181
	40.5-41.0	1,390	3.0	22.0	5.5	33.1	515
	60.5-61.0	1,300	1	22	7	41	78
	80.5-81.0	9,800	26	229	60	357	278

	Depth (ft)	TPH (a)
SB-9	5	4100
	10	<2

	Depth (ft)	TRPH (c)	B	T	E	X
401	18.5	40	<0.005	<0.005	<0.005	<0.005
	38.5	TR<10	<0.005	<0.005	<0.005	<0.005

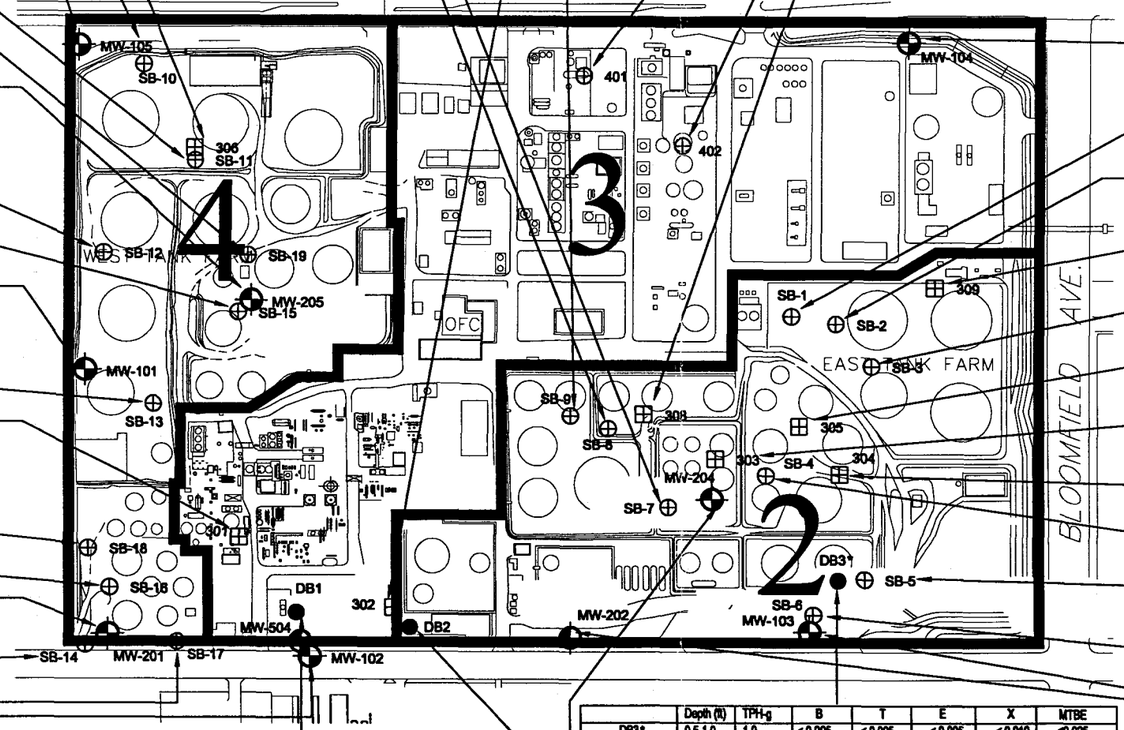
	Depth (ft)	TRPH (c)	B	T	E	X
402	8.5	940	<0.005	<0.005	<0.005	<0.005
	33.5	<10	<0.005	<0.005	<0.005	<0.005

	Depth (ft)	TRPH (c)	B	T	E	X
306	8.5	6	<0.005	<0.005	<0.005	<0.005
	38.5	1	<0.005	<0.005	<0.005	<0.005

LEGEND

SB-20	SOIL BORING LOCATION
MW-107	MONITORING WELL LOCATION
302	VAPOR MONITORING POINT/ SOIL BORING LOCATION
DB1	SOIL BORING LOCATION, 3/19/99

NOTE: SEE TABLE 2 FOR SAMPLE DATE.



	Depth (ft)	TRPH (c)	B	T	E	X
104	2.5	49	<0.005	<0.005	<0.005	<0.005
	12.5	59	<0.005	<0.005	<0.005	<0.005
	85	-	<0.005	<0.005	<0.005	<0.005

	Depth (ft)	TRPH (a)
SB-1	40	2440

	Depth (ft)	TRPH (a)
SB-2	15	118

	Depth (ft)	TPH (c)	B	T	E	X
309	8.5	<10	<0.005	<0.005	<0.005	<0.005
	38.5	20	<0.005	<0.005	<0.005	<0.005

	Depth (ft)	TRPH (a)
SB-3	5	4

	Depth (ft)	TRPH (c)	B	T	E	X
305	8.5	28	<0.005	<0.005	<0.005	<0.005
	38.5	42	<0.005	<0.005	<0.005	<0.005

	Depth (ft)	TRPH (c)	B	T	E	X
303	14	<20	<0.005	<0.005	<0.005	<0.005
	29	<20	<0.005	<0.005	<0.005	<0.005

	Depth (ft)	TRPH (c)	B	T	E	X
304	8.5	51	<0.005	<0.005	<0.005	<0.005
	38.5	86	<0.005	<0.005	<0.005	<0.005

	Depth (ft)	TRPH (a)
SB-4	5	12

	Depth (ft)	TRPH (a)
SB-5	10	<2
	15	26500

	Depth (ft)	TRPH (a)
SB-6	5	3

	Depth (ft)	TRPH (c)	B	T	E	X
103	3.5	77	<0.005	<0.005	<0.005	<0.005
	13	21	<0.005	<0.005	<0.005	<0.005
	85	18	<0.005	<0.005	<0.005	<0.005

	Depth (ft)	TRPH (c)	B	T	E	X
202	9.5	<20	<0.005	<0.005	<0.005	<0.005
	49.5	<20	<0.005	<0.005	<0.005	<0.005

NOTES:

TRPH	TOTAL RECOVERABLE PETROLEUM HYDROCARBONS (a) ASTM M2887 (b) AS OIL & GREASE	B	BENZENE
		T	TOLUENE
		E	ETHYL BENZENE
		X	TOTAL XYLENES
TPH-g	TPH-GASOLINE	MTBE	METHYL-tert-BUTYL ETHER
*	DB3 AT 5.5 FEET TO 61 FEET bgs WERE BELOW LABORATORY REPORTING LIMITS	CONCENTRATIONS LISTED IN MILLIGRAM PER KILOGRAM (MG/KG)	

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VERSAR JOB NO.: 3917-014

DRAWN / APPROVED: DKT / SRT

FILE: P/CENCO/MASTERWP/REVMWP/CAD/111599F8.DWG

CENCO REFINING COMPANY

SANTA FE SPRINGS, CALIFORNIA

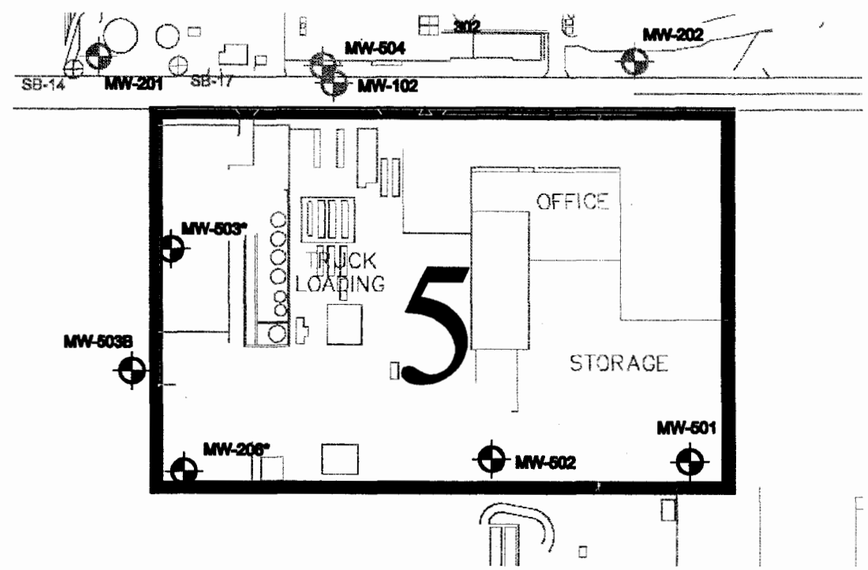
TOTAL PETROLEUM HYDROCARBONS, BTEX, AND MTBE CONCENTRATIONS IN SOIL

OPERATIONAL AREAS 2, 3, AND 4 - REFINERY AREA

FIGURE 8

LEGEND

⊕ SB-20	SOIL BORING LOCATION
MW-107	MONITORING WELL LOCATION
*	WELL ABANDONED



SOIL INVESTIGATION HAS BEEN COMPLETED, AND SITE HAS BEEN FULLY REMEDIATED. "NO FURTHER ACTION" IS REQUIRED PER RWQCB.

0 125 250 500 feet

GRAPHIC SCALE

Versar INC.
7844 MADISON AVENUE, SUITE 167
FAIR OAKS, CA 95628
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FAX: (916) 962-2678

VERSAR JOB NO.: 3917-014

DRAWN / APPROVED: DKT / SRT

FILE: P/CENCO/MASTERWP/REVMWP/CAD/111599F9.DWG

CENCO REFINING COMPANY

SANTA FE SPRINGS, CALIFORNIA

TOTAL PETROLEUM HYDROCARBONS AND BTEX CONCENTRATIONS IN SOIL

OPERATIONAL AREA 5 - FORMER LAKELAND PROPERTY

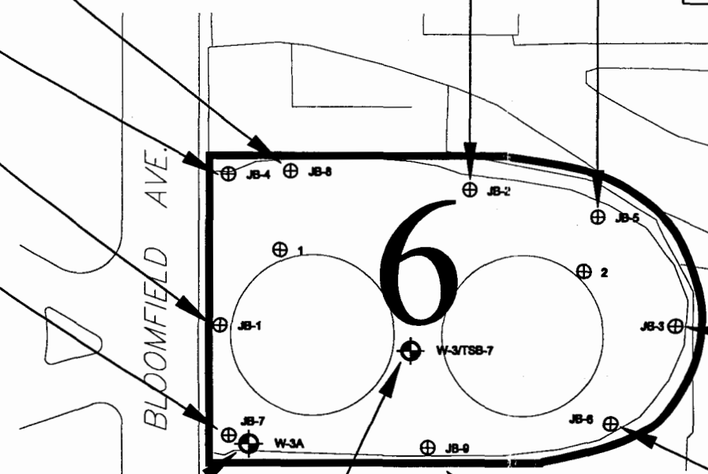
FIGURE 9

LEGEND

⊕ SB-20	SOIL BORING LOCATION
MW-107	MONITORING WELL LOCATION
TPH-g	TOTAL PETROLEUM HYDROCARBONS – GASOLINE RANGE
TPH	TOTAL PETROLEUM HYDROCARBONS RANGE (j) AS JET FUEL (d) AS DIESEL FUEL
TRPH	TOTAL RECOVERABLE PETROLEUM HYDROCARBONS (a) ASTM M2887
B	BENZENE
T	TOLUENE
E	ETHYL BENZENE
X	TOTAL XYLENES

CONCENTRATIONS LISTED IN MILLIGRAM PER KILOGRAM (MG/KG)

NOTE: SEE TABLE 3 FOR SAMPLE DATE.



	Depth (ft)	TPH
JB-8	20	7500 (d)
	70	4000 (d)
	90	< 5 (j)
	100	< 5 (d)

	Depth (ft)	TPH (d)
JB-4	70	< 5
	90	< 5

	Depth (ft)	TPH (j)
JB-1	20	4400
	102	5900
	107	10000

	Depth (ft)	TPH (j)
JB-7	40	< 5
	90	< 5
	102	3200

	Depth (ft)	TPH (j)
JB-2	30	< 5
	70	< 5
	105	< 5

	Depth (ft)	TPH
JB-5	30	5500 (d)
	40	< 5 (d,j)
	90	< 5 (d)
	101	< 5 (d)

	Depth (ft)	TPH (j)
JB-6	30	< 5
	70	< 5
	100	< 5

	Depth (ft)	TPH
JB-3	20	4200 (d)
	40	< 5 (d,j)
	90	< 5 (d)
	100	< 5 (d)

	Depth (ft)	TPH (j)
JB-9	10	870
	50	< 5
	70	14
	100	1300
	105	2500

	Depth (ft)	TRPH (a)
W-3	20	11000
	100	12000
	110	< 5

	Depth (ft)	TRPH (a)	TPH-g	B	T	E	X
W-3A	5	150	-	-	-	-	-
	10	3,200	140	< 0.1	< 0.1	< 0.1	< 0.3
	20	< 5	-	-	-	-	-
	30	5.5	< 1	< 0.005	< 0.005	< 0.005	< 0.015
	40	< 5	-	-	-	-	-
	55	22	990	< 0.67	< 0.67	< 0.67	< 2
	70	5,700	3,900	< 5	< 5	< 5	< 15
	75	3,400	-	-	-	-	-
	80	2,400	1,300	< 1.7	< 1.7	< 1.7	< 6
	85	1,600	-	-	-	-	-
	90	1,500	-	-	-	-	-
	95	460	-	-	-	-	-
	100	270	-	-	-	-	-
	105	88	11	< 0.01	< 0.01	< 0.01	< 0.03
	110	1,500	-	-	-	-	-

NOTE: EXTRACTABLE HYDROCARBONS ARE QUANTITATED AGAINST DIESEL FUEL AND JET FUEL STANDARD. HYDROCARBONS DETECTED BY THIS METHOD RANGE FROM C7 - C30.

0 50 100 200 feet

GRAPHIC SCALE

Versar INC.
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VERSAR JOB NO.: 3917-014

DRAWN / APPROVED: DKT / SRT

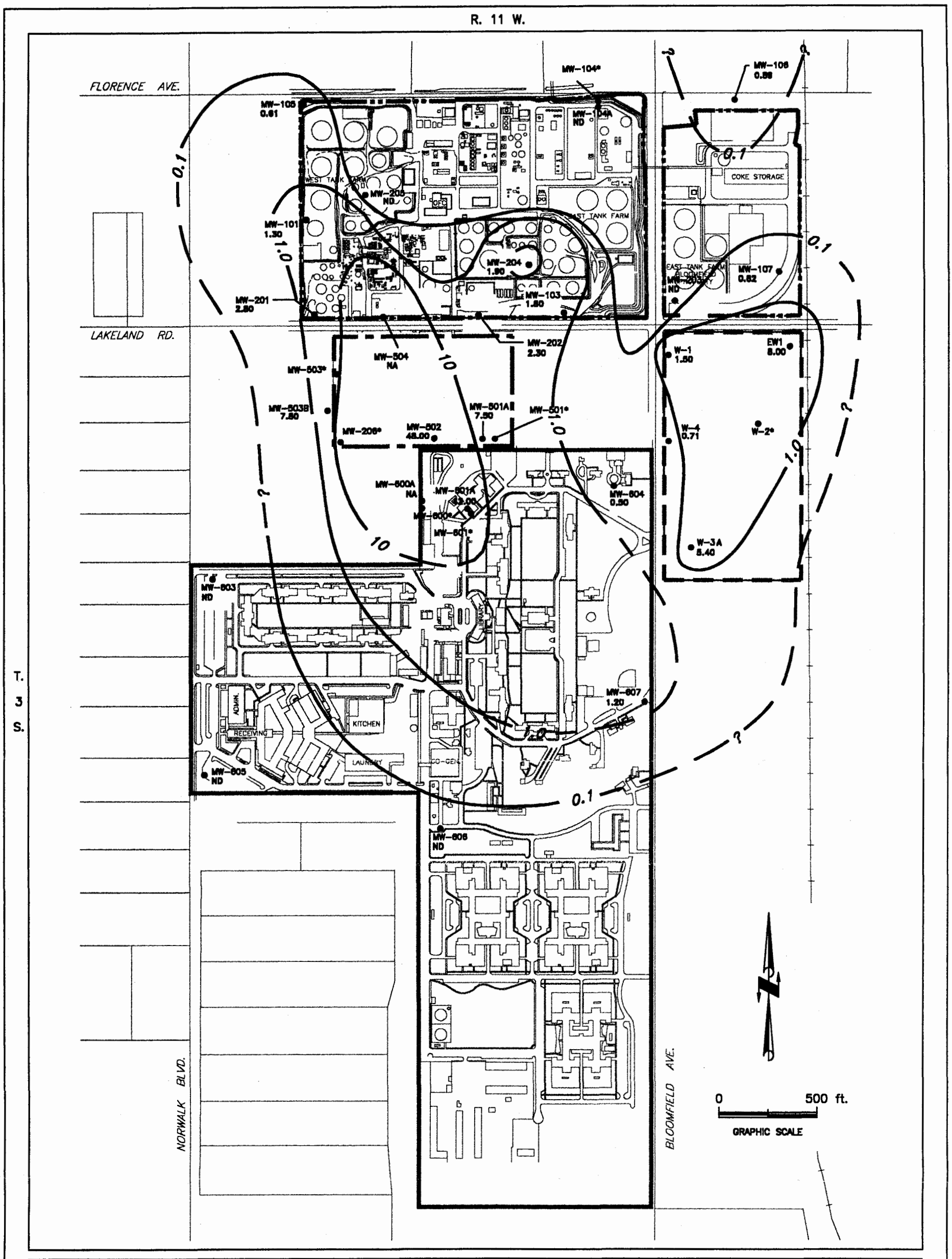
FILE: P/CENCO/MASTERWP/REVMWP/CAD/111599F0.DWG

CENCO REFINING COMPANY

SANTA FE SPRINGS, CALIFORNIA

TOTAL PETROLEUM HYDROCARBONS AND BTEX CONCENTRATIONS IN SOIL OPERATIONAL AREA 6 - FORMER AST AREA AT WALKER PROPERTY

FIGURE 10



LEGEND

● MW-105 0.61	MONITORING WELL LOCATION AND JULY '99 TPH-G CONCENTRATION (mg/L) ND = NOT DETECTED NA = NOT ANALYZED (NOT SAMPLED DUE TO FREE PRODUCT IN WELL)
(*)	WELL ABANDONED
10	TPH-G ISOCONCENTRATION GROUNDWATER CONTOURS (mg/L)
	CENCO PROPERTY BOUNDARY
	WALKER PROPERTY BOUNDARY
	FORMER LAKELAND PROPERTY
	METROPOLITAN STATE HOSPITAL

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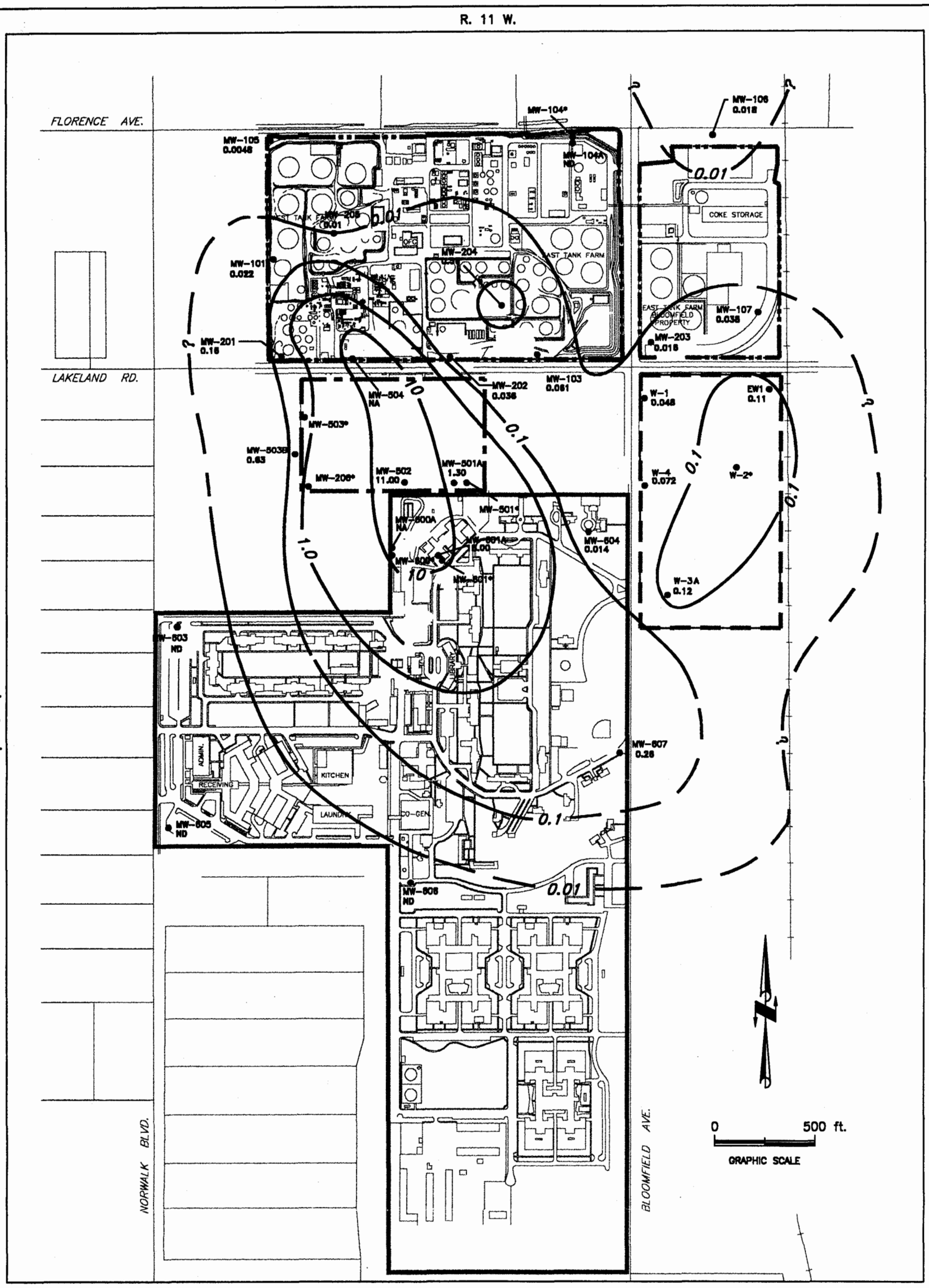
DRAWN / APPROVED: DKT / SRT
FILE: P/CENCO/MASTERWP/REVMWP/CAD/12399f11.DWG

GASOLINE RANGE PETROLEUM HYDROCARBON CONCENTRATIONS IN GROUNDWATER - JULY 1999
CENCO REFINING COMPANY
SANTA FE SPRINGS, CALIFORNIA

FIGURE 11



LEGEND

● MW-203 0.016	MONITORING WELL LOCATION AND JULY '99 BENZENE CONCENTRATION (mg/L) ND = NOT DETECTED NA = NOT ANALYZED (NOT SAMPLED DUE TO FREE PRODUCT IN WELL)
(*)	WELL ABANDONED
10	BENZENE ISOCONCENTRATION GROUNDWATER CONTOURS (mg/L)
	CENCO PROPERTY BOUNDARY
	WALKER PROPERTY BOUNDARY
	FORMER LAKELAND PROPERTY
	METROPOLITAN STATE HOSPITAL

Versar INC.
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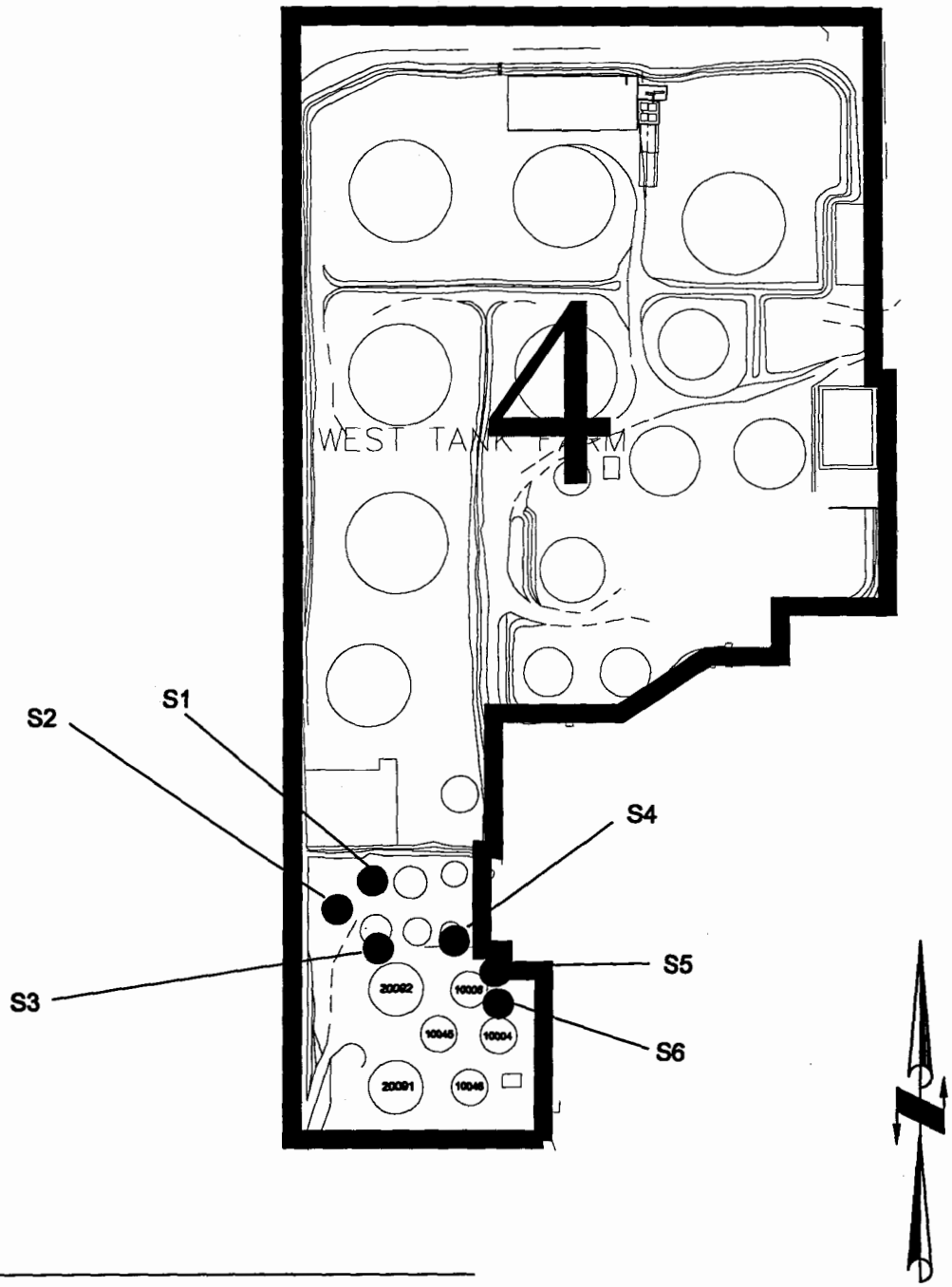
VERSAR JOB NO.: 3917-014
DRAWN / APPROVED: DKT/SRT
FILE: P/CENCO/MASTERWP/REVMWP/CAD/12399f12.DWG

BENZENE CONCENTRATIONS IN GROUNDWATER - JULY 1999
CENCO REFINING COMPANY
SANTA FE SPRINGS, CALIFORNIA

FIGURE 12



LEGEND

● S1 SOIL SAMPLE LOCATION

0 100 200 400 feet

GRAPHIC SCALE

Versar INC.
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VERSAR JOB NO.: 3917-014

DRAWN / APPROVED: DKT / SRT

FILE: P/CENCO/MASTERWP/REVMWP/CAD/12399F13.DWG

PROPOSED SOIL SAMPLE LOCATIONS
TANK 10006 & TANK 20092 AREAS

CENCO REFINING COMPANY
SANTA FE SPRINGS, CALIFORNIA

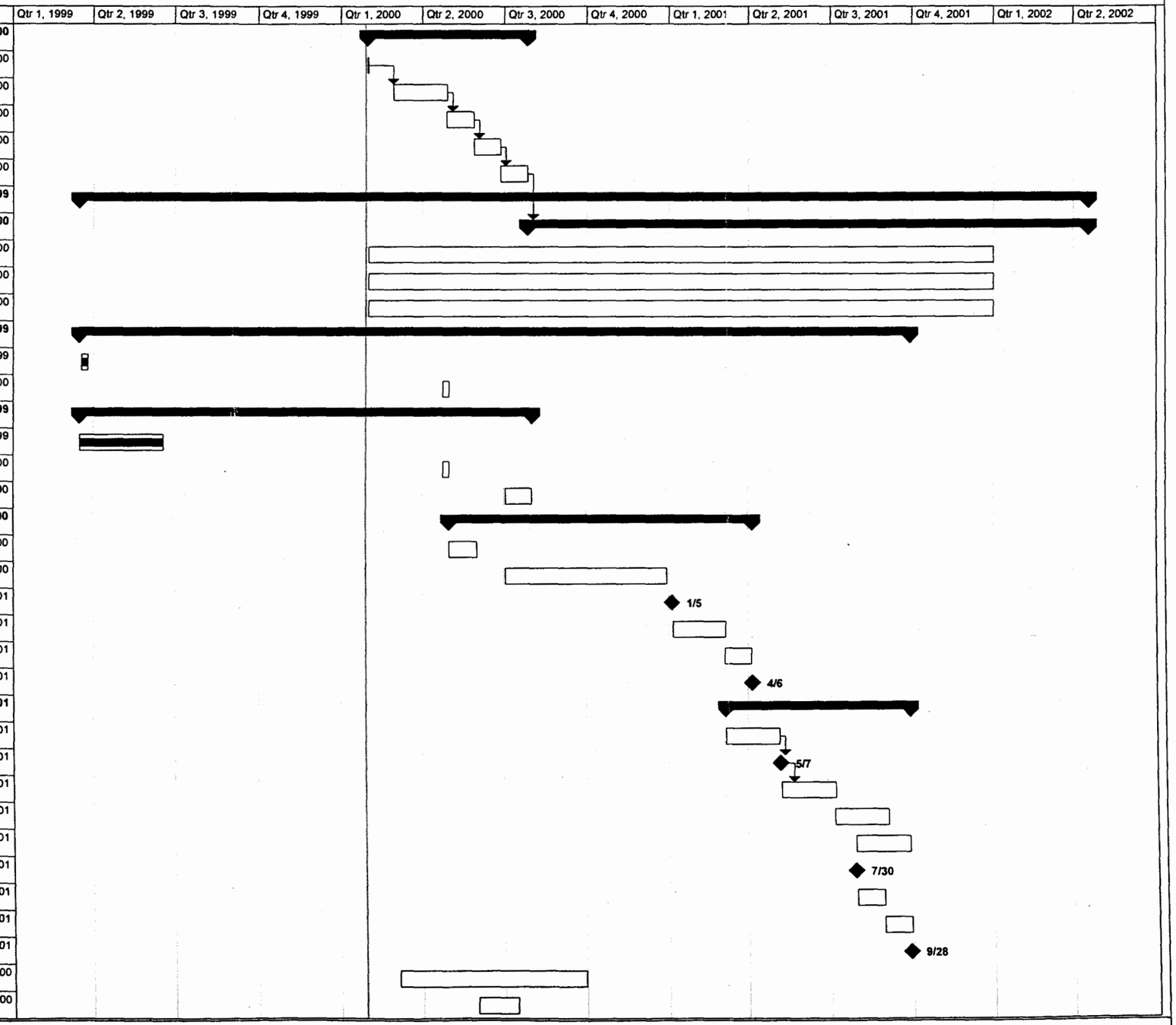
FIGURE 13

CENCO REFINING COMPANY
SANTA FE SPRINGS, CALIFORNIA

FIGURE 14
PROPOSED PROJECT SCHEDULE
CENCO REFINING COMPANY, SANTA FE SPRINGS, CALIFORNIA

Versar INC

ID	Task Name	Duration	Start
1	**PREPARATION AND SUBMITTAL OF REVISED MASTER WORK PLAN**	**178 days**	**Mon 1/31/00**
2	Submit Revised Master Work Plan to RWQCB	1 day	Mon 1/31/00
3	RWQCB Review and Comment	60 days	Tue 2/29/00
4	Response to RWQCB Comments	30 days	Fri 4/28/00
5	Submit Final Revised Master Work Plan to RWQCB	30 days	Sun 5/28/00
6	RWQCB Review and Approve Final Revised Master Work Plan	30 days	Tue 6/27/00
7	**IMPLEMENTATION OF MASTER WORK PLAN**	**1128 days**	**Wed 3/17/99**
8	***PHASE 1 - REGIONAL GROUNDWATER INVESTIGATION***	**630 days**	**Thu 7/27/00**
13	TASK 1.1: DEVELOPMENT OF A COMPREHENSIVE SCM	700 days	Tue 2/1/00
14	TASK 1.2: PRP RESEARCH	700 days	Tue 2/1/00
15	TASK 1.3: COMPILE ENVIRONMENTAL DATABASE	700 days	Tue 2/1/00
16	***PHASE 2 - ADDITIONAL INVESTIGATION***	**927 days**	**Wed 3/17/99**
17	TASK 2.1: SOIL BORING INVESTIGATION	1 wk	Fri 3/19/99
18	TASK 2.2: LEAD IN SOIL SAMPLING	1 wk	Mon 4/24/00
19	TASK 2.3: ADDITIONAL GROUNDWATER INVESTIGATION	**503 days**	**Wed 3/17/99**
20	TASK 2.3.1: Monitoring Well Replacement and Abandonment	93 days	Wed 3/17/99
21	TASK 2.3.2: Monitoring Well Installation	1 wk	Mon 4/24/00
22	TASK 2.3.4: Aquifer Testing	29 days	Mon 7/3/00
23	***PHASE 3 - FATE TRANSPORT MODEL AND RISK ASSESSMENT***	**340 days**	**Mon 5/1/00**
24	TASK 3.1: RISK ASSESSMENT	31 days	Mon 5/1/00
25	TASK 3.2: FATE AND TRANSPORT MODELING	180 days	Mon 7/3/00
26	Submittal of Fate Transport & Risk Assessment Report	0 days	Fri 1/5/01
27	RWQCB Review and Comment	60 days	Sat 1/6/01
28	Response to RWQCB Comments	30 days	Tue 3/6/01
29	Submit Final Fate and Transport and Risk Assessment Report	0 days	Fri 4/6/01
30	***PHASE 4 - FEASIBILITY STUDY/REMEDIAL ACTION PLAN (FS/RAP)***	**206 days**	**Wed 3/7/01**
31	TASK 4.1: FS	60 days	Wed 3/7/01
32	Submit Draft FS	0 days	Mon 5/7/01
33	RWQCB Review and Comment	60 days	Tue 5/8/01
34	TASK 4.2: TREATABILITY STUDY	60 days	Fri 7/6/01
35	TASK 4.3: REMEDIAL ACTION WORK PLAN	60 days	Mon 7/30/01
36	Submit Final FS/Draft RAP	0 days	Mon 7/30/01
37	RWQCB Review and Comment	30 days	Tue 7/31/01
38	Response to RWQCB Comments	30 days	Thu 8/30/01
39	Submit Final FS/RAP	0 days	Fri 9/28/01
40	**PIPELINE INVESTIGATION**	208 days	Mon 3/6/00
41	**REFINERY SOURCE IDENTIFICATION AND REDUCTION PLAN**	45 days	Thu 6/1/00



File: P:\CENCO\MASTER WP\ReviWP\SCHEDUL
Date: Fri 1/28/00
Page 1 of 1

Task | Progress | Summary | Rolled Up Split | Rolled Up Progress | Project Summary
Split | Milestone | Rolled Up Task | Rolled Up Milestone | External Tasks

Notes: Actual schedule will be subject to agency review and approval of work plans and reports.

TABLES

TABLE 1
SUMMARY OF HISTORICAL GROUNDWATER ELEVATIONS
CENCO REFINING COMPANY
SANTA FE SPRINGS, CALIFORNIA

WELL ID	DATE	TOC ELEVATION (feet msl)	DEPTH TO GROUNDWATER (feet)	DEPTH TO HYDROCARBONS (feet)	GROUNDWATER ELEVATION [1] (feet msl)	HYDROCARBON THICKNESS (feet)
MW-104 (ABANDONED)	Jun-88	141.60	87.95	ND	53.65	--
	Sep-88	141.60	88.25	ND	53.35	--
	Dec-88	141.60	88.67	ND	52.93	--
	Mar-89	141.60	89.15	ND	52.45	--
	Jun-89	141.60	89.57	ND	52.03	--
	Sep-89	141.60	89.90	ND	51.70	--
	Dec-89	141.60	90.17	ND	51.43	--
	Mar-90	141.60	90.62	ND	50.98	--
	Jun-90	141.60	90.82	ND	50.78	--
	Sep-90	141.60	90.96	ND	50.64	--
	Dec-90	141.60	91.13	ND	50.47	--
	Mar-91	141.60	91.12	ND	50.48	--
	Jun-91	141.60	91.02	ND	50.58	--
	Sep-91	141.60	90.76	ND	50.84	--
	Dec-91	141.60	90.63	ND	50.97	--
	Mar-92	141.60	90.45	ND	51.15	--
	Jun-92	141.60	89.90	ND	51.70	--
	Sep-92	141.60	89.33	ND	52.27	--
	Dec-92	141.60	89.10	ND	52.50	--
	Mar-93	141.60	88.71	ND	52.89	--
	May-93	141.60	87.55	ND	54.05	--
	Sep-93	141.60	86.15	ND	55.45	--
	Nov-93	141.60	84.05	ND	57.55	--
	Mar-94	141.60	82.33	ND	59.27	--
	Jun-94	141.60	80.55	ND	61.05	--
	Sep-94	141.60	79.37	79.36	62.24	0.01
	Dec-94	141.60	79.50	ND	62.10	--
	Mar-95	141.60	79.32	ND	62.28	--
	Sep-95	141.60	77.26	ND	64.34	--
	Dec-95	141.60	77.21	ND	64.39	--
	Jul-96	141.60	76.75	ND	64.85	--
	Dec-96	141.60	77.38	ND	64.22	--
	Jan-98	141.60	75.58	ND	66.02	--
	Aug-98	141.60	75.58	ND	66.02	--
	Jan-99	141.60	75.91	ND	65.69	--
MW-104A	Jul-99	141.16	76.32	ND	64.84	--
MW-105	Jul-96	138.63	73.85	ND	64.78	--
	Dec-96	138.63	75.12	ND	63.51	--
	Jan-98	138.63	74.13	ND	64.50	--
	Aug-98	138.63	72.66	ND	65.97	--
	Jan-99	138.63	73.15	ND	65.48	--
	Jul-99	138.63	74.95	ND	63.68	--
MW-106	Jul-96	148.41	81.86	ND	66.55	--
	Dec-96	148.41	82.05	ND	66.36	--
	Jan-98	148.41	81.29	ND	67.12	--
	Aug-98	148.41	80.47	ND	67.94	--
	Jan-99	148.41	80.48	ND	67.93	--
	Jul-99	148.41	80.92	ND	67.49	
MW-107	Jul-96	148.93	89.92	ND	59.01	--
	Dec-96	148.93	89.85	ND	59.08	--
	Jan-98	148.93	88.99	ND	59.94	--
	Aug-98	148.93	88.05	ND	60.88	--
	Jan-99	148.93	88.14	ND	60.79	--
	Jul-99	148.93	88.45	ND	60.48	--
MW-201	Jun-88	132.91	90.05	ND	42.86	--
	Sep-88	132.91	90.77	ND	42.14	--
	Dec-88	132.91	92.24	ND	40.67	--
	Mar-89	132.91	92.84	ND	40.07	--
	Jun-89	132.91	93.00	ND	39.91	--
	Sep-89	132.91	93.60	ND	39.31	--
	Dec-89	132.91	94.51	ND	38.40	--

For Notes and explanations see page 10

TABLE 1
SUMMARY OF HISTORICAL GROUNDWATER ELEVATIONS
CENCO REFINING COMPANY
SANTA FE SPRINGS, CALIFORNIA

WELL ID	DATE	TOC ELEVATION (feet msl)	DEPTH TO GROUNDWATER (feet)	DEPTH TO HYDROCARBONS (feet)	GROUNDWATER ELEVATION [1] (feet msl)	HYDROCARBON THICKNESS (feet)
MW-201 (cont.)	Mar-90	132.91	94.91	ND	38.00	--
	Jun-90	132.91	94.48	ND	38.43	--
	Sep-90	132.91	94.85	ND	38.06	--
	Dec-90	132.91	95.43	ND	37.48	--
	Mar-91	132.91	93.88	ND	39.03	--
	Jun-91	132.91	93.05	ND	39.86	--
	Sep-91	132.91	93.57	ND	39.34	--
	Dec-91	132.91	92.90	ND	40.01	--
	Mar-92	132.91	91.30	ND	41.61	--
	Jun-92	132.91	90.10	ND	42.81	--
	Sep-92	132.91	90.40	ND	42.51	--
	Dec-92	132.91	90.29	ND	42.62	--
	Mar-93	132.91	88.84	ND	44.07	--
	May-93	132.91	86.33	ND	46.58	--
	Sep-93	132.91	84.47	84.45	48.46	0.02
	Dec-93	132.91	82.75	82.74	50.17	0.01
	Mar-94	132.91	79.76	79.75	53.16	0.01
	Jun-94	132.91	78.06	78.05	54.86	0.01
	Sep-94	132.91	78.46	78.45	54.46	0.01
	Dec-94	132.91	79.10	ND	53.81	--
	Mar-95	132.91	77.87	ND	55.04	--
	Sep-95	132.91	76.53	ND	56.38	--
	Dec-95	132.91	76.79	ND	56.12	--
	Jul-96	132.91	76.00	ND	56.91	--
	Dec-96	132.91	76.93	ND	55.98	--
	Jan-98	132.91	76.02	ND	56.89	--
	Aug-98	132.91	75.01	ND	57.90	--
	Jan-99	132.91	75.36	ND	57.55	--
	Jul-99	132.91	76.88	ND	56.03	--
MW-202	Jun-88	137.89	DRY	ND	ND	--
	Sep-88	137.89	DRY	ND	ND	--
	Dec-88	137.89	DRY	ND	ND	--
	Mar-89	137.89	DRY	ND	ND	--
	Jun-89	137.89	DRY	ND	ND	--
	Sep-89	137.89	DRY	ND	ND	--
	Dec-89	137.89	DRY	ND	ND	--
	Mar-90	137.89	DRY	ND	ND	--
	Sep-90	137.89	DRY	ND	ND	--
	Dec-90	137.89	DRY	ND	ND	--
	Mar-91	137.89	DRY	ND	ND	--
	Jun-91	137.89	DRY	ND	ND	--
	Sep-91	137.89	DRY	ND	ND	--
	Dec-91	137.89	DRY	ND	ND	--
	Mar-92	137.89	DRY	ND	ND	--
	Jun-92	137.89	DRY	ND	ND	--
	Sep-92	137.89	DRY	ND	ND	--
	Dec-92	137.89	DRY	ND	ND	--
	Mar-93	137.89	DRY	ND	ND	--
	May-93	137.89	DRY	ND	ND	--
	Sep-93	137.89	89.36	89.35	48.54	0.01
	Nov-93	137.89	87.85	ND	50.04	--
	Mar-94	137.89	85.36	85.35	52.54	0.01
	Jun-94	137.89	83.53	83.52	54.37	0.01
	Sep-94	137.89	83.32	83.31	54.58	0.01
	Dec-94	137.89	83.88	83.87	54.02	0.01
	Mar-95	137.89	83.10	ND	54.79	--
	Sep-95	137.89	81.44	ND	56.45	--
	Dec-95	137.89	81.71	ND	56.18	--
	Jul-96	137.89	80.90	ND	56.99	--
	Dec-96	137.89	81.78	ND	56.11	--
	Jan-98	137.89	81.00	ND	56.89	--
	Aug-98	137.89	79.93	ND	57.96	--
	Jan-99	137.89	83.35	ND	54.54	--
	Jul-99	137.89	81.37	ND	56.52	--

For Notes and explanations see page 10

TABLE 1
SUMMARY OF HISTORICAL GROUNDWATER ELEVATIONS
CENCO REFINING COMPANY
SANTA FE SPRINGS, CALIFORNIA

WELL ID	DATE	TOC ELEVATION (feet msl)	DEPTH TO GROUNDWATER (feet)	DEPTH TO HYDROCARBONS (feet)	GROUNDWATER ELEVATION [1] (feet msl)	HYDROCARBON THICKNESS (feet)
MW-203	Jun-88	143.89	95.98	ND	47.91	--
	Sep-88	143.89	96.30	ND	47.59	--
	Dec-88	143.89	96.76	ND	47.13	--
	Mar-89	143.89	97.15	ND	46.74	--
	Jun-89	143.89	97.50	ND	46.39	--
	Sep-89	143.89	97.85	ND	46.04	--
	Dec-89	143.89	98.19	ND	45.70	--
	Mar-90	143.89	98.72	ND	45.17	--
	Sep-90	143.89	99.09	ND	44.80	--
	Dec-90	143.89	99.55	ND	44.34	--
	Mar-91	143.89	99.23	ND	44.66	--
	Jun-91	143.89	99.19	ND	44.70	--
	Sep-91	143.89	98.93	ND	44.96	--
	Dec-91	143.89	98.84	ND	45.05	--
	Mar-92	143.89	98.39	ND	45.50	--
	Jun-92	143.89	97.76	ND	46.13	--
	Sep-92	143.89	97.47	ND	46.42	--
	Dec-92	143.89	97.50	ND	46.39	--
	Mar-93	143.89	97.13	ND	46.76	--
	May-93	143.89	96.14	ND	47.75	--
	Sep-93	143.89	95.81	ND	48.08	--
	Nov-93	143.89	93.84	93.83	50.06	0.01
	Mar-94	143.89	92.27	92.25	51.64	0.02
	Jun-94	143.89	90.68	90.67	53.22	0.01
	Sep-94	143.89	89.61	89.60	54.29	0.01
	Dec-94	143.89	89.41	ND	54.48	--
	Mar-95	143.89	89.03	ND	54.86	--
	Sep-95	143.89	87.47	ND	56.42	--
	Dec-95	143.89	87.38	ND	56.51	--
	Jul-96	143.89	86.53	ND	57.36	--
	Dec-96	143.89	87.03	ND	56.86	--
	Jan-98	143.89	86.39	ND	57.50	--
	Aug-98	143.89	85.38	ND	58.51	--
	Jan-99	143.89	85.72	ND	58.17	--
	Jul-99	143.89	86.30	ND	57.59	--
MW-204	Jun-88	140.14	94.95	ND	45.19	--
	Sep-88	140.14	95.43	ND	44.71	--
	Dec-88	140.14	96.57	ND	43.57	--
	Mar-89	140.14	97.53	ND	42.61	--
	Jun-89	140.14	97.68	ND	42.46	--
	Sep-89	140.14	98.00	ND	42.14	--
	Dec-89	140.14	98.70	ND	41.44	--
	Mar-90	140.14	99.19	ND	40.95	--
	Jun-90	140.14	98.95	ND	41.19	--
	Sep-90	140.14	99.08	ND	41.06	--
	Dec-90	140.14	99.50	ND	40.64	--
	Mar-91	140.14	98.61	ND	41.53	--
	Jun-91	140.14	97.85	ND	42.29	--
	Sep-91	140.14	97.59	ND	42.55	--
	Dec-91	140.14	97.50	ND	42.64	--
	Mar-92	140.14	96.45	ND	43.69	--
	Jun-92	140.14	95.07	ND	45.07	--
	Sep-92	140.14	94.91	ND	45.23	--
	Dec-92	140.14	95.08	ND	45.06	--
	Mar-93	140.14	94.03	ND	46.11	--
	May-93	140.14	91.83	ND	48.31	--
	Sep-93	140.14	89.56	89.55	50.59	0.01
	Nov-93	140.14	88.10	88.09	52.05	0.01
	Mar-94	140.14	85.90	85.89	54.25	0.01
	Jun-94	140.14	84.09	ND	56.05	--
	Sep-94	140.14	83.71	83.70	56.44	0.01
	Dec-94	140.14	84.31	ND	55.83	--
	Mar-95	140.14	83.76	ND	56.38	--

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TABLE 1
SUMMARY OF HISTORICAL GROUNDWATER ELEVATIONS
CENCO REFINING COMPANY
SANTA FE SPRINGS, CALIFORNIA

WELL ID	DATE	TOC ELEVATION (feet msl)	DEPTH TO GROUNDWATER (feet)	DEPTH TO HYDROCARBONS (feet)	GROUNDWATER ELEVATION [1] (feet msl)	HYDROCARBON THICKNESS (feet)
MW-204 (cont.)	Sep-95	140.14	81.98	ND	58.16	--
	Dec-95	140.14	82.23	ND	57.91	--
	Jul-96	140.14	81.50	ND	58.64	--
	Dec-96	140.14	82.42	ND	57.72	--
	Jan-98	140.14	81.69	ND	58.45	--
	Aug-98	140.14	80.57	ND	59.57	--
	Jan-99	140.14	80.95	ND	59.19	--
	Jul-99	140.14	81.93	ND	58.21	--
MW-205	Jun-88	138.17	90.15	ND	48.02	--
	Sep-88	138.17	90.67	ND	47.50	--
	Dec-88	138.17	91.92	ND	46.25	--
	Mar-89	138.17	92.88	ND	45.29	--
	Jun-89	138.17	92.80	ND	45.37	--
	Sep-89	138.17	93.20	ND	44.97	--
	Dec-89	138.17	94.05	ND	44.12	--
	Mar-90	138.17	94.20	ND	43.97	--
	Jun-90	138.17	94.12	ND	44.05	--
	Sep-90	138.17	93.85	ND	44.32	--
	Dec-90	138.17	94.80	ND	43.37	--
	Mar-91	138.17	93.49	ND	44.68	--
	Jun-91	138.17	92.64	ND	45.53	--
	Sep-91	138.17	92.45	ND	45.72	--
	Dec-91	138.04	92.65	ND	45.39	--
	Mar-92	138.04	90.92	ND	47.12	--
	Jun-92	138.04	89.59	ND	48.45	--
	Sep-92	138.04	89.61	ND	48.43	--
	Dec-92	138.04	89.65	ND	48.39	--
	Mar-93	138.04	88.60	ND	49.44	--
	May-93	138.04	85.92	ND	52.12	--
	Sep-93	138.04	83.56	83.55	54.49	0.01
	Nov-93	138.04	82.00	ND	56.04	--
	Mar-94	138.04	79.55	79.54	58.50	0.01
	Jun-94	138.04	77.75	77.74	60.30	0.01
	Sep-94	138.04	77.80	77.79	60.25	0.01
	Dec-94	138.04	78.76	ND	59.28	--
	Mar-95	138.04	77.80	ND	60.24	--
	Sep-95	138.04	75.91	ND	62.13	--
	Dec-95	138.04	76.28	ND	61.76	--
	Jul-96	138.04	75.74	ND	62.30	--
	Dec-96	138.04	76.09	ND	61.95	--
	Jan-98	138.04	75.26	ND	62.78	--
	Aug-98	138.04	73.96	ND	64.08	--
	Jan-99	138.04	74.59	ND	63.45	--
	Jul-99	138.04	75.95	ND	62.09	--
MW-206 (ABANDONED)	Jun-88	129.93	92.37	ND	37.56	--
	Sep-88	129.93	93.37	ND	36.56	--
	Dec-88	129.93	94.93	ND	35.00	--
	Mar-89	129.93	95.20	ND	34.73	--
	Jun-89	129.93	95.55	ND	34.38	--
	Sep-89	129.93	96.88	ND	33.05	--
	Dec-89	129.93	94.75	ND	35.18	--
	Mar-90	129.93	97.75	ND	32.18	--
	Jun-90	129.93	97.48	ND	32.45	--
	Sep-90	129.93	98.02	ND	31.91	--
	Dec-90	129.93	98.64	ND	31.29	--
	Mar-91	129.93	96.92	ND	33.01	--
	Jun-91	129.93	96.11	ND	33.82	--
	Sep-91	129.93	96.41	ND	33.52	--
	Dec-91	129.93	96.12	ND	33.81	--
	Mar-92	129.93	94.32	ND	35.61	--
	Jun-92	129.93	93.45	ND	36.48	--

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CENCO REFINING COMPANY
SANTA FE SPRINGS, CALIFORNIA

WELL ID	DATE	TOC ELEVATION (feet msl)	DEPTH TO GROUNDWATER (feet)	DEPTH TO HYDROCARBONS (feet)	GROUNDWATER ELEVATION [1] (feet msl)	HYDROCARBON THICKNESS (feet)
MW-206 (cont.)	Sep-92	129.93	93.97	ND	35.96	--
	Dec-92	129.93	93.50	ND	36.43	--
	Mar-93	129.93	91.91	ND	38.02	--
	May-93	129.93	89.60	ND	40.33	--
	Sep-93	129.93	87.91	87.90	42.03	0.01
	Dec-93	129.93	86.43	86.41	43.52	0.02
	Mar-94	129.93	82.89	82.88	47.05	0.01
	Jun-94	129.93	81.30	81.29	48.64	0.01
	Sep-94	129.93	81.81	81.80	48.13	0.01
	Dec-94	129.93	82.00	ND	47.93	--
	Mar-95	129.93	80.33	ND	49.60	--
	Sep-95	129.93	79.68	ND	50.25	--
	Dec-95	129.93	79.65	ND	50.28	--
	Jul-96	129.93	78.57	ND	51.36	--
	Dec-96	129.93	79.40	ND	50.53	--
	Jan-98	129.93	78.40	ND	51.53	--
	Aug-98	Well Damaged	NR	NR	NAP	NAP
	Jan-99	Well Destroyed	NAP	NAP	NAP	NAP
MW-501 (ABANDONED)	Jun-88	128.70	92.46	91.16	37.23	1.30
	Sep-88	128.70	94.39	93.03	35.34	1.36
	Dec-88	128.70	94.41	93.71	34.82	0.70
	Mar-89	128.70	94.81	94.06	34.46	0.75
	Jun-89	128.70	94.62	93.81	34.70	0.81
	Sep-89	128.70	96.17	95.21	33.26	0.96
	Dec-89	128.70	97.15	96.32	32.18	0.83
	Mar-90	128.70	97.62	96.80	31.70	0.82
	Jun-90	128.70	96.02	95.27	33.25	0.75
	Sep-90	128.70	97.80	96.85	31.62	0.95
	Dec-90	128.70	98.82	97.64	30.78	1.18
	Mar-91	128.70	96.83	96.25	32.31	0.58
	Jun-91	128.70	95.94	95.44	33.14	0.50
	Sep-91	128.70	96.12	95.62	32.96	0.50
	Dec-91	128.70	95.91	95.44	33.15	0.47
	Mar-92	128.70	94.14	93.93	34.72	0.21
	Jun-92	128.70	92.98	92.97	35.73	0.01
	Sep-92	128.70	93.42	93.25	35.41	0.17
	Dec-92	128.70	92.99	92.85	35.82	0.14
	Mar-93	128.70	91.60	ND	37.10	--
	May-93	128.70	89.45	ND	39.25	--
	Sep-93	128.70	87.77	87.76	40.94	0.01
	Dec-93	128.70	86.25	86.24	42.46	0.01
	Mar-94	128.70	83.19	83.18	45.52	0.01
	Jun-94	128.70	81.35	81.34	47.36	0.01
	Sep-94	128.70	81.27	81.26	47.44	0.01
	Dec-94	128.70	81.50	81.49	47.21	0.01
	Mar-95	128.70	80.23	ND	48.47	--
	Sep-95	128.70	76.04	ND	52.66	--
	Dec-95	128.70	79.09	ND	49.61	--
	Jul-96	128.70	77.84	ND	50.86	--
	Dec-96	128.70	78.67	ND	50.03	--
	Jan-98	128.70	NR	NR	NAP	NAP
	Aug-98	Well Damaged	NR	NR	NAP	NAP
	Jan-99	Well Damaged	NR	NR	NAP	NAP
MW-501A	Jul-99	Not Surveyed	77.70	ND	NAP	NAP
MW-502	Jun-88	131.19	94.00	ND	37.19	--
	Sep-88	131.19	94.95	ND	36.24	--
	Dec-88	131.19	96.35	ND	34.84	--
	Mar-89	131.19	96.75	ND	34.44	--
	Jun-89	131.19	97.27	94.14	36.30	3.13
	Sep-89	131.19	99.08	96.25	34.26	2.83
	Dec-89	131.19	100.40	98.65	32.12	1.75

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CENCO REFINING COMPANY
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WELL ID	DATE	TOC ELEVATION (feet msl)	DEPTH TO GROUNDWATER (feet)	DEPTH TO HYDROCARBONS (feet)	GROUNDWATER ELEVATION [1] (feet msl)	HYDROCARBON THICKNESS (feet)
MW-502 (cont.)	Mar-90	131.19	100.96	99.23	31.54	1.73
	Jun-90	131.19	99.16	97.77	33.09	1.39
	Jun-91	130.82	97.95	97.21	33.43	0.74
	Sep-91	130.82	98.20	97.46	33.18	0.74
	Dec-91	130.82	97.97	97.19	33.44	0.78
	Mar-92	130.82	96.00	95.57	35.15	0.43
	Jun-92	130.82	94.95	94.65	36.10	0.30
	Sep-92	130.82	95.51	95.11	35.61	0.40
	Dec-92	130.82	95.14	94.87	35.89	0.27
	Mar-93	130.82	93.30	ND	37.52	--
	May-93	130.82	91.13	ND	39.69	--
	Sep-93	130.82	89.45	89.44	41.38	0.01
	Dec-93	130.82	87.94	87.93	42.89	0.01
	Mar-94	130.82	84.70	84.69	46.13	0.01
	Jun-94	130.82	82.99	82.98	47.84	0.01
	Sep-94	130.82	83.03	ND	47.79	--
	Dec-94	130.82	83.40	ND	47.42	--
	Mar-95	130.82	81.96	ND	48.86	--
	Sep-95	130.82	81.05	ND	49.77	--
	Dec-95	130.82	81.02	ND	49.80	--
	Jul-96	130.82	79.83	ND	50.99	--
	Dec-96	130.82	80.68	ND	50.14	--
	Jan-98	130.82	79.78	ND	51.04	--
	Aug-98	130.82	78.98	ND	51.84	--
	Jan-99	128.30	76.73	ND	51.57	--
	Jul-99	128.30	76.90	ND	51.40	--
MW-503 (ABANDONED)	Jun-88	131.43	92.55	ND	38.88	--
	Sep-88	131.43	93.26	ND	38.17	--
	Dec-88	131.43	94.74	ND	36.69	--
	Mar-89	131.43	95.18	ND	36.25	--
	Jun-89	131.43	95.50	ND	35.93	--
	Sep-89	131.43	96.30	ND	35.13	--
	Dec-89	131.43	97.16	ND	34.27	--
	Mar-90	131.43	97.54	ND	33.89	--
	Jun-90	131.43	97.30	ND	34.13	--
	Sep-90	131.43	97.70	ND	33.73	--
	Dec-90	131.43	98.27	ND	33.16	--
	Mar-91	131.43	96.64	ND	34.79	--
	Jun-91	131.43	95.79	ND	35.64	--
	Sep-91	131.43	96.05	ND	35.38	--
	Dec-91	131.43	95.80	ND	35.63	--
	Mar-92	131.43	93.98	ND	37.45	--
	Jun-92	131.43	93.01	ND	38.42	--
	Sep-92	131.43	93.52	ND	37.91	--
	Dec-92	131.43	93.11	ND	38.32	--
	Mar-93	131.43	91.67	ND	39.76	--
	May-93	134.43	88.78	ND	45.65	--
	Sep-93	134.43	87.47	87.45	46.98	0.02
	Dec-93	134.43	86.02	86.00	48.43	0.02
	Mar-94	134.43	82.54	82.53	51.90	0.01
	Jun-94	134.43	80.95	80.94	53.49	0.01
	Sep-94	134.43	81.41	81.40	53.03	0.01
	Dec-94	134.43	81.75	ND	52.68	--
	Mar-95	134.43	80.10	ND	54.33	--
	Sep-95	134.43	79.34	ND	55.09	--
	Dec-95	134.43	79.37	ND	55.06	--
	Jul-96	134.43	78.35	ND	56.08	--
	Dec-96	134.43	79.31	ND	55.12	--
	Jan-98	134.43	78.24	ND	56.19	--
	Aug-98	134.43	77.45	ND	56.98	--
	Jan-99	Well Destroyed	NAP	NAP	NAP	NAP
MW-503B	Feb-99	129.96	77.05	ND	52.91	--
	Jul-99	129.96	78.64	ND	51.32	--

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CENCO REFINING COMPANY
SANTA FE SPRINGS, CALIFORNIA

WELL ID	DATE	TOC ELEVATION (feet msl)	DEPTH TO GROUNDWATER (feet)	DEPTH TO HYDROCARBONS (feet)	GROUNDWATER ELEVATION [1] (feet msl)	HYDROCARBON THICKNESS (feet)
MW-504	Jun-88	133.83	92.56	90.73	42.66	1.83
	Sep-88	133.83	93.98	92.41	41.04	1.57
	Dec-88	133.83	94.70	92.83	40.55	1.87
	Mar-89	133.83	96.25	93.50	39.67	2.75
	Jun-89	133.83	94.36	92.16	41.14	2.20
	Sep-89	133.83	99.21	97.15	36.19	2.06
	Dec-89	133.83	96.80	95.45	38.06	1.35
	Mar-90	133.83	97.10	95.72	37.78	1.38
	Jun-90	133.83	95.75	95.13	38.55	0.62
	Dec-90	133.83	97.47	96.31	37.24	1.16
	Jun-91	134.51	95.20	ND	39.31	--
	Sep-91	134.51	95.19	ND	39.32	--
	Dec-91	134.51	95.08	ND	39.43	--
	Mar-92	134.51	95.55	ND	38.96	--
	Jun-92	134.51	92.28	ND	42.23	--
	Sep-92	134.51	92.47	ND	42.04	--
	Dec-92	134.51	92.32	ND	42.19	--
	Mar-93	134.51	91.09	ND	43.42	--
	May-93	134.51	88.78	ND	45.73	--
	Sep-93	134.51	86.64	86.63	47.88	0.01
	Nov-93	134.51	85.10	ND	49.41	--
	Mar-94	134.51	82.26	82.25	52.26	0.01
	Jun-94	134.51	80.43	ND	54.08	--
	Sep-94	134.51	80.59	80.58	53.93	0.01
	Dec-94	134.51	81.14	ND	53.37	--
	Mar-95	134.51	80.06	ND	54.45	--
	Sep-95	134.51	78.55	ND	55.96	--
	Dec-95	134.51	78.76	ND	55.75	--
	Jul-96	134.51	77.92	ND	56.59	--
	Dec-96	134.51	79.15	78.85	55.59	0.30
	Jan-98	134.51	78.00	77.98	56.53	0.02
	Aug-98	134.51	77.00	76.98	57.53	0.02
	Jan-99	134.51	77.56	77.46	57.03	0.10
	Jul-99	134.51	79.12	78.63	55.76	0.49
MW-600 (ABANDONED)	Sep-90	120.05	91.48	90.31	29.46	1.17
	Dec-90	120.05	92.43	90.79	28.87	1.64
	Mar-91	120.05	89.88	89.00	30.84	0.88
	Jun-91	120.05	89.35	88.45	31.38	0.90
	Sep-91	120.05	89.64	88.76	31.08	0.88
	Dec-91	120.05	88.91	88.58	31.39	0.33
	Mar-92	120.05	87.09	86.89	33.11	0.20
	Jun-92	120.05	86.26	86.12	33.90	0.14
	Sep-92	120.05	86.90	86.69	33.31	0.21
	Dec-92	120.05	86.02	86.00	34.05	0.02
	Mar-93	120.05	84.63	ND	35.42	--
	May-93	120.05	82.52	ND	37.53	--
	Sep-93	120.05	80.99	80.98	39.07	0.01
	Dec-93	120.05	79.49	79.48	40.57	0.01
	Mar-94	120.05	76.01	76.00	44.05	0.01
	Jun-94	120.05	74.40	74.39	45.66	0.01
	Sep-94	120.05	74.73	74.72	45.33	0.01
	Dec-94	120.05	74.90	74.84	45.20	0.06
	Mar-95	120.05	73.65	73.03	46.87	0.62
	Sep-95	120.05	73.69	73.30	46.66	0.39
	Dec-95	120.05	72.02	ND	48.03	--
	Jul-96	120.05	73.55	70.59	48.75	2.96
	Dec-96	120.05	73.90	71.35	48.09	2.55
	Jan-98	120.05	75.05	69.67	49.09	5.38
	Aug-98	120.05	74.50	72.70	49.09	1.8 [2]
	Jan-99	120.05	73.72	69.60	49.46	4.12
MW-600A	Jul-99	120.34	77.55	77.32	42.96	0.23

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WELL ID	DATE	TOC ELEVATION (feet msl)	DEPTH TO GROUNDWATER (feet)	DEPTH TO HYDROCARBONS (feet)	GROUNDWATER ELEVATION [1] (feet msl)	HYDROCARBON THICKNESS (feet)
MW-601 (ABANDONED)	Sep-90	125.03	96.64	95.89	28.96	0.75
	Dec-90	125.03	97.01	96.52	28.39	0.49
	Mar-91	125.03	94.84	ND	30.19	--
	Jun-91	125.03	94.27	ND	30.76	--
	Sep-91	125.03	94.54	ND	30.49	--
	Dec-91	125.03	94.30	ND	30.73	--
	Mar-92	125.03	92.66	ND	32.37	--
	Jun-92	125.03	91.81	ND	33.22	--
	Sep-92	125.03	92.80	92.28	32.63	0.52
	Dec-92	125.03	91.78	ND	33.25	--
	Mar-93	125.03	90.38	ND	34.65	--
	May-93	125.03	88.35	ND	36.68	--
	Sep-93	125.03	86.76	86.75	38.28	0.01
	Dec-93	125.03	85.36	85.35	39.68	0.01
	Mar-94	125.03	82.01	82.00	43.03	0.01
	Jun-94	125.03	80.30	80.25	44.77	0.05
	Sep-94	125.03	80.50	80.40	44.61	0.10
	Dec-94	125.03	80.65	80.52	44.48	0.13
	Mar-95	125.03	79.08	78.98	46.03	0.10
	Sep-95	125.03	78.36	78.11	46.86	0.25
	Dec-95	125.03	78.07	ND	46.96	--
	Jul-96	125.03	77.03	76.75	48.21	0.28
	Dec-96	125.03	77.57	ND	47.46	--
	Jan-98	125.03	76.79	76.40	48.54	0.39
	Aug-98	125.03	76.29	76.05	48.92	0.24 [2]
	Jan-99	125.03	76.62	75.95	48.92	0.67
MW-601A	Jul-99	126.53	77.39	77.36	49.16	0.03
MW-603	Jul-96	118.54	72.01	ND	46.53	--
	Dec-96	118.54	72.39	ND	46.15	--
	Jan-98	118.54	71.33	ND	47.21	--
	Aug-98	118.54	71.12	ND	47.42	--
	Jan-99	118.54	77.71	ND	40.83	--
	Jul-99	118.54	72.97	ND	45.57	--
MW-604	Jul-96	138.16	88.79	ND	49.37	--
	Dec-96	138.16	89.57	ND	48.59	--
	Jan-98	138.16	88.61	ND	49.55	--
	Aug-98	138.16	87.55	ND	50.61	--
	Jan-99	138.16	87.88	ND	50.28	--
	Jul-99	138.16	88.53	ND	49.63	--
MW-605	Jul-96	114.54	74.03	ND	40.51	--
	Dec-96	114.54	74.06	ND	40.48	--
	Jan-98	114.54	73.19	ND	41.35	--
	Aug-98	114.54	73.18	ND	41.36	--
	Jan-99	114.54	72.52	ND	42.02	--
	Jul-99	114.54	74.62	ND	39.92	--
MW-606	Jul-96	113.89	77.19	ND	36.70	--
	Dec-96	113.89	77.50	ND	36.39	--
	Jan-98	113.89	75.92	ND	37.97	--
	Aug-98	113.89	75.93	ND	37.96	--
	Jan-99	113.89	75.26	ND	38.63	--
	Jul-99	113.89	77.19	ND	36.70	--
MW-607	Jul-96	126.03	86.88	ND	39.15	--
	Dec-96	126.03	87.56	ND	38.47	--
	Jan-98	126.03	86.50	ND	39.53	--
	Aug-98	126.03	85.64	ND	40.39	--
	Jan-99	126.03	85.88	ND	40.15	--
	Jul-99	126.03	86.52	ND	39.51	--

For Notes and explanations see page 10

TABLE 1
SUMMARY OF HISTORICAL GROUNDWATER ELEVATIONS
CENCO REFINING COMPANY
SANTA FE SPRINGS, CALIFORNIA

WELL ID	DATE	TOC ELEVATION (feet msl)	DEPTH TO GROUNDWATER (feet)	DEPTH TO HYDROCARBONS (feet)	GROUNDWATER ELEVATION [1] (feet msl)	HYDROCARBON THICKNESS (feet)
W-1	Dec-96	142.89	90.10	ND	52.79	--
	Jan-98	142.89	89.28	ND	53.61	--
	Aug-98	142.89	88.19	ND	54.70	--
	Jan-99	142.89	88.62	ND	54.27	--
	Jul-99	142.89	89.25	ND	53.64	--
W-2 (ABANDONED)	Dec-96	139.31	88.72	ND	50.59	--
	Jan-98	139.31	87.95	ND	51.36	--
	Aug-98	139.31	86.95	ND	52.36	--
	Jan-99	NS	NS	NAP	NAP	NAP
W-3 (ABANDONED)	Dec-96	136.11	90.98	ND	45.13	--
	Jan-98	136.11	89.95	ND	46.16	--
	Aug-98	NS	NS	NAP	NAP	NAP
	Jan-99	NS	NS	NAP	NAP	NAP
W-4	Dec-96	142.38	92.88	ND	49.50	--
	Jan-98	142.38	92.01	ND	50.37	--
	Aug-98	142.38	90.90	ND	51.48	--
	Jan-99	142.38	91.31	ND	51.07	--
	Jul-99	142.38	91.90	ND	50.48	--
W-3A	Aug-98	124.00	91.14	ND	32.86	--
	Jan-99	124.00	91.55	ND	32.45	--
	Jul-99	124.00	92.21	ND	31.79	--
EW-1	Aug-98	112.40	85.99	ND	26.41	--
	Jan-99	112.40	86.22	ND	26.18	--
	Jul-99	112.40	86.51	ND	25.89	--

NOTES:
Measurements prior to January, 1998, were conducted by consultants other than Versar, Inc.
[1] Groundwater elevations for wells containing free product were adjusted for hydrocarbon thickness using methods described in API, 1989. A specific gravity value of 0.76 was used for free product. Previously reported groundwater elevations did not take into account the effect of the specific gravity of free product on groundwater elevation and therefore may differ from groundwater elevations reported herein.
[2] Product thickness was estimated due to disfunction of product elevation measurement equipment.
TOC: Top of Well Casing Elevation
feet msl: Feet above mean sea level
Well Damaged: Well damaged due to construction activities.
NR: Not recorded due to well damage, or improper equipment reading.
NAP: Not Applicable
ND: None Detected
NS: Not scheduled for measurement

For Notes and explanations see page 10

TABLE 2
WELL CONSTRUCTION DETAILS
CENCO REFINING COMPANY
SANTE FE SPRINGS, CALIFORNIA

Well ID	Well Status	Installation Date	Diameter Inches	Total Depth (feet)	Screen Interval (feet)	Top of Casing Elevation (feet msl)	Notes
EW-1	Active	1989	4	113.5	- -	112.40	Emcon
EW-2	--	1989	--	108	- -	--	Emcon
MW-101	Active	Aug-85	4	94.4	70 - 90	135.23	IT
MW-103	Active	Aug-85	4	99	79 - 99	136.95	IT
MW-104	Abandoned	Aug-85	4	97	76.5 - 97	141.60	IT
MW-104A	Active	Jun-99	4	100	65 - 100	141.16	Versar
MW-105	Active	Dec-95	4	100	68 - 98	138.63	TriHydro
MW-106	Active	Dec-95	4	106	74 - 104	148.41	TriHydro
MW-107	Active	Dec-95	4	108	75 - 105	148.93	TriHydro
MW-201	Active	Aug-85	4	103	72 - 102	132.91	IT
MW-202	Active	Aug-85	4	105	63 - 93	137.89	IT
MW-203	Active	Aug-85	4	107	77 - 107	143.89	IT
MW-204	Active	Aug-85	4	99.5	73.3 - 103.3	140.14	IT
MW-205	Active	Aug-85	4	103	69.5 - 99.5	138.04	IT
MW-206	Abandoned	Jun-86	4	104	71 - 101	129.93	IT
MW-501	Destroyed	Jun-86	4	107	71 - 101	128.70	IT
MW-501A	Active	Mar-99	4	95	75 - 95	Not Surveyed	ATC
MW-502	Active	Jun-86	4	104	74 - 104	130.82	IT
MW-503	Abandoned	Jun-86	4	110.5	80.5 - 110.5	134.43	IT
MW-503B	Active	Jan-99	4	109	69 - 109	129.96	Versar
MW-504	Active	Jun-86	4	118	58 - 118	134.51	IT
MW-600	Abandoned	Aug-90	4	110	78 - 108	120.05	ENSR
MW-600A	Active	Jun-99	4	100	65 - 100	120.34	Versar
MW-601	Abandoned	Aug-90	4	117	85 - 115	125.03	ENSR
MW-601A	Active	Jun-99	4	100	65 - 100	126.53	Versar
MW-603	Active	Dec-95	4	100	70 - 100	118.54	TriHydro
MW-604	Active	Dec-95	4	103	73 - 103	138.16	TriHydro
MW-605	Active	Dec-95	4	95	65 - 95	114.54	TriHydro
MW-606	Active	Dec-95	4	100	70 - 100	113.89	TriHydro
MW-607	Active	Dec-95	4	107	77 - 107	126.03	TriHydro
W-1	Active	Dec-95	4	129	70 - 129	142.89	TRC
W-2	Abandoned	Dec-95	4	129	84 - 129	139.31	TRC
W-3	Abandoned	Dec-95	4	124	82 - 122	136.11	TRC
W-3A	Active	--	4	115	- -	124.00	--
W-4	Active	Dec-95	4	132	- -	142.38	TRC

Notes:
feet msl = feet above mean seal level
-- = information not available

TABLE 3
SUMMARY OF HISTORICAL SOIL SAMPLING DATA (MG/KG)
CENCO REFINING COMPANY
SANTA FE SPRINGS, CALIFORNIA

Sample Site Count	Soil Boring ID	Sample Depth (feet)	Sampled by/Date	TRPH (a) ASTM M2887 (b) Method 418.1 (c) as oil & grease	TPH-g	TPH by M8015 (d) diesel (j) jet fuel (s) simulated distillation	B	T	E	X	MTBE	MC	PCE	2-Methyl-Butane	Pentane	Cyclo hexane	Methyl cyclo pentane	2,3-Dimethyl butane	Hexane	Butane	1,1,3-Trimethyl cyclo hexane	2-Methyl heptane	2,2,3,4-Methyl pentane	Methyl cyclo hexane	Octane	2,4-Dichloro phenol	2,4,6-Trichloro phenol	2-Nitro phenol	Cyanide	TOX	HVOCs	1,1,1-TCA	Lead
OPERATIONAL AREA 1: BLOOMFIELD PROPERTY																																	
1	106	10	Trihydro	<10 (a)	< 1	-	< 0.005	< 0.005	< 0.005	0.014	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.001	< 0.001	4.1
2		60	2/96	<10 (a)	< 1	-	< 0.005	< 0.005	< 0.005	< 0.005	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.001	< 0.001	4.9
3		80		<10 (a)	4.2	-	0.018	0.019	0.011	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.001	< 0.001	<2.5
4	107	10	Trihydro	<10 (a)	< 1	-	< 0.005	< 0.005	< 0.005	< 0.005	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 0.001	2.8
5		30	2/96	<10 (a)	< 1	-	< 0.005	< 0.005	< 0.005	< 0.005	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 0.001	<2.5
6		70		<10 (a)	< 1	-	< 0.005	< 0.005	< 0.005	< 0.005	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 0.001	<2.5
7	203	8.5	IT, 1985	< 20 (c)	-	-	< 0.005	< 0.005	< 0.005	< 0.005	-	< 0.005	< 0.005	-	-	-	-	-	-	-	-	-	-	-	-	< 0.001	< 0.001	< 0.001	< 0.2	< 15	ND (z)	<0.005	11
8		13.5		TR < 20 (c)	-	-	< 0.005	< 0.005	< 0.005	< 0.005	-	< 0.005	< 0.005	-	-	-	-	-	-	-	-	-	-	-	-	< 0.001	< 0.001	< 0.001	< 0.2	< 15	ND (z)	<0.005	2.4
9		88.5		TR < 20 (c)	-	-	< 0.005	< 0.005	< 0.005	< 0.005	-	< 0.005	< 0.005	-	-	-	-	-	-	-	-	-	-	-	-	< 0.001	< 0.001	< 0.001	1.5	< 15	ND (z)	<0.005	5.3
10	SB-20	5		-	-	<2 (s)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11		10		-	-	<2 (s)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	NCH-B1	2	Trihydro, 1997	-	-	<10 (s)	< 0.005	< 0.005	< 0.005	< 0.005	-	<0.01	<0.005	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	23
13		20		-	-	<10 (s)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	NCH-B2	2	Trihydro, 1997	-	-	640 (s)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15		14-16		-	-	<10 (s)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16	NCH-B3	2	Trihydro, 1997	-	-	150 (s)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17		11		-	-	<10 (s)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18	NCH-B4	2	Trihydro, 1997	-	-	<10 (s)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19		15		-	-	<10 (s)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
OPERATIONAL AREA 2: EAST TANK FARM AREA																																	
20	103	3.5	IT, 1985	77 (c)	-	-	< 0.005	< 0.005	< 0.005	< 0.005	-	0.1	< 0.005	-	-	-	-	-	-	-	-	-	-	-	-	< 0.001	< 0.001	< 0.001	< 0.2	26	0.1 (z)	<0.005	8.9
21		13		21(c)	-	-	< 0.005	< 0.005	< 0.005	< 0.005	-	< 0.005	< 0.005	-	-	-	-	-	-	-	-	-	-	-	-	< 0.001	< 0.001	< 0.001	< 0.2	< 20	<0.005	<0.005	2.4
22		85		18 (c)	-	-	< 0.005	< 0.005	< 0.005	< 0.005	-	0.11	< 0.005	-	-	-	-	-	-	-	-	-	-	-	-	< 0.001	< 0.001	< 0.001	< 0.2	< 20	0.11 (z)	<0.005	4.1
23	202	9.5	IT, 1985	< 20 (c)	-	-	< 0.005	< 0.005	< 0.005	< 0.005	-	< 0.005	< 0.005	-	-	-	-	-	-	-	-	-	-	-	-	< 0.001	< 0.001	< 0.001	< 0.2	< 14	ND (z)	<0.005	10
24		49.5		< 20 (c)	-	-	< 0.005	< 0.005	< 0.005	< 0.005	-	< 0.005	< 0.005	-	-	-	-	-	-	-	-	-	-	-	-	< 0.001	< 0.001	< 0.001	< 0.2	< 14	ND (z)	<0.005	5
25	204	4.5	IT, 1985	< 20 (c)	-	-	< 0.025	0.32	0.32	4.4	-	< 0.025	< 0.025	-	-	-	-	-	-	-	-	-	-	-	-	< 0.002	< 0.002	< 0.002	< 0.2	< 14	ND (z)	<0.025	11
26		68.5		TR < 20 (c)	-	-	< 0.005	< 0.005	< 0.005	< 0.005	-	< 0.005	< 0.005	-	-	-	-	-	-	-	-	-	-	-	-	< 0.001	< 0.001	< 0.001	< 0.2	22	ND (z)	<0.005	5
27	303	14	IT, 1985	<20 (c)	-	-	< 0.005	< 0.005	< 0.005	< 0.005	-	< 0.005	< 0.005	-	-	-	-	-	-	-	-	-	-	-	-	< 0.001	< 0.001	< 0.001	< 0.2	17	ND (z)	<0.005	4
28		29		<20 (c)	-	-	< 0.005	< 0.005	< 0.005	< 0.005	-	< 0.005	< 0.005	-	-	-	-	-	-	-	-	-	-	-	-	< 0.001	< 0.001	< 0.001	< 0.2	< 14	ND (z)	<0.005	6
29	304	8.5	IT, 1985	51 (c)	-	-	< 0.005	< 0.005	< 0.005	< 0.005	-	< 0.005	< 0.005	-	-	-	-	-	-	-	-	-	-	-	-	< 0.001	< 0.001	< 0.001	< 0.2	< 20	ND (z)	<0.005	4
30		38.5		86 (c)	-	-	< 0.005	< 0.005	< 0.005	< 0.005	-	< 0.005	< 0.005	-	-	-	-	-	-	-	-	-	-	-	-	< 0.001	< 0.001	< 0.001	< 0.2	< 20	ND (z)	<0.005	7
31	305	8.5	IT, 1985	28 (c)	-	-	< 0.005	< 0.005	< 0.005	< 0.005	-	< 0.005	< 0.005	-	-	-	-	-	-	-	-	-	-	-	-	< 0.001	< 0.001	< 0.001	< 0.2	< 20	ND (z)	<0.005	4
32		38.5		42 (c)	-	-	< 0.005	< 0.005	< 0.005	< 0.005	-	< 0.005	< 0.005	-	-	-	-	-	-	-	-	-	-	-	-	0.027	0.004	< 0.002	< 0.2	< 20	ND (z)	<0.005	2
33	308	8.5	IT, 1985	6 (c)	-	-	< 0.005	< 0.005	< 0.005	< 0.005	-	< 0.005	< 0.005	-	-	-	-	-	-	-	-	-	-	-	-	< 0.001	< 0.001	< 0.001	< 0.2	< 15	ND (z)	<0.005	9
34		38.5		1 (c)	-	-	< 0.005	< 0.005	< 0.005	< 0.005	-	< 0.005	< 0.005	-	-	-	-	-	-	-	-	-	-	-	-	< 0.001	< 0.001	< 0.001	< 0.2	< 15	ND (z)	<0.005	5
35	309	8.5	IT, 1985	<10 (c)	-	-	< 0.005	< 0.005	< 0.005	< 0.005	-	0.15	0.23	-	-	-	-	-	-	-	-	-	-	-	-	< 0.001	< 0.001	< 0.001	< 0.2	17	0.38 (z)	<0.005	5
36		38.5		20 (c)	-	-	< 0.005	< 0.005	< 0.005	< 0.005	-	< 0.005	< 0.005	-	-	-	-	-	-	-	-	-	-	-	-	< 0.001	< 0.001	< 0.001	< 0.2	< 15	ND (z)	<0.005	3
37	SB-1	40	IT, 1985	2440 (a)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
38	SB-2	15	IT, 1985	118 (a)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
39	SB-3	5	IT, 1985	4 (a)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
40	SB-4	5	IT, 1985	12 (a)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
41	SB-5	10	IT, 1985	<2 (a)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
42		15		26500 (a)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
43	SB-6	5	IT, 1985	3 (a)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
44	SB-7	25	IT, 1985	3100 (a)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
45		35		<2 (a)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
46	SB-8	10	IT, 1985	4140 (a)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
47		15		<2 (a)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
48	SB-9	5	IT, 1985	4100 (a)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
49		10		<2 (a)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
50	DB2	0.5	Versar, 1999	-	1.1	-	<0.005	<0.005	<0.005	<0.010	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
51		5.5		-	4.2	-	0.053	<0.005	0.012	0.016	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
52		10.5		-	8.4	-	0.018	0.027	<0.005	0.046	13.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
53		20.5		-	5050	-	11.3	179	48.7	288	181	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
54		40.5		-	1390	-	3	22	5.5	33.1	515	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
55		60.5		-	1300	-	1	22	7	41	78	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
56		80.5		-	9800	-	26	229	60	357	276	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
57	DB3	0.5	Versar, 1999	-	1	-	<0.005	<0.005	<0.005	<0.010	<0.025	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
58		5.5		-	<0.5	-	<0.005	<0.005	<0.005	<0.010	<0.025	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
59		10		-	<0.5	-	<0.005	<0.005	<0.005	<0.010	<0.025	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
60		20		-	<0.5	-	<0.005	<0.005	<0.005	<0.010	<0.025	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
61		30.5		-	<0.5	-	<0.005	<0.005	<0.005	<0.010	<0.025	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
62		40.5		-	<0.5	-	<0.005	<0.005	<0.005	<0.010	<0.025	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
63		60.5		-	<0.5	-	<0.005	<0.005	<0.005	<0.010	<0.025	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
64		80.5		-	<0.5	-	0.074	<0.005	<0.005	<0.010	<0.025	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
OPERATIONAL AREA 3: PROCESSING AREA																																	
66	102	8.5	IT, 1985	32000 (c)	-	-	0.39	1.4	0.39	TR 0.049	-	< 0.005	< 0.005	0.1	0.1	0.3	0.4	0.06	0.04	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.01	< 0.01	< 0.01	< 0.2	< 20	ND (z)	<0.005	6.9
67		13.5		8100 (c)	-	-	0.25	0.1	0.22	TR 0.026	-	0.13	< 0.005	0.3	0.2	0.2	0.3	0.6	0.05	0.06	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0.2	< 0.1	< 0.1	< 0.2	< 20	0.13 (z)	<0.005	8.3

SEE NOTES ON PAGE 4

TABLE 3
SUMMARY OF HISTORICAL SOIL SAMPLING DATA (MG/KG)
CENCO REFINING COMPANY
SANTA FE SPRINGS, CALIFORNIA

Sample Site Count	Soil Boring ID	Sample Depth (feet)	Sampled by/Date	TRPH (a) ASTM M2887 (b) Method 418.1 (c) as oil & grease	TPH-g	TPH by M8015 (d) diesel (j) jet fuel (s) simulated distillation	B	T	E	X	MTBE	MC	PCE	2-Methyl-Butane	Pentane	Cyclo hexane	Methyl cyclo pentane	2,3-Dimethyl butane	Hexane	Butane	1,1,3-Trimethyl cyclo hexane	2-Methyl heptane	2,2,3,4-Methyl pentane	Methyl cyclo hexane	Octane	2,4-Dichloro phenol	2,4,6-Trichloro phenol	2-Nitro phenol	Cyanide	TOX	HVOCs	1,1,1-TCA	Lead
68		18.5		-	-	-	0.23	0.51	0.29	1.2	-	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0.38	< 0.005	-	-	-	-	-	ND (z)	<0.005	-
69		28.5		-	-	-	< 0.063	TR 0.43	1.5	4.1	-	< 0.063	< 0.063	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0.9	< 0.005	< 0.005	-	-	-	-	-	ND (z)	<0.005	-
70		43.5		-	-	-	< 0.005	< 0.005	< 0.005	TR 0.012	-	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	-	-	-	-	-	ND (z)	<0.005	-
71		48.5		1500 (e)	-	-	0.078	3.2	1.1	2.3	-	0.21	< 0.005	< 0.005	< 0.005	0.1	0.1	< 0.005	< 0.005	< 0.005	2	< 0.005	< 0.005	< 0.005	< 0.005	0.118	< 0.01	0.012	< 0.2	< 15	0.21 (z)	<0.005	4
72		58.5		-	-	-	< 0.005	< 0.005	< 0.005	< 0.005	-	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0.04	< 0.005	< 0.005	< 0.005	< 0.005	-	-	-	-	-	ND (z)	<0.005	-
73		73.5		-	-	-	< 0.005	< 0.005	< 0.005	< 0.005	-	0.23	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	-	-	-	-	-	0.23 (z)	<0.005	-
74		83.5		-	-	-	< 0.005	< 0.005	< 0.005	TR 0.023	-	0.1	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	-	-	-	-	-	0.1 (z)	<0.005	2
75		88.5		-	-	-	< 0.005	< 0.005	< 0.005	< 0.005	-	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	-	-	-	-	-	ND (z)	<0.005	-
76	104	2.5	IT, 1985	49 (c)	-	-	< 0.005	< 0.005	< 0.005	< 0.005	-	< 0.005	< 0.005	-	-	-	-	-	-	-	-	-	-	-	-	< 0.001	< 0.001	< 0.001	< 0.2	< 1	ND (z)	<0.005	12
77		12.5		59 (c)	-	-	< 0.005	< 0.005	< 0.005	< 0.005	-	< 0.005	< 0.005	-	-	-	-	-	-	-	-	-	-	-	-	< 0.001	< 0.001	< 0.001	< 0.2	< 1	ND (z)	<0.005	3
78		85		-	-	-	< 0.005	< 0.005	< 0.005	< 0.005	-	< 0.005	< 0.005	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.2	< 1	ND (z)	<0.005	4
76	301	8.5	IT, 1985	14 (c)	-	-	< 0.005	< 0.005	< 0.005	< 0.005	-	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.001	< 0.001	< 0.001	2	< 15	ND (z)	<0.005	8
77		28.5		36 (c)	-	-	< 0.13	< 0.13	< 0.13	TR < 1	-	< 0.13	< 0.13	< 0.005	< 0.005	< 0.005	0.35	< 0.005	< 0.005	< 0.005	1.9	2.5	< 0.005	< 0.005	< 0.005	< 0.001	< 0.001	< 0.001	0.7	< 15	ND (z)	<0.005	10
78		38.5		12 (c)	-	-	< 0.025	< 0.025	TR < 0.17	TR < 0.19	-	< 0.025	< 0.025	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0.5	0.6	< 0.005	< 0.005	0.3	< 0.001	< 0.001	< 0.001	< 0.2	< 15	ND (z)	<0.005	10
79	302	8.5	IT, 1985	5060 (c)	-	-	< 0.005	< 0.005	< 0.005	< 0.005	-	< 0.005	< 0.005	-	-	-	-	-	-	-	-	-	-	-	-	0.104	TR < 0.01	TR < 0.01	< 0.2	22	ND (z)	<0.005	10
80		38.5		< 1 (c)	-	-	< 0.005	< 0.005	< 0.005	< 0.005	-	< 0.005	< 0.005	-	-	-	-	-	-	-	-	-	-	-	-	< 0.001	< 0.001	< 0.001	< 0.2	< 15	ND (z)	<0.005	8
81	401	18.5	IT, 1985	40 (c)	-	-	< 0.005	< 0.005	< 0.005	< 0.005	-	0.14	< 0.005	-	-	-	-	-	-	-	-	-	-	-	-	< 0.001	< 0.001	< 0.001	0.9	< 15	0.14 (z)	<0.005	3
82		38.5		TR < 10 (c)	-	-	< 0.005	< 0.005	< 0.005	< 0.005	-	< 0.005	< 0.005	-	-	-	-	-	-	-	-	-	-	-	-	< 0.001	< 0.001	< 0.001	< 0.2	< 15	ND (z)	<0.005	10
83	402	8.5	IT, 1985	940 (c)	-	-	< 0.005	< 0.005	< 0.005	< 0.005	-	< 0.005	< 0.005	-	-	-	-	-	-	-	-	-	-	-	-	< 0.001	< 0.001	< 0.001	1.1	< 29	ND (z)	<0.005	5
84		33.5		< 10 (c)	-	-	< 0.005	< 0.005	< 0.005	< 0.005	-	< 0.005	< 0.005	-	-	-	-	-	-	-	-	-	-	-	-	< 0.001	< 0.001	< 0.001	4	< 15	ND (z)	<0.005	6
85	LBS-10	5	Trihydro, 1996	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	ND	-	-
86		20		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	ND	-	-
87	LBS-11	5	Trihydro, 1996	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	ND	-	-
88		21		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	ND	-	-
89	LBS-5	5	Trihydro, 1996	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	ND	-	-
90		15		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	ND	-	-
91	DB1	0.5	Versar, 1999		<0.5	-	<0.005	<0.005	<0.005	<0.010	<0.025	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
92		5.5			<0.5	-	<0.005	<0.005	<0.005	<0.010	0.029	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
93		10			<0.5	-	<0.005	<0.005	<0.005	<0.010	<0.025	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
94		20.5			110	-	0.5	0.8	1	3.8	<0.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
95		30.5			<0.5	-	<0.005	<0.005	<0.005	<0.010	<0.025	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
96		40.5			550	-	1	5.6	5.5	30.6	<2.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
97		60.5			7200	-	58	128	75	392	<12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
98		80.5			1200	-	6	6.3	8.7	31.5	3.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
OPERATIONAL AREA 4: WEST TANK FARM AREA																																	
99	101	9	IT, 1985	60 (c)	-	-	< 0.005	< 0.005	< 0.005	< 0.005	-	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.001	< 0.001	< 0.001	< 0.2	5.8	ND (z)	<0.005	8
100		13.5		71 (c)	-	-	< 0.005	< 0.005	< 0.005	< 0.005	-	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.001	< 0.001	< 0.001	2	57	ND (z)	<0.005	8
101		78.5		82 (c)	-	-	< 0.005	< 0.005	< 0.005	< 0.005	-	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.001	< 0.001	< 0.001	< 0.2	27	ND (z)	<0.005	3
102	105	10	IT, 1985	<10 (a)	< 1	-	< 0.005	0.0055	< 0.005	0.034	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 0.001	4.9
103		60		<10 (a)	< 1	-	< 0.005	< 0.005	< 0.005	0.017	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 0.001	<2.5
104		70		<10 (a)	< 1	-	< 0.005	< 0.005	< 0.005	0.022	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 0.001	<2.5
105	201	8.5	IT, 1985	11000 (c)	-	-	< 0.005	0.36	TR 0.011	0.087	-	< 0.005	< 0.005	-	-	-	-	-	-	-	-	-	-	-	-	0.178	< 0.001	TR < 0.1	0.9	17	ND (z)	<0.005	5
106		83.5		< 20 (c)	-	-	< 0.005	< 0.005	< 0.005	< 0.005	-	< 0.005	< 0.005	-	-	-	-	-	-	-	-	-	-	-	-	< 0.001	< 0.001	< 0.001	< 0.2	< 15	ND (z)	<0.005	8.7
107	205	8.5	IT, 1985	20 (c)	-	-	< 0.005	< 0.005	< 0.005	< 0.005	-	< 0.005	< 0.005	-	-	-	-	-	-	-	-	-	-	-	-	< 0.001	< 0.001	< 0.001	< 0.2	< 17	ND (z)	<0.005	9
108		14		36 (c)	-	-	< 0.005	< 0.005	< 0.005	< 0.005	-	< 0.005	< 0.005	-	-	-	-	-	-	-	-	-	-	-	-	< 0.001	< 0.001	< 0.001	< 0.2	< 17	ND (z)	<0.005	9
109		68.5		35 (c)	-	-	< 0.005	< 0.005	< 0.005	< 0.005	-	< 0.005	< 0.005	-	-	-	-	-	-	-	-	-	-	-	-	< 0.001	< 0.001	< 0.001	< 0.2	< 17	ND (z)	<0.005	5
110	306	8.5	IT, 1985	20 (c)	-	-	< 0.005	< 0.005	< 0.005	< 0.005	-	< 0.005	< 0.005	-	-	-	-	-	-	-	-	-	-	-	-	< 0.001	< 0.001	< 0.001	< 0.2	< 20	ND (z)	<0.005	5
111		38.5		5.3 (c)	-	-	< 0.005	< 0.005	< 0.005	< 0.005	-	< 0.005	< 0.005	-	-	-	-	-	-	-	-	-	-	-	-	< 0.001	< 0.001	< 0.001	< 0.2	< 20	ND (z)	<0.005	2
112	SB-10	5	IT,1985	< 2 (c)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
113	SB-11	5	IT,1985	< 2 (c)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
114	SB-12	5	IT,1985	< 2 (c)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
115	SB-13	5	IT,1985	198 (c)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
116	SB-14	5	IT,1985	29 (c)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
117	SB-15	5	IT,1985	4 (c)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
118	SB-16	5	IT,1985	4 (c)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
119	SB-17	10	IT,1985	< 2 (c)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
120	SB-18	5	IT,1985	< 2 (c)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
121	SB-19	5	IT,1985	< 2 (c)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
OPERATIONAL AREA 5: LAKELAND PROPERTY																																	
122	206	8.5	IT, 1985	TR < 20 (c)	-	-	< 0.005	< 0.005	< 0.005	< 0.005	-	< 0.005	< 0.005	-	-	-	-	-	-	-	-	-	-	-	-	< 0.001	< 0.001	< 0.001	< 0.2	19	ND (z)	<0.005	9
123		13.5		TR < 20 (c)	-	-	< 0.005	< 0.005	< 0.005	< 0.005	-	< 0.005	< 0.005	-	-	-	-	-	-	-	-	-	-	-	-	< 0.001	< 0.001	< 0.001	< 0.2	< 14	ND (z)	<0.005	9
124		68.5		TR < 20 (c)	-	-	< 0.005	< 0.005	< 0.005	< 0.005	-	< 0.005	< 0.005	-	-	-	-	-	-	-	-	-	-	-	-	< 0.001	< 0.001	< 0.001	< 0.2	23	ND (z)	<0.005	8
125	307	8.5	IT, 1985	20 (c)	-	-	< 0.005	< 0.005	< 0.005	< 0.005	-	< 0.005	< 0.005	-	-	-	-	-	-	-	-	-	-	-	-	< 0.001	< 0.001	< 0.001	< 0.2	< 17	ND (z)	<0.005	11
126		38.5		26 (c)	-	-	< 0.005	< 0.005	< 0.005	< 0.005	-	< 0.005	< 0.005	-	-	-	-	-	-	-	-	-	-	-	-	< 0.001	< 0.001	< 0.001	1.4	< 17	ND (z)	<0.005	10
106	PTR1	14.5	Trihydro, 1997	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	ND	-	-
107		29.5		-	-	<10 (s)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
108		54.5		-	-	-	0.087	0.12	0.013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.347 (y)	-	-
109		59.5		-	-	<10 (s)	0.05	0.025	0.01	0.045	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
110		69.5		-	-	<10 (s)	<0.005	0.011	<0.005	0.016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

TABLE 3
SUMMARY OF HISTORICAL SOIL SAMPLING DATA (MG/KG)
CENCO REFINING COMPANY
SANTA FE SPRINGS, CALIFORNIA

Sample Site Count	Soil Boring ID	Sample Depth (feet)	Sampled by/Date	TRPH (a) ASTM M2887 (b) Method 418.1 (c) as oil & grease	TPH-g	TPH by M8015 (d) diesel (j) jet fuel (s) simulated distillation	B	T	E	X	MTBE	MC	PCE	2-Methyl-Butane	Pentane	Cyclo hexane	Methyl cyclo pentane	2,3-Dimethyl butane	Hexane	Butane	1,1,3-Trimethyl cyclo hexane	2-Methyl heptane	2,2,3,4-Methyl pentane	Methyl cyclo hexane	Octane	2,4-Dichloro phenol	2,4,6-Trichloro phenol	2-Nitro phenol	Cyanide	TOX	HVOCs	1,1,1-TCA	Lead
111		74.5		-	-	<10 (s)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
112	PTR2	14.5	Trihydro, 1997	-	-	-	-	4	10	60	-															-	-	-	-	-	293.1(y)	-	-
113		24.5		-	-	5300 (s)	2.6	1.6	7	22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
114		34.5		-	-	-	14	130	49	340	-																				754.2 (y)		
115		44.5		-	-	27000 (s)	13	100	32	210	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	498 (y)	-	-
116		59.5		-	-	-	130	900	270	1800	-															-	-	-	-	-	4399 (y)	-	-
117		64.5		-	-	<10 (s)	<0.005	0.014	<0.005	0.009	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
118		69.5		-	-	80 (s)	1.3	4.6	4.4	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
119	PTR3	29.5	Trihydro, 1997	-	-	14500 (s)	200	900	75	2000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
120		39.5		-	-	-	46	180	84	400	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1064 (y)	-	-
121		49.5		-	-	910 (s)	28	50	40	120	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
122		59.5		-	-	-	1.7	7.3	2.7	19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	52.91 (y)	-	-
123		64.5		-	-	680 (s)	1.2	15	13	40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
124	PTR4	34.5	Trihydro, 1997	-	-	300 (s)	22	25	19	58	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
125		44.5		-	-	870 (s)	25	55	41	120	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
126		54.5		-	-	340 (s)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
127		59.5		-	-	-	9.4	49	14	90	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	219.7 (y)	-	-
128		64.5		-	-	850 (s)	0.46	6.1	3.5	27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	75.49 (y)	-	-
129	PTR5	1.5	Trihydro, 1997	-	-	-	<0.005	<0.005	<0.005	4.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14 (y)	-	-
130		39.5		-	-	< 10 (s)	0.057	0.0094	0.021	0.039	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.1709 (y)	-	-
131		54.5		-	-	-	<0.005	<0.005	<0.005	<0.005	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	ND	-	-
132		59.5		-	-	-	0.03	0.02	0.005	0.017	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
133	PTR6	54.5	Trihydro, 1997	-	-	< 10 (s)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
134		59.5		-	-	-	0.5	0.66	0.88	0.57	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.009 (y)	-	-
135		64.5		-	-	-	<0.005	<0.005	<0.005	<0.005	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	ND	-	-
136	PTR7	19.5	Trihydro, 1997	-	-	< 10 (s)	<0.005	<0.005	<0.005	<0.005	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.28 (y)	-	-
137		54.5		-	-	< 10 (s)	<0.005	<0.005	<0.005	<0.005	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.05 (y)	-	-
138		64.5		-	-	-	0.026	0.02	< 0.005	0.014	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
139	SB-501	1	IT, 1986	34 (c)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
140		4		161 (c)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
141		9		< 2 (c)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
142	SB-502	1	IT, 1986	28 (c)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
143		8		< 2 (c)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
144		9		< 2 (c)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
145	SB-503	1	IT, 1986	4 (c)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
146		9		6 (c)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
OPERATIONAL AREA 6: FORMER AST AREA AT WALKER PROPERTY																																	
147	1	25-40	D&M, Apr. 1985	-	-	-	-	-	-	-	-	-	< 0.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
140	2	25-30	D&M, Apr. 1985	-	-	-	-	-	-	-	-	-	< 0.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
141	JB-1	20	HLA 93	-	-	4400 (j)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
142		102		-	-	5900 (j)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
143		107		-	-	10000 (j)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
144	JB-2	30	HLA 93	-	-	< 5 (j)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
145		70		-	-	< 5 (j)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
146		105		-	-	< 5 (j)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
147	JB-3	20	HLA 93	-	-	4199 (d)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
148		40		-	-	< 5 (d, j)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
149		90		-	-	< 5 (d)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
150		100		-	-	< 5 (d)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
151	JB-4	70	HLA 93	-	-	< 5 (d)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
152		90		-	-	< 5 (d)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
153	JB-5	30	HLA 93	-	-	5499 (d)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
154		40		-	-	< 5 (d, j)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
155		90		-	-	< 5 (d)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
156		101		-	-	< 5 (d)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
157	JB-6	30	HLA 93	-	-	< 5 (j)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
158		70		-	-	< 5 (j)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
159		100		-	-	< 5 (j)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
160	JB-7	40	HLA 93	-	-	< 5 (j)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
161		90		-	-	< 5 9 (j)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
162		102		-	-	3200 (j)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
163	JB-8	20	HLA 93	-	-	7500 (d)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
164		70		-	-	4000 (d)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
165		90		-	-	< 5 (j)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
166		100		-	-	< 5 (d)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
167	JB-9	10	HLA 93	-	-	869 (j)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
168		50		-	-	< 5 (j)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
169		70		-	-	14 (j)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
170		100		-	-	1300 (j)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
171		105		-	-	2500 (j)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

SEE NOTES ON PAGE 4

TABLE 3
SUMMARY OF HISTORICAL SOIL SAMPLING DATA (MG/KG)
CENCO REFINING COMPANY
SANTA FE SPRINGS, CALIFORNIA

Sample Site Count	Soil Boring ID	Sample Depth (feet)	Sampled by/Date	TRPH (a) ASTM M2887 (b) Method 418.1 (c) as oil & grease	TPH-g	TPH by M8015 (d) diesel (j) jet fuel (s) simulated distillation	B	T	E	X	MTBE	MC	PCE	2-Methyl-Butane	Pentane	Cyclo hexane	Methyl cyclo pentane	2,3-Dimethyl butane	Hexane	Butane	1,1,3-Trimethyl cyclo hexane	2-Methyl heptane	2,2,3,4-Methyl pentane	Methyl cyclo hexane	Octane	2,4-Dichloro phenol	2,4,6-Trichloro phenol	2-Nitro phenol	Cyanide	TOX	HVOCs	1,1,1-TCA	Lead
172	W-3	20	HLA 93	11000 (a)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
173		100		12000 (a)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
174		110		<5 (a)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
175	W-3A	5	Avalon 98	150 (a)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
176		10		3200 (a)	140	-	<0.1	<0.1	<0.1	<0.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
177		20		<5 (a)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
178		30		5.5 (a)	< 1	-	<0.005	<0.005	<0.005	<0.015	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
179		40		<5 (a)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180		55		22 (a)	990	-	<0.67	<0.67	<0.67	<2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
181		70		5700 (a)	3900	-	<5	<5	<5	<15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
182		75		3400 (a)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
183		80		2400 (a)	1300	-	<1.7	<1.7	<1.7	<6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
184		85		1600 (a)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
185		90		1500 (a)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
186		95		460 (a)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
187		100		270 (a)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
188		105		88 (a)	11	-	<0.01	<0.01	<0.01	<0.03	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
189		110		1500 (a)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
OFF-SITE SOIL BORINGS: WALKER PROPERTY																																	
190	4	1.5-8.5	D&M, Apr. 1985	-	-	-	-	-	-	-	-	-	< 0.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
191	FB-1		TRC, Feb. 1990	-	-	53	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
192				-	-	< 5 (d)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
191	FB-2	40	TRC, Feb. 1990	-	-	< 5 (d)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
192	FB-3	20	TRC, Feb. 1990	-	-	< 5 (d)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
193	FB-4	20	TRC, Feb. 1990	-	-	< 5 (d)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
194	FB-5	20	TRC, Feb. 1990	-	-	< 5 (d)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
195	PT-3	10	HLA 93	33 (a)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
196	PT-6	12	HLA 93	2900 (a)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
OFF-SITE SOIL BORINGS: METROPOLITAN STATE HOSPITAL																																	
197	603	10	Tribydro, Dec. 1995	<10 (a)	< 1	-	< 0.005	< 0.005	< 0.005	< 0.005	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.001	0.00099	6.7
198		20		<10 (a)	< 1	-	< 0.005	< 0.005	< 0.005	< 0.005	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.001	< 0.001	5.5
199		70		<10 (a)	< 1	-	< 0.005	< 0.005	< 0.005	< 0.005	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.001	0.001	6.2
200	604	10	Tribydro, Dec. 1995	<10 (a)	< 1	-	< 0.005	< 0.005	< 0.005	0.0065	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 0.001	< 0.001	6.8
201		60		<10 (a)	1.3	-	< 0.005	< 0.005	< 0.005	0.014	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 0.001	< 0.001	2.9
202		80		<10 (a)	< 1	-	< 0.005	< 0.005	< 0.005	0.013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 0.001	< 0.001	<2.5
203	605	10	Tribydro, Dec. 1995	<10 (a)	< 1	-	< 0.005	< 0.005	< 0.005	< 0.005	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 0.001	< 0.001	6.7
204		60		<10 (a)	< 1	-	< 0.005	< 0.005	< 0.005	< 0.005	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 0.001	< 0.001	5.4
205		70		<10 (a)	< 1	-	< 0.005	< 0.005	< 0.005	< 0.005	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 0.001	< 0.001	3.6
206	606	10	Tribydro, Dec. 1995	<10 (a)	< 1	-	< 0.005	< 0.005	< 0.005	< 0.005	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 0.001	< 0.001	2.5
207		50		<10 (a)	< 1	-	< 0.005	< 0.005	< 0.005	< 0.005	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 0.001	< 0.001	4.3
208		80		<10 (a)	< 1	-	< 0.005	< 0.005	< 0.005	< 0.005	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 0.001	< 0.001	5.5
209	607	10	Tribydro, Dec. 1995	<10 (a)	< 1	-	< 0.005	< 0.005	< 0.005	< 0.005	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 0.001	< 0.001	2.8
210		70		<10 (a)	< 1	-	< 0.005	< 0.005	< 0.005	< 0.005	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 0.001	< 0.001	2.8
211		80		<10 (a)	< 1	-	< 0.005	< 0.005	< 0.005	< 0.005	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 0.001	< 0.001	2.7

NOTES

All concentrations reported in milligrams per kilogram (mg/Kg).

- = Not analyzed or Data Not Available

TR : Trace; This compound was present, but its concentration was too low to be accurately quantified.

< 0.005 = Not detected above laboratory detection limit of 0.005 mg/Kg.

1 - Where sample date is unavailable, report that presents sample analytical results is referenced.

Abbreviations:

(a) = simulated extraction: differentiation of hydrocarbon ranges simulated by progressive distillation

(j) = extractable hydrocarbons quantitated as jet fuel in range from C7 to C30.

(y) = Total HVOCs by EPA Method 8260

(z) = Total HVOCs by EPA Method 8240, not including BTEX

Abbreviations:

B = benzene
T = toluene
E = ethylbenzene
X = total xylene isomers
TPH = total petroleum hydrocarbons
TRPH = total recoverable petroleum hydrocarbons
TPH-g = total petroleum hydrocarbons as gasoline

MTBE = methyl tertiary butyl ether
MC = methlene chloride
PCE = perchloroethylene
MEK = methyl ethyl ketone, or 2-butanone
1,1,1-TCA = trichloroethane
HVOCs = halogenated volatile organic compounds
TOX = total halide-containing organic compounds

SEE NOTES ON PAGE 4

TABLE 4
SUMMARY OF HISTORICAL GROUNDWATER QUALITY RESULTS (MG/L)
CENCO REFINING COMPANY
SANTA FE SPRINGS, CALIFORNIA

Monitoring Well ID	Date	TPH-g	TPH-d	TRPH	MTBE	B	T	E	X	BDCM	BCM	Chloroform	c-1,2-DCE	1,2-DCB	Dichloro-difluoro methane	1,1-DCA	1,2-DCA	1,1-DCE	1,2-DCP	isoPB	MC	n-BB	n-PB	Napthalene	p-isoPT	sec-BB	Phenol	PCE	t-1,2-DCE	TCE	1,2,4-TMB	1,3,5-TMB	TOX	VC	CB
OPERATIONAL AREA 1: BLOOMFIELD PROPERTY																																			
MW-106	12/20/95	0.79	--	<10	--	0.012	0.0035	0.01	0.01	--	--	--	0.033	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.015	0.0015	--	--	--	--	--
	7/31/96	0.6	--	--	0.0036	0.014	0.0022	0.009	<0.005	<0.0003	--	<0.0003	0.026	<0.0003	<0.0003	<0.0003	<0.0003	0.00054	<0.0003	--	<0.0003	--	--	--	--	--	--	<0.0003	0.017	0.0025	--	--	--	0.00098	--
	12/17/96	0.36	--	--	<0.002	0.0031	<0.002	<0.002	<0.004	<0.002	<0.002	<0.002	0.063	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.0027	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	--	<0.002	0.026	<0.002	<0.002	<0.002	--	<0.004	--
	1/20/98	0.8	--	--	<0.005	0.024	<0.005	0.0081	<0.005	<0.005	<0.005	<0.005	0.046	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	0.0073	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	--	<0.005	0.01	<0.005	<0.005	<0.005	--	<0.01	<0.005
	8/20/98	1	--	--	<0.005	0.027	<0.005	0.084	<0.005	<0.005	<0.005	<0.005	0.43	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	0.0096	<0.005	<0.005	0.0059	<0.01	<0.005	<0.005	--	<0.005	0.0058	<0.005	<0.005	<0.005	--	<0.01	<0.005
	1/27/99	1.1	--	--	<0.005	21	<0.005	0.0085	<0.005	<0.005	<0.005	<0.005	0.047	<0.005		<0.005	<0.005	<0.005	<0.005	0.009	<0.005	<0.005	0.0072	<0.01	<0.005	<0.005	--	<0.005	<0.005	<0.005	<0.005	<0.005	--	<0.01	<0.005
	7/19/99	0.89	--	--	<0.001	0.018	<0.001	0.0077	<0.001	<0.001	<0.001	<0.001	0.039	<0.001	<0.001	0.0017	<0.0005	0.0012	<0.001	0.007	<0.01	<0.001	0.0052	<0.01	<0.001	0.0015	--	<0.001	0.0064	0.0026	<0.001	<0.001	--	<0.0005	<0.001
MW-107	12/1/21995	<0.5	--	<10	--	0.016	0.00099	0.00077	0.0029	--	--	--	0.028	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.0065	--	--	--	--	--	--
	7/31/96	0.6	--	--	0.11	0.031	0.0044	0.0066	<0.005	<0.0003	--	<0.0003	0.031	<0.0003	<0.0003	<0.0003	<0.0003	0.00045	<0.0003	--	<0.0003	--	--	--	--	--	--	<0.0003	0.019	0.00078	--	--	--	0.0011	--
	12/17/96	0.38	--	--	<0.002	0.022	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	0.08	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	--	<0.005	0.033	<0.005	<0.005	<0.005	--	<0.01	--
	1/20/98	0.83	--	--	<0.005	0.042	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.12	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	--	<0.005	0.047	<0.005	<0.005	<0.005	--	<0.01	<0.005
	8/20/98	0.83	--	--	<0.005	0.028	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.098	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	0.0062	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	--	<0.005	0.025	<0.005	<0.005	<0.005	--	<0.01	<0.005
	1/27/99	1.1	--	--	<0.005	0.036	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.1	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	0.0069	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	--	<0.005	0.044	<0.005	<0.005	<0.005	--	<0.01	<0.005
	7/19/99	0.82	--	--	<0.005	0.038	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.12	<0.005	<0.005	<0.005	<0.0025	<0.005	<0.005	<0.005	<0.05	<0.005	<0.005	<0.05	<0.005	<0.005	--	<0.005	0.077	<0.005	<0.005	<0.005	--	<0.0025	<0.005
MW-203	6/1/88	--	--	--	--	0.046	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	9/1/88	--	--	--	--	0.076	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/1/88	--	--	--	--	0.064	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	3/1/89	--	--	--	--	0.11	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	6/1/89	--	--	--	--	0.11	<0.005	0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	9/1/89	--	--	--	--	0.08	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/1/89	--	--	--	--	0.1	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	3/1/90	--	--	--	--	0.09	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	6/1/90	--	--	--	--	0.088	0.002	0.007	0.002	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	9/1/90	--	--	--	--	0.13	<0.005	0.009	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/1/90	--	--	--	--	0.094	<0.005	0.007	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	3/1/91	--	--	--	--	0.1	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	6/1/91	--	--	--	--	0.1	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	9/1/91	--	--	--	--	0.14	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/1/91	--	--	--	--	0.13	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	3/1/92	--	--	--	--	0.12	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	6/1/92	--	--	--	--	0.085	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	9/1/92	--	--	--	--	0.046	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/1/92	--	--	--	--	0.064	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	3/1/93	--	--	--	--	0.069	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	5/1/93	--	--	--	--	0.086	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	5/25/93	--	--	--	--	0.086	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	9/1/93	--	--	--	--	0.04	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/1/94	--	--	--	--	0.039	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	3/1/95	--	--	--	--	0.027	<0.005	<0.005	<0.015	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	9/1/95	--	--	--	--	0.028	<0.002	<0.002	<0.002	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/13/95	0.64	--	<5	--	0.037	0.001	0.012	0.0019	--	--	--	0.04	--	--	0.00061	--	--	--	--	--	--	--	--	--	--	--	--	0.0045	--	--	--	--	0.0014	--
	7/31/96	0.5	--	--	<0.02	0.043	0.002	0.0018	<0.005	<0.0003	--	<0.0003	0.022	<0.0003	<0.0003	0.00034	<0.0003	<0.0003	<0.0003	--	<0.0003	--	--	--	--	--	--	<0.0003	0.0017	0.00034	--	--	--	0.002	--
	12/17/96	0.16	--	--	<0.002	0.03	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0012	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	--	<0.001	<0.001	<0.001	<0.001	<0.001	--	<0.002	--
	1/20/98	0.25	--	--	<0.005	0.024	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.028	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	--	<0.005	<0.005	<0.005	<0.005	<0.005	--	<0.01	<0.005
	8/20/98	0.29	--	--	<0.005	0.017	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.035	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	--	<0.005	<0.005	<0.005	<0.005	<0.005	--	<0.01	<0.005
	1/27/99	0.33	--	--	<0.005	0.012	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.035	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	--	<0.005	<0.005	<0.005	<0.005	<0.005	--	<0.01	<0.005
	7/19/99	<0.50	--	--	<0.001	0.016	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.024	<0.001	<0.001	<0.001	<0.0005	<0.001	<0.001	<0.001	<0.010	<0.001	<0.001	<0.01	<0.001	<0.001	--	<0.001	0.0019	<0.001	<0.001	<0.001	--	<0.00050	<0.001
OPERATIONAL AREA 2: EAST TANK FARM AREA																																			
MW-103	8/85	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.06	--	--
	6/1/88	--	--	--	--	0.97	0.074	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	9/1/88	--	--	--	--	0.3	<0.005	<0.005	0.008	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/1/88	--	--	--	--	0.37	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	3/1/89	--	--	--	--	0.94	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	6/1/89	--	--	--	--	0.7	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	9/1/89	--	--	--	--	1	0.03	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	3/1/92	--	--	--	--	0.21	<0.005	0.005	0.023	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	6/1/92	--	--	--	--	0.88	<0.005	<0.005	0.055	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	9/1/92	--	--	--	--	0.2	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/1/92	--	--	--	--	0.35	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	3/1/93	--	--	--	--	<0.005	0.008	0.019	0.01	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	5/1/93	--	--	--	--	4.8	<0.25	<0.25	<0.25	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	5/25/93	--	--	--	--	4.8	<0.25	<0.25	<0.25	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	9/1/93	--	--	--	--	1.3	0.088	0.062	0.23	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	11/1/93	--	--	--	--	1.4	<0.25	<0.25	<0.25	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/1/94	--	--	--	--	0.24	<0.01	<0.01	0.011	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	3/1/95	--	--	--	--	0.16	<0.005	<0.005	<0.015	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	9/1/95	--	--	--	--	0.9	<0.05	<0.05	<0.05	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/13/95	4.1	--	<0.5	--	0.41	0.0041	0.0026	0.0077	--	--	--	<0.0005	--	--	0.0022	0.0021	<0.0005	<0.0005	--	<0.0005	--	--	--	--	--	--	<0.0005	<0.0005	<0.0005	--	--	--	0.0025	--
	7/31/96	2.7	--	--	<0.01	0.34	0.005	<0.0005	0.012	<0.0003	--	<0.0003	0.0007	0.0012	0.011	0.017	0.0017	<0.0003	<0.0003	--	<0.0003	--	--	--	--	--	--	<0.0003	<0.0003	0.00038	--	--	--	<0.0003	--
	12/17/96	2.4	--	--	<0.01	0.2	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	0.027	<0.005	<0.005	<0.005	0.006	<0.005	<0.005	0.0084	<0.005	<0.005	<0.005	--	0.0089	<0.005	<0.005	<0.005	<0.005	--	0.054	--
	1/21/98	1.3	--	--	<0.005	0.23	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	0.011	<0.005	<0.005	0.015	<0.01	<0.005	<0.005	--	<0.005	<0.005	<0.005	<0.005	<0.005	--	0.028	<0.005
	8/19/98	1.6	--	--	<0.005	0.22	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	0.011	<0.005	0.0069	0.018	<0.01	<0.005	0.0054	--	<0.005	<0.005	<0.005	<0.005	<0.005	--	<0.01	<0.005
	1/27/99	1.9	--	--	<0.005	0.11	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	0.0071	<0.005	<0.005	0.0059	<0.01	<0.005	<0.005	--	<0.005	<0.005	<0.005	<0.005	<0.005	--	<0.01	<0.005
	7/19/99	1.8	--	--	<0.001	0.061	0.0011	<0.001	<0.001	<0.001	<0.001	<0.001	0.0012	<0.001	<0.001	<0.001	<0.0005	<0.001	<0.001	0.0088	<0.01	0.0031	0.0081	<0.01	<0.001	0.0039	--	<0.001	<0.001	<0.001	<0.001	<0.001	--	<0.0005	<0.001
MW-202	8/85	--	--	--	--	--	--	--	--										--	--	--	--	--	--	--	--	1.9	--	--	--	--	--	--	--	--
	11/1/93	--	--	--	--	7.7	<0.5	2.6	6.3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	3/1/95	--	--	--	--	0.4	0.007	0.029	0.042	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	9/1/95	--	--	--	--	0.5	0.01	0.048	0.042	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/1/95	6.5	--	--	--	0.33	0.021	0.051	0.074	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	7/31/96	4.8	--	--	0.062	0.64	0.015	<0.0005	0.032	<0.0003	--	<0.0003	0.002	<0.0003	0.0057	0.00054	0.00058	<0.0003	0.0004	--	<0.0003	--	--	--	--	--	--	<0.0003	0.00034	0.00037	--	--	--	<0.0003	--
	12/17/96	7.4	--	--	<0.02	0.89	<0.05	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.055	<0.05	<0.05	0.1	<0.05	<0.05	<0.05	--	<0.05	<0.05	<0.05	<0.05	<0.05	--	<0.01	--
	1/21/98	1.6	--	--	<0.005	0.45	<0.005	0.019	0.021	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	0.057	<0.005	0.011	0.1	<0.01	<0.005	0.016	--	<0.005	<0.005	<0.005	<0.005	<0.005	--	<0.01	<0.005

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TABLE 4
SUMMARY OF HISTORICAL GROUNDWATER QUALITY RESULTS (MG/L)
CENCO REFINING COMPANY
SANTA FE SPRINGS, CALIFORNIA

Monitoring Well ID	Date	TPH-g	TPH-d	TRPH	MTBE	B	T	E	X	BDCM	BCM	Chloroform	c-1,2-DCE	1,2-DCB	Dichloro-difluoro methane	1,1-DCA	1,2-DCA	1,1-DCE	1,2-DCP	isoPB	MC	n-BB	n-PB	Napthalene	p-isoPT	sec-BB	Phenol	PCE	t-1,2-DCE	TCE	1,2,4-TMB	1,3,5-TMB	TOX	VC	CB
	8/18/98	3.1	--	--	<0.005	0.28	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	0.049	<0.005	0.016	0.091	<0.01	<0.005	0.026	--	<0.005	<0.005	<0.005	<0.005	<0.005	--	<0.01	<0.005
	1/27/99	2.3	--	--	<0.005	0.076	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	0.067	<0.005	<0.005	0.13	<0.01	<0.005	0.029	--	<0.005	<0.005	<0.005	<0.005	<0.005	--	<0.01	<0.005
	7/19/99	2.3	--	--	<0.002	0.036	0.0021	0.0037	0.0024	<0.002	<0.002	<0.002	0.0033	<0.002	<0.002	<0.002	<0.001	<0.002	<0.002	0.062	<0.02	0.019	0.13	<0.02	<0.002	0.029	--	<0.002	<0.002	<0.002	<0.002	<0.002	--	<0.001	<0.002
MW-204	6/1/88	--	--	--	--	0.019	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	9/1/88	--	--	--	--	0.006	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/1/88	--	--	--	--	0.033	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	3/1/89	--	--	--	--	0.039	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	6/1/89	--	--	--	--	0.076	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	9/1/89	--	--	--	--	0.064	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/1/89	--	--	--	--	0.16	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	3/1/90	--	--	--	--	0.009	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	6/1/90	--	--	--	--	0.002	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	9/1/90	--	--	--	--	0.025	<0.005	<0.005	0.006	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/1/90	--	--	--	--	<0.005	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	3/1/91	--	--	--	--	<0.005	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	6/1/91	--	--	--	--	<0.005	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	9/1/91	--	--	--	--	0.027	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/1/91	--	--	--	--	0.047	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	3/1/92	--	--	--	--	0.09	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	6/1/92	--	--	--	--	0.11	0.071	<0.005	0.02	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	9/1/92	--	--	--	--	0.09	0.02	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/1/92	--	--	--	--	2.7	3.7	<0.005	1.06	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	4/1/93	--	--	--	--	0.13	0.028	0.021	0.193	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	5/1/93	--	--	--	--	0.78	<0.05	<0.05	<0.05	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	5/25/93	--	--	--	--	0.78	<0.05	<0.05	<0.05	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/1/94	--	--	--	--	5.5	0.63	0.19	0.99	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	3/1/95	--	--	--	--	5	0.077	0.12	0.49	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	9/1/95	--	--	--	--	6.9	4.7	0.65	3.7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/13/95	12000	--	<5	--	0.88	0.67	0.24	0.86	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	8/1/96	14	--	--	0.032	1.4	1.3	0.52	1.7	<0.001	--	<0.001	0.0029	<0.001	<0.001	0.0033	0.0072	<0.001	<0.001	--	<0.001	--	--	--	--	--	--	<0.001	<0.001	0.0011	--	--	--	0.0052	--
	12/17/96	2.1	--	--	<0.2	0.75	0.058	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	--	<0.05	<0.05	<0.05	<0.05	<0.05	--	<0.1	--
	1/21/98	6	--	--	0.0051	2.3	0.079	0.21	0.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	0.012	<0.005	<0.005	0.036	0.069	<0.005	0.081	--	<0.005	<0.005	<0.005	0.09	0.023	--	0.009	<0.005
	8/21/98	11	--	--	<0.05	5.1	0.51	0.52	1.73	<0.05	<0.05	<0.05	<0.05	<0.05	<0.1	<0.05	0.15	<0.05	<0.05	<0.05	<0.05	<0.05	0.054	<0.1	<0.05	<0.05	--	<0.05	<0.05	<0.05	0.2	<0.05	--	<0.1	<0.05
	1/28/99	10	--	--	<0.05	3.3	0.11	0.47	1.84	<0.05	<0.05	<0.05	<0.05	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.1	<0.05	<0.05	--	<0.05	<0.05	<0.05	0.21	0.052	--	<0.1	<0.05
DUP	1/28/99	10	--	--	0.0052	3.1	0.12	0.53	2.08	<.005	<.005	<.005	<.005	<.005	<0.01	<.005	<.005	<.005	<.005	0.018	<.005	<.005	0.048	0.094	<.005	<.005	--	<.005	<.005	<.005	0.25	0.061	--	0.012	<0.005
	7/19/99	1.9	--	--	0.027	0.56	<0.01	0.11	0.23	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.005	<0.01	<0.01	<0.01	<0.1	<0.01	0.023	<0.1	<0.01	<0.01	--	<0.01	<0.01	<0.01	0.047	0.011	--	<0.005	<0.01
OPERATIONAL AREA 3: PROCESSING AREA																																			
MW-104 (ABANDONED)	6/1/88	--	--	--	--	<0.005	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	9/1/88	--	--	--	--	<0.005	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/1/88	--	--	--	--	<0.005	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	3/1/89	--	--	--	--	<0.005	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	6/1/89	--	--	--	--	<0.005	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	9/1/89	--	--	--	--	<0.005	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/1/89	--	--	--	--	<0.005	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	3/1/90	--	--	--	--	<0.005	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	6/1/90	--	--	--	--	<0.005	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	9/1/90	--	--	--	--	<0.005	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/1/90	--	--	--	--	<0.005	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	3/1/91	--	--	--	--	<0.005	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	6/1/91	--	--	--	--	<0.005	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	9/1/91	--	--	--	--	<0.005	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/1/91	--	--	--	--	<0.005	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	3/1/92	--	--	--	--	<0.005	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	6/1/92	--	--	--	--	<0.005	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	9/1/92	--	--	--	--	<0.005	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/1/92	--	--	--	--	<0.005	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	3/1/93	--	--	--	--	<0.005	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	5/1/93	--	--	--	--	<0.005	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	5/25/93	--	--	--	--	<0.005	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	9/1/93	--	--	--	--	<0.005	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	11/1/93	--	--	--	--	<0.005	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	3/1/94	--	--	--	--	<0.005	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	6/1/94	--	--	--	--	<0.005	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/1/94	--	--	--	--	<0.005	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	3/1/95	--	--	--	--	<0.005	<0.005	<0.005	<0.015	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	9/1/95	--	--	--	--	0.003	<0.002	<0.002	<0.002	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/13/95	<0.5	--	--	--	0.003	0.0006	<0.005	<0.005	--	--	--	--	--	--	0.0027	--	--	--	--	--	--	--	--	--	--	--	--	0.00078	--	--	--	--	--	--
	7/31/96	<0.1	--	--	<0.01	0.0022	0.0018	<0.001	0.0027	<0.0003	--	<0.0003	0.0015	<0.0003	<0.0003	0.00058	0.00051	<0.0003	<0.0003	--	<0.0003	--	--	--	--	--	--	<0.0003	<0.0003	0.00054	--	--	--	<0.0003	--
	12/16/96	0.31	--	--	<0.002	0.0042	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	0.0027	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.01	<0.001	<0.001	0.0052	<0.001	<0.001	0.0029	--	<0.001	<0.001	<0.001	<0.001	<0.001	--	0.0032	--
	1/20/98	<0.1	--	--	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	--	<0.005	<0.005	<0.005	<0.005	<0.005	--	<0.01	<0.005
	8/18/98	<0.1	--	--	--	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	--	<0.005	<0.005	<0.005	<0.005	<0.005	--	<0.01	<0.005
	1/27/99	<0.1	--	--	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	--	<0.005	<0.005	<0.005	<0.005	<0.005	--	<0.01	<0.005
MW-104A	7/19/99	<0.5	--	--	<0.001	<0.0005	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0056	<0.001	<0.001	<0.001	0.0012	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.01	<0.001	<0.001	--	<0.001	<0.001	0.0012	<0.001	<0.001	--	<0.0005	<0.001
MW-504	12/1/93	--	--	--	--	11	1.3	1.8	9.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	6/1/94	--	--	--	--	8.6	2.1	<0.5	8.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/1/94	--	--	--	--	5.8	0.7	0.84	7.6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	3/1/95	--	--	--	--	5.2	1.1	1.2	12	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	9/1/95	--	--	--	--	8	1.3	2.2	11	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/13/95	99	--	36.9	--	2.7	0.73	0.8	2.6	--	--	--	0.014	--	--	0.013	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	8/1/96	80	--	--	0.37	3.4	1.4	0.96	3.7	<0.001	--	<0.001	0.02	<0.001	<0.001	0.004	0.02	<0.001	<0.001	--	<0.001	--	--	--	--	--	--	<0.001	0.00046	0.00078	--	--	--	0.0011	--
	12/18/96	33	--	--	<0.05	6	2.8	1	3.3	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	0.35	2.3	0.37	<0.25	--	<0.25	<0.25	<0.25	5	2.1	--	<0.5	--
	1/21/98	30	--	--	<0.25	4.6	0.94	0.75	2.08	<0.25	<0.25	<0.25	<0.25	<0.25	<0.5	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	0.36	<0.25	<0.25	--	<0.25	<0.25	<0.25	0.8	0.34	--	<0.5	<0.25
	8/20/98	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	1/28/99	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	7/19/99	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

SEE NOTES ON PAGE 6

TABLE 4
SUMMARY OF HISTORICAL GROUNDWATER QUALITY RESULTS (MG/L)
CENCO REFINING COMPANY
SANTA FE SPRINGS, CALIFORNIA

Monitoring Well ID	Date	TPH-g	TPH-d	TRPH	MTBE	B	T	E	X	BDCM	BCM	Chloroform	c-1,2-DCE	1,2-DCB	Dichloro-difluoro methane	1,1-DCA	1,2-DCA	1,1-DCE	1,2-DCP	isoPB	MC	n-BB	n-PB	Napthalene	p-isoPT	sec-BB	Phenol	PCE	t-1,2-DCE	TCE	1,2,4-TMB	1,3,5-TMB	TOX	VC	CB
OPERATIONAL AREA 4: WEST TANK FARM AREA																																			
MW-101	8/85	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.18	--	--
	6/1/88	--	--	--	--	0.62	<0.005	<0.005	0.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	9/1/88	--	--	--	--	0.31	0.01	0.034	0.013	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/1/88	--	--	--	--	0.49	0.028	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	6/1/92	--	--	--	--	0.44	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	9/1/92	--	--	--	--	0.34	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/1/92	--	--	--	--	0.29	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	3/1/93	--	--	--	--	0.2	<0.005	<0.005	<0.025	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/1/94	--	--	--	--	0.062	<0.005	0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	3/1/95	--	--	--	--	0.11	<0.005	0.11	<0.15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	9/1/95	--	--	--	--	0.18	<0.004	0.18	<0.004	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/13/95	2.4	--	<5	--	0.09	0.0059	0.0064	0.0029	--	--	--	0.045	--	--	0.0093	0.0018	0.067	<0.0005	--	0.0013	--	--	--	--	--	--	0.036	0.00097	0.1	--	--	--	<0.0005	--
	7/31/96	2.3	--	--	<0.01	0.13	0.014	0.13	0.014	<0.0003	--	<0.0003	0.35	<0.0003	<0.0003	0.0086	0.0016	0.052	<0.0003	--	<0.0003	--	--	--	--	--	--	24	<0.0003	0.041	--	--	--	<0.0003	--
	12/17/96	0.92	--	--	<0.002	<0.025	<0.05	<0.025	<0.05	<0.025	<0.025	<0.025	0.09	<0.025	<0.025	<0.025	<0.025	0.14	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	--	0.057	<0.025	0.24	<0.025	<0.025	--	<0.05	--
	1/19/98	1.4	--	--	<0.005	0.065	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.062	<0.005	<0.01	0.017	<0.005	<50	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	--	0.18	<0.005	0.32	<0.005	<0.005	--	<0.01	<0.005
	8/18/98	3.2	--	--	--	0.14	<0.005	0.015	0.0067	<0.005	<0.005	<0.005	0.052	<0.005	<0.01	<0.005	<0.005	0.092	<0.005	0.0064	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	--	0.034	<0.005	<0.005	<0.005	<0.005	--	<0.01	<0.005
	1/26/99	3.2	--	--	<0.005	0.0684	<0.005	0.00708	<0.005	<0.005	<0.005	<0.005	0.0719	<0.005	<0.01	0.0139	<0.005	0.0979	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	--	0.0193	<0.005	0.16	<0.005	<0.005	--	<0.01	<0.005
	7/19/99	1.3	--	--	<0.002	0.022	<0.002	0.0024	<0.002	<0.002	<0.002	<0.002	0.057	<0.002	<0.002	0.018	<0.001	0.15	<0.002	<0.002	<0.02	<0.002	<0.002	<0.02	<0.002	<0.002	--	0.078	0.0085	0.27	<0.002	<0.002	--	<0.001	<0.002
MW-105	12/21/95	<0.5	--	<10	--	0.011	0.0017	0.00081	0.0037	--	--	--	0.0094	--	--	0.0045	0.0033	0.013	--	--	--	--	--	--	--	--	--	0.016	--	0.046	--	--	--	--	--
	7/31/96	0.65	--	--	<0.01	0.091	0.0018	0.002	0.0018	<0.003	--	<0.0003	0.0084	<0.0003	<0.0003	0.012	0.0014	0.02	<0.0003	--	<0.0003	--	--	--	--	--	--	0.024	<0.0003	0.033	--	--	--	<0.0003	--
	12/16/96	0.24	--	--	<0.002	0.014	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	0.01	<0.005	<0.005	<0.005	<0.005	0.05	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	--	0.08	<0.005	0.11	<0.005	<0.005	--	<0.01	--
	1/20/98	0.51	--	--	<0.005	0.021	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.025	<0.005	<0.01	0.022	<0.005	0.14	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	--	0.15	<0.005	0.21	<0.005	<0.005	--	<0.01	<0.005
	8/18/98	0.68	--	--	--	0.0536	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0253	<0.005	<0.01	0.0154	<0.005	0.108	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	--	0.0967	<0.005	0.162	<0.005	<0.005	--	<0.01	<0.005
	1/25/99	0.53	--	--	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.022	<0.005	<0.01	0.014	<0.005	0.117	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	--	0.125	<0.005	0.187	<0.005	<0.005	--	0.00643	<0.005
	7/19/99	0.61	--	--	<0.001	0.0048	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.029	<0.001	<0.001	0.016	0.0034	0.13	<0.001	<0.001	<0.01	<0.001	<0.001	<0.01	<0.001	<0.001	--	0.078	0.015	0.28	<0.001	<0.001	--	<0.0005	<0.001
MW-201	8/85	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.1	--	--	--	--	--	--	--	--
	6/1/88	--	--	--	--	1	0.15	<0.005	0.25	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	9/1/88	--	--	--	--	0.52	0.21	0.11	0.4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/1/88	--	--	--	--	0.42	0.065	0.019	0.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	3/1/89	--	--	--	--	0.21	0.027	0.024	0.047	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	6/1/89	--	--	--	--	0.35	<0.005	<0.005	0.05	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	9/1/89	--	--	--	--	0.83	0.1	0.032	0.21	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/1/89	--	--	--	--	0.51	0.076	0.024	0.17	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	3/1/90	--	--	--	--	0.35	0.038	0.029	0.085	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	6/1/90	--	--	--	--	0.82	0.049	0.084	0.083	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	9/1/90	--	--	--	--	0.34	0.015	0.02	0.073	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/1/90	--	--	--	--	0.24	0.012	0.007	0.055	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	3/1/91	--	--	--	--	0.5	<0.005	<0.005	0.24	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	6/1/91	--	--	--	--	0.53	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	9/1/91	--	--	--	--	0.37	<0.005	<0.005	0.13	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/1/91	--	--	--	--	0.34	0.01	0.009	0.08	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	6/1/92	--	--	--	--	0.025	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	9/1/92	--	--	--	--	0.35	<0.005	<0.005	0.13	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/1/92	--	--	--	--	1.15	<0.005	<0.005	0.56	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	3/1/93	--	--	--	--	0.56	0.077	<0.05	0.41	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/1/94	--	--	--	--	1.3	0.066	0.5	0.56	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	3/1/95	--	--	--	--	0.29	<0.005	<0.005	<0.015	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	9/1/95	--	--	--	--	1.1	0.028	0.13	0.14	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/13/95	9	--	<5	--	0.44	0.042	0.12	0.094	--	--	--	0.044	--	--	0.0094	0.0044	0.087	0.00081	--	0.0007	--	--	--	--	--	--	0.058	0.0017	0.11	--	--	--	--	--
	7/31/96	<0.1	--	--	<0.01	0.48	0.02	0.032	0.025	<0.0003	--	<0.0003	0.034	<0.0003	<0.0003	0.0094	0.0027	0.098	<0.0003	--	<0.0003	--	--	--	--	--	--	0.11	<0.0003	0.12	--	--	--	<0.0003	--
	12/17/96	3.7	--	--	<0.01	0.11	0.012	0.096	0.121	<0.01	<0.01	<0.01	0.089	<0.01	<0.01	<0.01	<0.01	0.17	<0.01	0.021	<0.01	<0.01	0.021	<0.01	<0.01	<0.01	--	0.21	<0.01	0.21	0.14	0.028	--	<0.02	--
	1/21/98	2.6	--	--	<0.005	0.22	0.014	0.087	0.017	<0.005	<0.005	<0.005	0.064	<0.005	<0.01	0.01	<0.005	0.1	<0.005	0.019	<0.005	<0.005	0.021	0.011	<0.005	<0.005	--	0.16	0.0053	0.18	0.02	0.012	--	<0.01	<0.005
DUP	1/21/98	2.1	--	--	<0.005	0.25	0.012	0.069	0.016	<0.005	<0.005	<0.005	0.071	<0.005	<0.01	0.0099	<0.005	0.074	<0.005	0.018	<0.005	<0.005	0.02	<0.01	<0.005	<0.005	--	0.012	0.0055	0.16	0.018	0.0099	--	<0.01	<0.005
	8/18/98	2.6	--	--	--	0.44	0.0086	0.02	0.013	<0.005	<0.005	<0.005	0.063	<0.005	<0.01	0.0063	<0.005	0.046	<0.005	0.0051	<0.005	<0.005	<0.005	0.011	<0.005	<0.005	--	0.016	<0.005	0.12	<0.005	<0.005	--	<0.01	<0.005
	7/19/99	2.8	--	--	<0.005	0.16	0.029	0.069	0.0546	<0.005	<0.005	<0.005	0.063	<0.005	<0.005	0.0093	<0.0025	0.061	<0.005	0.021	<0.05	<0.005	0.025	<0.050	0.005	<0.005	--	0.04	0.012	0.16	0.053	0.015	--	<0.0025	<0.005
MW-205	6/1/88	--	--	--	--	0.013	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	9/1/88	--	--	--	--	0.027	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/1/88	--	--	--	--	0.12	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	3/1/89	--	--	--	--	0.04	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	6/1/89	--	--	--	--	0.12	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	9/1/89	--	--	--	--	0.081	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/1/89	--	--	--	--	0.17	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	3/1/90	--	--	--	--	0.14	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	6/1/90	--	--	--	--	0.056	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	9/1/90	--	--	--	--	0.045	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/1/90	--	--	--	--	0.047	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	3/1/91	--	--	--	--	0.04	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	6/1/91	--	--	--	--	<0.005	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	9/1/91	--	--	--	--	0.043	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/1/91	--	--	--	--	0.085	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	3/1/92	--	--	--	--	0.035	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	6/1/92	--	--	--	--	0.006	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	9/1/92	--	--	--	--	0.005	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/1/92	--	--	--	--	0.01	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	3/1/93	--	--	--	--	<0.005	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	5/1/93	--	--	--	--	0.022	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	5/25/93	--	--	--	--	0.022	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	11/1/93	--	--	--	--	0.032	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/1/94	--	--	--	--	<0.005	<0.005	<0.005	<0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	3/1/95	--	--	--	--	<0.005	<0.005	<0.005	<0.015	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	9/1/95	--	--	--	--	0.0053	<0.002	<0.002	<0.002	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/13/95	2.1	--	<5	--	0.11	0.0013	0.018	0.037	--	--	--	0.051	--	--	0.0073	0.002	0.022	--	--	0.00058	--	--	--	--	--	--	0.0028	0.0053	0.08	--	--	--	--	--
	7/31/96	<0.1	--	--	<0.01	0.0051	<0.002	<0.002	<0.002	<0.0003	--	<0.0003	0.03	<0.0003	<0.0003	0.0028	<0.0003	0.014	<0.0003	--	<0.0003	--	--	--	--	--	--	0.0035	<0.0003	0.084	--	--	--	<0.0003	--
	12/16/96	0.27	--	--	0.002	<0.002	<0.002	<0.002	<0.004	<0.002	<0.002	<0.002	0.035	<0.002	<0.002	<0.002	<0.002	0.0071	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	--	<0.002	<0.002	0.045	<0.002	<0.002	--	<0.004	--

SEE NOTES ON PAGE 6

TABLE 4
SUMMARY OF HISTORICAL GROUNDWATER QUALITY RESULTS (MG/L)
CENCO REFINING COMPANY
SANTA FE SPRINGS, CALIFORNIA

Monitoring Well ID	Date	TPH-g	TPH-d	TRPH	MTBE	B	T	E	X	BDCM	BCM	Chloroform	c-1,2-DCE	1,2-DCB	Dichloro-difluoro methane	1,1-DCA	1,2-DCA	1,1-DCE	1,2-DCP	isoPB	MC	n-BB	n-PB	Napthalene	p-isoPT	sec-BB	Phenol	PCE	t-1,2-DCE	TCE	1,2,4-TMB	1,3,5-TMB	TOX	VC	CB
	1/20/98	0.19	--	--	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.027	<0.005	<0.01	<0.005	<0.005	0.0087	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	--	<0.005	<0.005	0.048	<0.005	<0.005	--	<0.01	<0.005
	8/21/98	0.017	--	--	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.032	<0.005	<0.01	<0.005	<0.005	0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	--	<0.005	<0.005	0.062	<0.005	<0.005	--	<0.01	<0.005
	1/26/99	0.22	--	--	<0.005	0.00687	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0261	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	--	<0.005	<0.005	0.0251	<0.005	<0.005	--	<0.01	<0.005
	7/19/99	<0.5	--	--	<0.001	0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.023	<0.001	<0.001	<0.001	<0.0005	0.0026	<0.001	<0.001	<0.01	<0.001	<0.001	<0.010	<0.001	<0.001	--	<0.001	0.0018	0.012	<0.001	<0.001	--	<0.0005	<0.001
OPERATIONAL AREA 5: LAKELAND PROPERTY																																			
MW-206 (ABANDONED)	6/1/88	--	--	--	--	5.8	2.4	2.1	4.9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	9/1/88	--	--	--	--	4.2	1	2	6.6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/1/88	--	--	--	--	4.3	0.92	2.1	5.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	3/1/89	--	--	--	--	2.7	3.2	2.4	12	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	6/1/89	--	--	--	--	3.1	1.2	2.3	8.6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	9/1/89	--	--	--	--	4.5	0.62	2.4	6.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/1/89	--	--	--	--	3.2	1	2	6.6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	3/1/90	--	--	--	--	3.7	1.7	2.6	9.4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	6/1/90	--	--	--	--	3.7	0.96	2	6.3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	9/1/90	--	--	--	--	5.1	2.1	2.3	6.8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/1/90	--	--	--	--	7.1	2.1	2.4	8.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	3/1/91	--	--	--	--	4.9	2.6	2.2	9.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	6/1/91	--	--	--	--	5.22	1.08	2.4	6.88	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	9/1/91	--	--	--	--	4.5	2.1	2	5.4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/1/91	--	--	--	--	3.4	0.72	2.5	4.74	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	3/1/92	--	--	--	--	2	0.47	2.5	4.87	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	6/1/92	--	--	--	--	3.2	0.42	2.1	2.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	9/1/92	--	--	--	--	9.9	1.4	3.2	7.3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/1/92	--	--	--	--	13	2	6	13	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/1/94	--	--	--	--	8.4	4.9	1.8	9.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	3/1/95	--	--	--	--	9	0.72	2	5.8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	9/1/95	--	--	--	--	6.2	0.8	1.6	3.6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/13/95	12	--	<5	--	0.11	0.016	0.032	0.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	7/31/96	33	--	--	0.51	0.57	0.11	0.42	0.49	<0.0003	--	<0.0003	0.02	<0.0003	<0.0003	0.0088	0.0058	0.022	<0.0003	--	<0.0003	--	--	--	--	--	--	<0.0003	<0.0003	0.0014	--	--	--	<0.0003	--
	12/18/96	8.2	--	--	<0.02	2.2	<0.1	1.2	0.34	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.12	0.13	<0.1	<0.1	--	<0.1	<0.1	<0.1	0.19	0.14	--	<0.2	--
	1/21/98	13	--	--	<0.005	1.5	0.29	1.6	0.78	<0.005	<0.005	<0.005	0.13	<0.005	<0.01	<0.005	<0.005	0.082	<0.005	0.085	<0.005	0.017	0.22	0.059	0.005	0.011	--	<0.005	<0.005	<0.005	0.035	0.012	--	<0.01	0.05
	8/20/98	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW-501 (DESTROYED)	3/1/95	--	--	--	--	4.2	0.23	1	2.7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	9/1/95	--	--	--	--	2.4	0.27	<0.2	<0.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/13/95	69	--	19.9	--	1.6	0.1	0.88	2.2	--	--	--	0.0085	--	--	0.0016	0.0032	0.001	0.0013	--	0.001	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	7/31/96	18	--	--	0.18	1.7	0.073	0.22	1.1	<0.0003	--	<0.0003	0.0072	<0.0003	<0.0003	0.00081	0.0013	<0.0003	0.001	--	<0.0003	--	--	--	--	--	--	<0.0003	<0.0003	0.00039	--	--	--	<0.0003	--
	12/18/96	6.8	--	--	<0.01	1.2	<0.05	0.51	0.65	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.092	<0.05	<0.05	0.2	<0.05	<0.05	<0.05	--	<0.05	<0.05	<0.05	0.31	0.13	--	<0.1	--
	1/21/98	0.95	--	--	<0.005	0.26	<0.005	0.011	0.023	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0061	<0.01	<0.005	<0.005	--	<0.005	<0.005	<0.005	0.0093	<0.005	--	<0.01	<0.005
	8/20/98	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	1/26/99	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW-501A	7/19/99	7.5	--	--	<0.025	1.3	<0.025	<0.025	0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.013	<0.013	<0.013	0.041	<0.25	<0.025	0.052	<0.25	<0.025	<0.025	--	<0.025	<0.025	<0.025	<0.025	<0.025	--	<0.013	<0.025
MW-502	6/1/88	--	--	--	--	0.95	0.079	0.062	0.016	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	9/1/88	--	--	--	--	1.3	0.18	2.8	12	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/1/88	--	--	--	--	6.5	0.86	1.5	5.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	3/1/89	--	--	--	--	5.3	1.2	1.9	7.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	9/1/94	--	--	--	--	9.8	0.86	1.9	3.3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/1/94	--	--	--	--	8.4	1.6	1.6	6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	3/1/95	--	--	--	--	18	0.48	2.1	7.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	9/1/95	--	--	--	--	15	0.69	3.3	8.8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/13/95	220	--	41.1	--	6.9	0.95	3.3	8.5	--	--	--	0.0069	--	--	0.00089	0.0061	--	--	0.0011	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	7/31/96	110	--	--	1	13	0.4	1.8	6.8	<0.0003	--	<0.0003	0.0068	<0.0003	<0.0003	<0.0003	0.012	0.00076	<0.0003	--	<0.0003	--	--	--	--	--	--	<0.0003	<0.0003	0.00052	--	--	--	<0.0003	--
	12/18/96	30	--	--	<0.01	11	<0.5	2.1	0.57	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	--	<0.5	<0.5	<0.5	<0.5	<0.5	--	<1	--
	1/22/98	24	--	--	70	7.8	0.13	1.3	0.921	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	0.09	<0.025	<0.025	0.18	0.32	<0.025	<0.025	--	<0.025	<0.025	<0.025	0.3	0.07	--	<0.05	<0.025
	8/19/98	86	--	--	290	12	0.1	1.4	0.953	<0.005	<0.005	<0.005	0.01	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	0.067	<0.005	0.016	0.14	0.28	<0.005	0.01	--	<0.005	<0.005	<0.005	0.34	0.06	--	<0.01	<0.005
	1/26/99	120	--	--	119	8.8	0.0804	1.03	0.554	<0.005	<0.005	<0.005	0.0104	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	0.0767	<0.005	<0.005	0.135	0.255	<0.005	0.0151	--	<0.005	<0.005	<0.005	0.179	0.0471	--	<0.01	<0.005
	7/19/99	48	--	--	92	11	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<2.5	<5	<5	<5	<50	<5	<5	<50	<5	<5	--	<5	<5	<5	<5	<5	--	<2.5	<5
MW-503 (ABANDONED)	6/1/88	--	--	--	--	0.6	0.14	0.34	0.6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	9/1/88	--	--	--	--	0.8	0.28	0.3	0.91	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/1/88	--	--	--	--	1.5	0.57	0.38	0.96	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	3/1/89	--	--	--	--	0.4	0.19	0.36	0.75	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	6/1/89	--	--	--	--	0.6	0.34	0.63	1.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	9/1/89	--	--	--	--	0.99	0.55	0.2	0.85	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/1/89	--	--	--	--	0.27	0.18	0.18	0.56	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	3/1/90	--	--	--	--	0.31	0.14	0.14	0.28	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	6/1/90	--	--	--	--	0.034	0.024	0.11	0.19	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	9/1/90	--	--	--	--	0.17	0.11	0.14	0.27	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/1/90	--	--	--	--	2.1	1.3	0.1	2.3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	3/1/91	--	--	--	--	0.9	0.65	0.25	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	6/1/91	--	--	--	--	1.04	0.7	0.33	1.23	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/1/92	--	--	--	--	3.3	0.75	0.34	1.58	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	3/1/93	--	--	--	--	2.9	0.4	<0.25	1.88	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/1/94	--	--	--	--	0.24	0.022	0.066	0.079	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	3/1/95	--	--	--	--	0.39	0.055	0.1	0.19	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	9/1/95	--	--	--	--	0.53	0.093	0.13	0.18	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/13/95	8.2	--	<5	--	0.34	0.079	0.19	0.2	--	--	--	0.038	--	--	0.015	0.0065	0.12	0.00072	--	0.001	--	--	--	--	--	--	--	0.0012	0.085	--	--	--	0.0014	--
	7/31/96	5.1	--	--	<0.01	0.15	0.049	0.025	0.084	<0.0003	--	<0.0003	0.036	<0.0003	<0.0003	0.015	0.0031	0.15	<0.0003	--	<0.0003	--	--	--	--	--	--	0.09	<0.0003	0.15	--	--	--	<0.0003	--
	12/18/96	4.6	--	--	<0.02	0.21	0.019	0.14	0.056	<0.01	<0.01	<0.01	0.04	<0.01	<0.01	<0.01	<0.01	0.32	<0.01	0.044	<0.01	<0.01	0.048	0.028	<0.01	0.012	--	0.014	<0.01	0.27	0.063	0.023	--	<0.02	--
	1/21/98	3.1	--	--	<0.005	0.21	0.031	0.28	0.063	<0.005	<0.005	<0.005	0.067	<0.005	<0.01	0.0096	<0.005	0.21	<0.005	0.053	<0.005	0.006	0.068	0.017	<0.005	0.012	--	<0.005	0.027	0.46	0.0058	0.014	--	<0.01	<0.005
	8/19/98	0.96	--	--	--	0.072	0.0079	0.053	0.0076	<0.005	<0.005	<0.005	0.041	<0.005	<0.01	<0.005	<0.005	0.037	<0.005	0.011	<0.005	<0.005	0.014	0.0053	<0.005	<0.005	--	<0.005	0.071	0.063	0.005	<0.005	--	<0.01	<0.005
MW-503B	2/9/99	10	--	--	--	0.97	<0.05	0.42	<0.05	<0.05	<0.05	<0.05	0.11	<0.05	<0.1	<0.05	<0.05	0.061	<0.05	0.05	<0.05	<0.05	0.084	<0.05	<0.05	<0.05	--	<0.05	0.15	<0.05	<0.05	<0.05	--	<0.1	<0.05
	7/19/99	7.8	--	--	<0.02	0.63	<0.02	0.54	<0.02	<0.02	<0.02	<0.02	0.18	<0.02	<0.02	<0.02	<0.01	0.083	<0.02	0.073	<0.2	<0.02	0.13	<0.2	<0.02	0.02	--	<0.02	0.25	0.025	<0.02	<0.02	--	<0.01	<0.02

SEE NOTES ON PAGE 6

TABLE 4
SUMMARY OF HISTORICAL GROUNDWATER QUALITY RESULTS (MG/L)
CENCO REFINING COMPANY
SANTA FE SPRINGS, CALIFORNIA

Monitoring Well ID	Date	TPH-g	TPH-d	TRPH	MTBE	B	T	E	X	BDCM	BCM	Chloroform	c-1,2-DCE	1,2-DCE	Dichloro-difluoro methane	1,1-DCA	1,2-DCA	1,1-DCE	1,2-DCP	isoPB	MC	n-BB	n-PB	Napthalene	p-isoPT	sec-BB	Phenol	PCE	t-1,2-DCE	TCE	1,2,4-TMB	1,3,5-TMB	TOX	VC	CB
OPERATIONAL AREA 6: FORMER AST AREA AT WALKER PROPERTY																																			
W-3	11/1/89	--	<1	--	--	0.019	0.0026	0.0076	0.013	<0.0005	<0.0005	<0.0005	--	--	--	0.0025(A)	<0.0005	<0.0005	<0.0005	--	<0.0005	--	--	--	--	--	--	<0.0005	<0.0005	<0.0005	--	--	--	0.0071(A)	<0.0005
(ABANDONED)	1/1/90	--	--	--	--	<0.0005	<0.0005	<0.0005	0.0033	<0.001	<0.001	<0.0005	--	<0.002	<0.002	0.001	<0.0005	<0.0005	<0.0005	--	<0.002	--	--	--	--	--	--	<0.0005	<0.001	<0.0005	--	--	--	<0.002	<0.001
	3/1/90	--	--	--	--	0.0053	0.0045	<0.0005	<0.002	<0.001	<0.001	<0.0005	--	<0.002	<0.002	0.0005	<0.0005	<0.0005	<0.0005	--	<0.002	--	--	--	--	--	--	<0.0005	<0.001	<0.0005	--	--	--	<0.002	<0.001
	4/1/90*	--	--	--	--	0.0034	0.0045	<0.001	<0.001	<0.001	<0.001	<0.0005	<0.005	<0.002	<0.002	<0.0005	<0.0005	<0.0005	<0.0005	--	<0.002	--	--	--	--	--	--	<0.0005	<0.001	<0.0005	--	--	--	<0.002	<0.001
	12/18/96	1.3	--	--	<0.01	0.59	<0.025	<0.025	<0.05	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	--	<0.025	<0.025	<0.025	<0.025	<0.025	--	<0.05	--
	1/13/98	2.2	--	--	<0.005	0.28	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	0.006	<0.005	<0.005	<0.005	0.027	<0.005	<0.005	0.016	<0.01	<0.005	0.006	--	<0.005	<0.005	<0.005	<0.005	<0.005	--	0.051	<0.005
	8/20/98	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
W-3A	1/13/98	4300	--	--	<200	150	<6	35	<12	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	8/20/98	1.1	--	--	0.44	0.22	<0.025	0.033	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.05	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	0.35	<0.025	<0.025	--	<0.025	<0.025	<0.025	<0.025	<0.025	--	<0.05	<0.025
	1/28/99	0.69	--	--	0.34	0.16	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.24	<0.05	<0.05	--	<0.05	<0.05	<0.05	<0.05	<0.05	--	<0.1	<0.05
	7/19/99	5.4	--	--	0.38	0.12	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.01	<0.02	<0.02	0.021	<0.2	0.025	0.026	<0.2	<0.02	<0.02	--	<0.02	<0.02	<0.02	0.037	<0.02	--	<0.01	<0.02
OFF-SITE WELLS: WALKER PROPERTY																																			
W-1	11/1/89	--	<1	3.6	--	0.39	0.0039	0.0021	0.0064	<0.0005	<0.0006	<0.0005(A)	--	--	--	0.0035(A)	<0.0005(A)	0.0006(A)	<0.0005(A)	--	<0.0005(A)	--	--	--	--	--	--	<0.0005(A)	<0.0005(A)	<0.0005(A)	--	--	--	0.021	<0.0005
	3/1/90	--	--	--	--	0.14	<0.005	<0.005	<0.02	<0.01	<0.01	<0.005	--	<0.020	<0.020	<0.005	<0.005	<0.005	<0.005	--	<0.02	--	--	--	--	--	--	<0.005	<0.01	<0.005	--	--	--	<0.02	<0.01
	4/1/90*	--	--	--	--	0.2	0.012	0.012	0.0027	<0.005	<0.005	<0.005	<0.025	<0.020	<0.020	0.0016	<0.005	<0.005	<0.005	--	<0.005	--	--	--	--	--	--	<0.005	<0.005	<0.005	--	--	--	<0.005	<0.005
	12/18/96	0.8	--	--	<0.01	0.078	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.027	<0.005	<0.005	0.031	0.01	<0.005	<0.005	--	<0.005	<0.005	<0.005	<0.005	<0.005	--	<0.01	--
	1/14/98	1.1	--	--	<0.005	0.062	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	0.019	<0.005	<0.005	0.02	<0.01	<0.005	<0.005	--	<0.005	<0.005	<0.005	<0.005	<0.005	--	0.016	<0.005
	8/20/98	1.2	--	--	0.014	0.079	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0086	<0.005	<0.01	0.0084	<0.005	<0.005	<0.005	0.027	<0.005	<0.005	0.03	<0.01	<0.005	0.005	--	<0.005	<0.005	<0.005	<0.005	<0.005	--	0.026	<0.005
	1/29/99	1.4	--	--	<0.005	0.057	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	0.024	<0.005	<0.005	0.028	<0.01	<0.005	<0.005	--	<0.005	<0.005	<0.005	<0.005	<0.005	--	0.018	<0.005
	7/19/99	1.5	--	--	<0.002	0.048	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.001	<0.002	<0.002	0.019	<0.020	0.0027	0.023	<0.02	<0.002	0.0044	--	<0.002	<0.002	<0.002	<0.002	<0.002	--	<0.001	<0.002
																											--						--		
W-2	11/1/89	--	<1	--	--	0.078	0.0065	0.0065	0.005	<0.0005	<0.0005	<0.0005(A)	--	--	--	0.0043(A)	<0.0005(A)	<0.0005(A)	<0.0005(A)	--	<0.0005(A)	--	--	--	--	--	--	<0.0005(A)	<0.0005(A)	<0.0005(A)	--	--	--	0.075(A)	<0.0005
(ABANDONED)	3/1/90	--	--	--	--	0.062	<0.0005	<0.0005	<0.002	<0.001	<0.001	<0.0005	--	<0.002	<0.002	<0.0005	<0.0005	<0.0005	<0.0005	--	<0.002	--	--	--	--	--	--	<0.0005	<0.001	<0.0005	--	--	--	<0.002	<0.001
	4/1/90*	--	--	--	--	0.083	0.026	0.004	0.0015	<0.005	<0.005	<0.0025	0.013	<0.001	<0.01	0.003	<0.0025	<0.0025	<0.0025	--	<0.005	--	--	--	--	--	--	<0.0025	<0.005	<0.0025	--	--	--	0.0059	<0.001
	12/18/96	0.56	--	--	<0.002	0.056	<0.002	<0.002	<0.004	<0.002	<0.002	<0.002	0.013	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.018	<0.002	<0.002	0.012	<0.002	<0.002	<0.002	--	<0.002	<0.002	<0.002	<0.002	<0.002	--	0.011	--
	1/14/98	0.7	--	--	<0.005	0.085	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.017	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	0.015	<0.005	<0.005	0.006	<0.01	<0.005	<0.005	--	<0.005	<0.005	<0.005	<0.005	<0.005	--	0.027	<0.005
	8/20/98	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
W-4	3/1/90*	--	--	--	--	0.12	<0.0005	0.019	<0.0005	<0.0005	<0.0005	<0.0005	0.0032	<0.0005	<0.0005	0.0083	<0.0005	<0.0005	<0.0005	--	<0.0005	--	--	--	--	--	--	<0.0005	<0.0005	<0.0005	--	--	--	<0.0005	<0.0005
	4/1/90*	--	--	--	--	0.028	0.0014	0.0048	0.0022	<0.001	<0.001	<0.001	0.00081	<0.001	<0.0005	0.0022	<0.001	<0.001	<0.001	--	<0.002	--	--	--	--	--	--	<0.001	<0.001	<0.001	--	--	--	0.0043	<0.001
	12/18/96	0.42	--	--	<0.01	0.08	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.019	<0.005	<0.005	0.018	<0.005	<0.005	<0.005	--	<0.005	<0.005	<0.005	<0.005	<0.005	--	<0.01	--
	1/14/98	0.92	--	--	<0.005	0.12	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	0.028	<0.005	<0.005	0.027	<0.01	<0.005	<0.005	--	<0.005	<0.005	<0.005	<0.005	<0.005	--	0.016	<0.005
	8/20/98	0.5	--	--	0.018	0.057	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	0.026	<0.005	<0.005	0.025	<0.01	<0.005	<0.005	--	<0.005	<0.005	<0.005	<0.005	<0.005	--	0.0098	<0.005
	1/29/99	0.46	--	--	0.02	0.055	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	0.018	<0.005	<0.005	0.016	<0.01	<0.005	<0.005	--	<0.005	<0.005	<0.005	<0.005	<0.005	--	0.011	<0.005
	7/19/99	0.71	--	--	<0.002	0.072	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.001	<0.002	<0.002	0.014	<0.02	<0.002	0.015	<0.02	<0.002	0.0027	--	<0.002	<0.002	<0.002	<0.002	<0.002	--	<0.001	<0.002
EW-1	11/1/89	9.8	--	--	--	0.73	0.016	1.4(A)	1(A)	<0.005	<0.005	<0.005	--	--	--	<0.005	<0.005	<0.005	<0.005	--	<0.005	--	--	--	--	--	--	<0.005	0.0098	<0.005	--	--	--	0.029	<0.005
	3/1/90	--	--	--	--	1.8	0.3	1.8	0.62	<0.05	<0.05	<0.025	--	<0.1	<0.1	<0.025	<0.025	<0.025	<0.025	--	<0.1	--	--	--	--	--	--	<0.025	<0.05	<0.025	--	--	--	<0.1	<0.05
	4/1/90*	--	--	--	--	1.3	0.29	1.6	2	<0.02	<0.02	<0.02	0.011	<0.002	<0.02	<0.01	<0.01	<0.01	<0.01	--	<0.005	--	--	--	--	--	--	<0.001	0.02	<0.01	--	--	--	<0.02	<0.01
	8/21/98	5	--	--	<0.05	0.23	<0.05	0.63	0.17	<0.05	<0.05	<0.05	<0.05	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	0.2	<0.05	<0.05	0.17	0.15	<0.05	<0.05	--	<0.05	<0.05	<0.05	<0.05	<0.05	--	<0.1	<0.05
	1/28/99	7.9	--	--	<0.05	0.11	<0.05	0.54	0.17	<0.05	<0.05	<0.05	<0.05	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	0.17	<0.05	<0.05	0.15	0.13	<0.05	<0.05	--	<0.05	<0.05	<0.05	<0.05	<0.05	--	<0.1	<0.05
	7/19/99	8	--	--	<0.025	0.11	<0.025	1	0.34	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.013	<0.025	<0.025	0.2	<0.25	<0.025	0.16	<0.25	<0.025	<0.025	--	<0.025	<0.025	<0.025	<0.025	0.025	--	<0.013	<0.025
OFF-SITE WELLS: METROPOLITAN STATE HOSPITAL																																			
MW-600	8/1/90	380	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
(ABANDONED)	2/20/91	0.0502	--	--	--	18	9.2	1.3	9.9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/13/95	3500	--	912	--	23	40	18	101	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	8/1/96	210	--	--	<0.01	14	15	3.5	20	<0.001	--	<0.001	0.0038	<0.001	<0.001	0.00036	0.0055	<0.001	<0.001	--	<0.001	--	--	--	--	--	--	<0.001	<0.001	0.00053	--	--	--	<0.001	--
	12/19/96	87	--	--	<0.01	14	15	1.8	9.1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	--	<0.5	<0.5	<0.5	1.8	0.58	--	<1	--
	1/22/98	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	8/20/98	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	1/28/99	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW-600A	7/19/99	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW-601	8/1/90	360	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
(ABANDONED)	2/20/91	0.024	--	--	--	12	4.9	1.9	11.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/13/95	3500	--	1110	--	18	17	130	100	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	8/1/96	250	--	--	<0.01	12	1.4	4.6	16	<0.001	--	<0.001	0.0044	<0.001	<0.001	0.0014	0.0029	<0.001	0.00085	--	<0.001	--	--	--	--	--	--	<0.001	<0.001	0.00051	--	--	--	0.0019	--
	12/19/96	70	--	--	<0.01	10	<0.5	1.6	4	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	--	<0.5	<0.5	<0.5	1.1	<0.5	--	<1	--
	1/22/98	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	8/20/98	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	1/28/99	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW-601A	7/19/99	42	--	--	11	18	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<2.5	<5	<5	<5	<50	<5	<5	<50	<5	<5	--	<5	<5	<5	<5	<5	--	<2.5	<5
MW-603	12/1/95	<0.5	--	<10	--	0.00098	0.0014	0.00062	0.0033	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	7/30/96	<0.1	--	--	0.002	0.0006	<0.0005	0.0014	<0.0005	0.0026	--	<0.0003	0.0064	<0.0003	<0.0003	0.0039	0.0095	0.03	<0.0003	--	<0.0003	--	--	--	--	--	--	0.053	<0.003	0.056	--	--	--	0.00045	--
	12/16/96	<0.1	--	--	<0.002	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.034	<0.005	<0.005	0.006	<0.005	<0.005	<0.005	<0.005	<0.005	--	0.037	<0.005	0.056	<0.005	<0.005	--	<0.01	--
	1/22/98	<0.1	--	--	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.009	<0.005	<0.01	0.005	<0.005	0.063	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	--	0.059	<0.005	0.089	<0.005	<0.005	--	<0.01	<0.005
	8/19/98	<0.1	--	--	--	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	0.029	0.014	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	--	0.013	<0.005	0.031	<0.005	<0.005	--	<0.01	<0.005
	1/27/99	<0.1	--	--	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0053	<0.005	<0.01	<0.005	0.039	0.019	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	--	0.025	<0.005	0.042	<0.005	<0.005	--	<0.01	<0.005
	7/19/99	<0.5	--	--	<0.001	<0.0005	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0074	0.0021	<0.001	0.003	0.04	0.031	<0.001	<0.001	<0.01	<0.01	<0.001	<0.01	<0.001	<0.001	--	0.037	<0.001	0.062	<0.001	<0.001	--	<0.0005	<0.001
MW-604	12/20/95	1.9	--	<10	--	0.16	0.0033	0.0078	0.021	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	7/30/96	0.9	--	--	0.0124	0.073	0.0078	<0.0005	0.009	<0.0003	--	<0.0003	0.00098	<0.0003	<0.0003	0.0017	0.0011	<0.0003	<0.0003	--	<0.0003	--	--	--	--	--	--	<0.0003	<0.0003	<0.0003	--	--	--	<0.0003	--
	12/17/96	0.71	--	--	<0.002	0.047	<0.002	<0.002	<0.004	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.0057	<0.002	<0.002	0.0036	<0.002	<0.002	0.0022	--	<0.0020	<0.002	<0.002	<0.002	<0.002	--	<0.004	--
	1/22/98	0.41	--	--	<0.005	0.007	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	0.007	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	--	<0.005	<0.005	<0.005	<0.005	<0.005	--	<0.01	--
	8/19/98	0.37	--	--	--	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	--	<0.005	<0.005	<0.005	<0.005	<0.005	--	<0.01	<0.005
	1/27/99	0.23	--	--	<0.005	0.025	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	0.0064	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	--	<0.005	<0.005	<0.005	<0.005	<0.005	--	<0.01	<0.005
	7/19/99	0.5	--	--	<0.001	0.014	<0.001	<0.001	0.0013	<0.001	<0.001	<0.001	0.0042	<0.001	<0.001	<0.001	<0.0005	<0.001	<0.001	0.0049	<0.01	<0.001	0.0013	<0.01	<0.001	0.0026	--	<0.001	<0.001	<0.001	<0.001	<0.001	--	<0.0005	<0.001
MW-605	12/20/95	<1.0	--	--	--	0.01	<0.0005	<0.0005	0.0049	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

SEE NOTES ON PAGE 6

TABLE 4
SUMMARY OF HISTORICAL GROUNDWATER QUALITY RESULTS (MG/L)
CENCO REFINING COMPANY
SANTA FE SPRINGS, CALIFORNIA

Monitoring Well ID	Date	TPH-g	TPH-d	TRPH	MTBE	B	T	E	X	BDCM	BCM	Chloroform	c-1,2-DCE	1,2-DCB	Dichloro-difluoro methane	1,1-DCA	1,2-DCA	1,1-DCE	1,2-DCP	isoPB	MC	n-BB	n-PB	Napthalene	p-isoPT	sec-BB	Phenol	PCE	t-1,2-DCE	TCE	1,2,4-TMB	1,3,5-TMB	TOX	VC	CB
	7/31/96	<0.1	--	--	<0.02	<0.0005	<0.0005	<0.0005	<0.0005	<0.0003	--	<0.0003	<0.0003	<0.0003	<0.0003	0.0012	<0.0003	0.0043	<0.0003	--	<0.0003	--	--	--	--	--	--	0.013	<0.0003	0.018	--	--	--	<0.0003	--
	12/16/96	<0.1	--	--	<0.002	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	--	0.011	<0.001	2	<0.001	<0.001	--	<0.002	--
	1/22/98	<0.1	--	--	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	0.006	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	--	0.014	<0.005	0.032	<0.005	<0.005	--	<0.01	<0.005
	8/19/98	<0.1	--	--	--	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	--	<0.005	<0.005	<0.005	<0.005	<0.005	--	<0.01	<0.005
	1/28/99	<0.1	--	--	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	--	<0.005	<0.005	<0.005	<0.005	<0.005	--	<0.01	<0.005
	7/19/99	<0.5	--	--	<0.001	<0.0005	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.0005	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.01	<0.001	<0.001	--	0.0016	0.0032	<0.001	<0.001	<0.001	--	<0.0005	<0.001
MW-606	12/19/95	<0.5	--	--	--	<0.0005	<0.0005	<0.0005	<0.0005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	7/31/96	<0.1	--	--	<0.02	<0.0005	<0.0005	<0.0005	<0.0005	0.00036	--	0.00054	<0.0003	<0.0003	<0.0003	<0.0003	0.00096	<0.0003	<0.0003	--	<0.0003	--	--	--	--	--	--	<0.0003	<0.0003	<0.0003	--	--	--	<0.0003	--
	12/16/96	<0.1	--	--	<0.002	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	--	<0.001	<0.001	<0.001	<0.001	<0.001	--	<0.002	--
	1/22/98	<0.1	--	--	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	--	<0.005	<0.005	<0.005	<0.005	<0.005	--	<0.01	<0.005
	8/19/98	0.17	--	--	--	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	--	<0.005	<0.005	<0.005	<0.005	<0.005	--	<0.01	<0.005
	1/28/99	<0.1	--	--	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	--	<0.005	<0.005	<0.005	<0.005	<0.005	--	<0.01	<0.005
	7/19/99	<0.5	--	--	<0.001	<0.0005	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.0005	<0.001	<0.001	<0.001	<0.010	<0.001	<0.001	<0.01	<0.001	<0.001	--	<0.001	<0.001	<0.001	<0.001	<0.001	--	<0.0005	<0.001
MW-607	12/19/95	1.2	--	31	--	0.033	0.035	0.0017	0.0094	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	7/31/96	0.9	--	--	0.012	0.019	0.005	0.0028	0.008	<0.0003	--	<0.0003	<0.0003	<0.0003	<0.0003	0.00068	<0.0003	<0.0003	<0.0003	--	<0.0003	--	--	--	--	--	--	<0.0003	<0.0003	<0.0003	--	--	--	0.0011	--
	12/17/96	1	--	--	<0.002	0.021	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.018	<0.001	0.0033	0.027	0.002	<0.001	0.0036	--	<0.001	<0.001	<0.001	<0.001	0.0017	--	<0.002	--
	1/22/98	1.2	--	--	0.4	0.22	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.05	<0.025	0.22	<0.025	<0.025	<0.025	<0.025	<0.025	0.029	<0.05	<0.025	<0.025	--	<0.025	<0.025	<0.025	<0.025	<0.025	--	<0.05	<0.025
	8/19/98	0.26	--	--	0.012	0.017	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	--	<0.005	<0.005	<0.005	<0.005	<0.005	--	<0.01	<0.005
	1/27/99	1.76	--	--	0.0062	0.22	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	0.015	<0.005	<0.005	0.025	<0.01	<0.005	<0.005	--	<0.005	<0.005	<0.005	<0.005	<0.005	--	<0.01	<0.005
	7/19/99	1.2	--	--	<0.005	0.26	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0025	<0.005	<0.005	0.013	<0.05	0.0055	0.02	<0.05	<0.005	0.0052	--	<0.005	<0.005	<0.005	<0.005	<0.005	--	<0.0025	<0.005
MW-A (ABANDONED)	2/20/91	0.0498	--	--	--	17	14	1.8	12.5	--	--	--	--	<0.25	--	--	--	--	--	--	--	--	--	--	--	--		--	--	--	--	--	--	--	<0.25
MW-B (ABANDONED)	2/25/91	<1	--	--	--	3.5	0.03	0.18	0.467	--	--	--	--	<0.0005	--	--	--	--	--	--	--	--	--	--	--	--		--	--	--	--	--	--	--	<0.0005
MW-1 (ABANDONED)	2/19/91	11	--	--	--	9.2	2.4	1.5	8.7	--	--	--	--	<0.05	--	--	--	--	--	--	--	--	--	--	--	--		--	--	--	--	--	--	--	<0.05
MW-C (ABANDONED)	3/31/95	0.06	--	--	--	0.0006	0.014	<0.0005	0.0027	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		--	--	--	--	--	--	--	--
	7/11/95	<0.05	--	--	--	<0.0003	<0.0003	<0.0003	<0.0006	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		--	--	--	--	--	--	--	--
	10/5/95	<0.5	--	--	--	<0.0003	<0.0003	<0.0003	<0.0006	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		--	--	--	--	--	--	--	--
	12/8/95	<0.5	--	--	--	<0.0003	<0.0003	<0.0003	<0.0006	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	3/7/96	<0.5	--	--	--	<0.0005	<0.0005	<0.0005	<0.0015	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	6/17/96	<0.5	--	--	<0.02	<0.0005	<0.0005	<0.0005	<0.0015	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-D (ABANDONED)	3/31/95	<0.05	--	--	--	<0.0005	0.0066	<0.0005	0.0016	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	7/11/95	<0.05	--	--	--	<0.0003	<0.0003	<0.0003	<0.0006	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	10/5/95	<0.5	--	--	--	<0.0003	<0.0003	<0.0003	<0.0006	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/8/95	<0.5	--	--	--	<0.0003	<0.0003	<0.0003	<0.0006	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	3/7/96	<0.5	--	--	--	<0.0005	<0.0005	<0.0005	<0.0015	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	6/17/96	<0.5	--	--	<0.02	<0.0005	<0.0005	<0.0005	<0.0015	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-E (ABANDONED)	3/31/95	0.06	--	--	--	0.0091	0.0066	0.0011	0.0023	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	7/11/95	<0.05	--	--	--	<0.0003	<0.0003	<0.0003	<0.0006	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	10/5/95	<0.5	--	--	--	<0.0003	<0.0003	<0.0003	<0.0006	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/8/95	<0.5	--	--	--	<0.0003	<0.0003	<0.0003	<0.0006	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	3/7/96	<0.5	--	--	--	<0.0005	<0.0005	<0.0005	<0.0015	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	6/17/96	<0.5	--	--	<0.02	<0.0005	<0.0005	<0.0005	<0.0015	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

NOTES:
All concentrations reported in milligrams per liter (mg/L)
-- = Not analyzed
<0.001 = Not detected above laboratory the shown reporting limit.
* = Sample was analyzed by both EPA Methods 8010/8020 and 8240; highest detection value of the two analyses is shown
NS: Not sampled due to well damage, free product in well, or not scheduled for sampling.
(A) = EPA Method 601/8010
(B) = EPA Method 602/8020

Abbreviation:
TPH-g = Total Petroleum Hydrocarbons as Gasoline (Method 8020)
TPH-d = Total Petroleum Hydrocarbons as Diesel (Method 8015)
TRPH = ASTM Method 2887 (unless otherwise indicated)
MTBE = Methyl tertiary butyl ether
B= Benzene
T= Toluene
E= Ethylbenzene
X= Total xylenes
BDCM= Bromodichloromerhane
BCM= Bromochloromethane
c-1,2-DCE = cis-1,2-dichloroethene
CB= Chlorobenzene
1,2-DCB= 1,2 dichlorobenzene
1,1-DCA = 1,1- dichloroethane
1,2-DCA = 1,2-dichloroethane
1,1-DCE = 1,1-dichloroethene
1,2-DCP= 1,2-dichloropropane
iso-PB= iso-propylbenzene
MC= Methylene chloride
n-BB= n-Butylbenzene
n-PB= n-Propylbenzene
p-iso-PT= p-iso-Propyltoluene
sec-BB= sec-Butylbenzene
PCE = tetrachloroethene
t-1,2-DCE = trans-1,2-dichloroethene
TCE = trichloroethene
1,2,4-TMB= 1,2,4-Trimethylbenzene
1,3,5-TMB= 1,3,5-Trimethylbenzene
TOX = Total Halogenated Volatile Organics (ASTM Method 2885)
VC = Vinyl chloride

SEE NOTES ON PAGE 6

TABLE 5
SUMMARY OF INTRINSIC BIOREMEDIATION PARAMETER RESULTS
CENCO REFINING COMPANY
SANTA FE SPRINGS, CALIFORNIA

Monitoring Well ID	Sampling Date	Total Heterotrophic Bacteria (cfu/ml)	*Psuedomonas* Bacteria (MPN/100)	Ferrous Iron (mg/L)	Alkalinity (mg/L)	Nitrate (mg/L)	Sulfate (mg/L)
MW-104	7/22/99	520	ND	0.2	851	<0.050	45
MW-205	7/22/99	100	ND	0.5	648	<0.050	249
MW-502	7/23/99	28,000	ND	5.5	808	<0.050	<2
MW-605	7/20/99	40	ND	<.1	467	4.13	177
MW-606	7/20/99	72	ND	<.1	400	7.94	200
EW1	7/22/99	1,800	ND	0.2	731	<0.050	<2

Notes:

cfu/ml = colony forming units per milliliter

MPN/100 = Most Probable Number of bacteria per 100 milliliters of sample

mg/L = milligrams per liter

ND = Psuedomonas Bacteria were Not Detected

TABLE 6
ANALYTICAL RESULTS FOR LEAD IN SOIL IN THE TANK 10006 AND TANK 20092 AREAS
CENCO REFINING COMPANY
SANTE FE SPRINGS, CALIFORNIA

Sample Identification	Sample Date	Depth (feet bgs)	Sample Location	Total Lead Concentration [a,b] (mg/kg)	Soluble Lead Concentration [c,d] (mg/L)
Tank 20092 Area					
POC-6-128A[e]	1/28/98	0 - 0-5	In berm to the west of S2 and northwest of Tank 20092	NA	5.3[f]
POC-6-128B[e]	1/28/98	0 - 0-5		140	3.2
Asphalt-4-045	10/1/98	0 - 0-5	South of Tank 20092	80	0.86
Asphalt-5-092	10/1/98	0 - 0-5	East of S2	180	6.1[f]
Tank 10006 Area					
POC-7-128A[e]	1/28/98	0 - 0-5	Adjacent to eastside of Tank 10006	NA	27[f]
POC-7-128B[e]	1/28/98	0 - 0-5		360	12[f]
Asphalt-1-006	10/1/98	0.7		72	5.7[f]
Other Sample Locations					
Asphalt-2-046	10/1/98	0 - 0-5	Southeast of Tank 10046	72	2.52
Asphalt-3-091	10/1/98	0 - 0-5	Southwest of Tank 20091	54	0.72

bgs = below ground surface; mg/kg = milligrams per kilogram; mg/L = miligrams per liter; NA = not analyzed.

[a]Total Threshold Limit Concentration (TTLC) for led is 1,000 mg/kg.

[b]Total lead concentrations were measured using EPA method 6010.

[c]Soluble Threshold Limit Concentration (STLC) for lead is 5 mg/L.

[d]Soluble lead concentrations were measured using the California Waste Extraction Test (WET).

[e]Sample collected and analyzed by the California Department of Toxic Substances Control (DTSC).

[f]Soluble lead concentration is greater thant STLC.

APPENDIX A

RWQCB CLEANUP AND ABATEMENT ORDER 97-118

State of California
CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
LOS ANGELES REGION

CLEANUP AND ABATEMENT ORDER NO. 97-118

REQUIRING POWERINE OIL COMPANY
TO CLEANUP AND ABATE THE EFFECTS OF UNCONTROLLED RELEASES OF
PETROLEUM HYDROCARBONS
TO SOIL AND GROUND WATER

(File No. 85-18)

The California Regional Water Quality Control Board, Los Angeles Region, finds:

1. The Powerine Oil Company, a California corporation, (hereafter referred to as the Discharger), operates a 88 acre Refinery, located at 12345 Lakeland Road. The refinery includes the Bloomfield Property, located at 10820 Bloomfield Avenue, and interconnecting pipelines from the refinery to its former Marine Terminal located at Berth 73 Port of Long Beach. The Powerine Oil Company is currently owned by Energy Merchant Corporation.

2. The refinery site has been used for refining purposes since 1936. The refinery processes raw materials, including crude oil, raw naphtha to produce petroleum products. The components 1,2-dichloroethane and tetrachloroethene were used at the site and stored near the refinery laboratory in above ground tanks. Tetrachlorethene may have been used at the site as a catalyst activator and 1,2-dichloroethane may have been used as a lead scavenger. The main products produced by the refinery are transportation fuels, including kerosene, jet A fuel, unleaded gasoline, high and low sulfur diesel, fuel oil, and petroleum coke. The refinery also produces refinery gas and hydrogen, which are consumed internally by the refinery. In addition, the refinery produces revenue generating non-fuel by-products such as sulfur and carbon dioxide.

3. From 1968 to March 1986, the Discharger leased a small portion of the Walker property, located at 11240 Bloomfield Avenue, Santa Fe Springs, as a terminalling facility for storage and transferring of asphalt, jet fuel, gas oil, fuel oil, butane, carbon dioxide, and liquified petroleum gas. The two large tanks existed at the site as early as 1945, prior to Powerine use of the tanks.

4. In March 1984, Powerine sought Chapter 11 bankruptcy protection and shut down the refinery. In September, 1986, Powerine Oil Company emerged from bankruptcy. The refinery operated from 1986 until 1995 undergoing a series of ownership changes that ultimately resulted in a July, 1995 shutdown of their 49,500 barrel per day refining process and layoff of most of their 400 employees. During this time, Order No. 85-17 was adopted by this Regional Board directing Powerine Oil Company to conduct a subsurface investigation of their Refinery and to detect and assess any conditions of soil and ground water pollution which may be present. This Order provides that additional Orders shall be issued to correct any condition of pollution found. In response to this Order, the Discharger: Investigated the extent of ground water contamination originating from the

refinery and initiated some soil cleanup and operation of a free-phase petroleum hydrocarbon product removal system. In 1991, free-phase hydrocarbon removal was suspended due to the unrecoverability of the remaining free-phase petroleum hydrocarbon on the ground water. Little free-phase petroleum hydrocarbon contamination remains but extensive dissolved-phase contamination remain on-site and off-site, including under the State Hospital to the south. In early 1996 the Energy Merchant Corporation acquired Powerine with the intent of restarting the refinery and reestablishing Powerine in the petroleum refining business. Powerine stated that the sale of its former administrative building and terminalling facility property located at 12354 Lakeland Road, is key to the financing of the proposed refinery start-up. To facilitate this sale, on June 24, 1997, Powerine requested that this Regional Board enter into a Prospective Purchaser Agreement covering only the Lakeland Road portion of their refinery property.

5. Prior to their request for a Prospective Purchaser Agreement, Powerine initiated shallow soil remediation on the Lakeland Property and requested a no further action letter to facilitate the sale of the land. This remediation action consisted of demolition of the above ground tanks and associated pipelines at the Lakeland Property and removal of about 5,100 cubic yards of petroleum hydrocarbon saturated soils for staging prior to treatment or off-site disposal.

6. After Powerine's remediation efforts, on May 14, 1997, staff issued a "No Further Action" letter regarding soil contamination which provided that reasonable precautions are to be taken by those involved in any excavation, borings or related activities involving the subsurface of the subject site. This no further action letter was based upon:

   a. Shallow soils meet the Board's cleanup goals for low risk sites. Deeper soil contamination remaining contain up to 27,000 mg/kg total petroleum hydrocarbon (TPH) as gasoline, up to 3.3 mg/kg methyl tertiary butyl ether (MTBE), 200 mg/kg benzene and up to 110 mg/kg naphthalene and pose no risk to surface development.

   b. A "Fate and Transport/Human Health Risk Assessment", dated March 21, 1997, and update of May 12, 1997, indicate that remaining site soil contaminants will not impact the ground water, the incremental cancer risk was predicted to be less than 0.5 in one million for a site industrial worker, and the non-carcinogenic hazard index was predicted to be less than 0.013.

   c. Existing ground water contamination with up to 14,000 mg/ℓ benzene was deferred from the no further action letter for later cleanup under the refinery cleanup and abatement Order. Analyses for three on-site production wells, screened in the Silverado aquifer, were below detection limits for all constituents except for 0.88 µg/ℓ toluene in production well number 6, which appeared to be an anomaly.

7. The refinery is underlain by several water-bearing zones. The uppermost water-bearing zone is the unconfined Artesia aquifer. The depth to ground water underlying the refinery is generally 80 feet to 100 feet below ground surface (bgs). Ground water flow direction is generally south in the vicinity of the refinery with an apparent ground water divide about one mile south of the refinery. A deeper probable water-bearing zone at about 200 feet to 400 feet bgs located in the Lynwood formation and a water bearing zone at about 600 to 800 feet bgs called the Silverado aquifer, is a drinking water source for the area.

8. Ground water production wells, screened in the Silverado aquifer, within four miles of the refinery supply drinking water for approximately 114,000 people, supplied by five water purveyors.

9. Free-floating hydrocarbon product was identified in the Artesia aquifer underlying the refinery and is known to have migrated off-site in this aquifer. The discharger initiated recovery of free floating hydrocarbon from the Artesia aquifer in the summer of 1990. As of March 1995, about 520 gallons of hydrocarbon have been recovered from the Artesia aquifer and the maximum hydrocarbon thickness has been reduced to from 2.96 feet to 0.3 feet.

10. The U.S. EPA conducted a Site Inspection Prioritization (SIP) of the refinery and prepared a report, dated September 11, 1995. This report indicated that further assessment is needed under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), the Regional Board is the lead agency for this site and that EPA will continue to monitor the sites progress.

11. The Regional Board adopted a revised Water Quality Control Plan for the Los Angeles Region on June 13, 1994. This Water Quality Control Plan designates beneficial uses and establishes water quality objectives for all ground water within the Region. Existing or potential beneficial uses for ground water in the Coastal Plain, where the site is located, are municipal and domestic supply, agricultural supply, and industrial service and process supply. Ground water in the Silverado aquifer is usually of best quality and quantity.

12. The California Water Code, Section 13304, "Cleanup and Abatement Orders", requires in part, that any discharge of waste into the waters of the state, that creates, or threatens to create, a condition of pollution or nuisance, shall upon order of the Regional Board cleanup such waste or abate the effects thereof. If such waste is cleaned up, the effects thereof abated, the person or persons who discharged the waste, shall be liable to that governmental agency [for its supervision] to the extent of the reasonable costs actually incurred in cleaning up such waste and abating the effects thereof.

13. Additionally, under the Aboveground Tank Act (SB 1050), the discharger is required to reimburse the State of California for staff oversight costs associated with cleanup and abatement activities. To that end, the discharger, via a letter dated March 11, 1993, agreed to reimburse the State of California for staff oversight costs associated with cleanup activities at this facility.

14. This enforcement action is being taken for the protection of the environment and, as such, is exempt from the provisions of the California Environmental Quality Act (Public Resources Code, Section 21000, et. seq.) in accordance with Section 15321, Chapter 3, Title 14, California Code of Regulations.

The Regional Board has notified the discharger of its intent to issue an Order requiring it to cleanup and abate conditions of soil and ground water pollution caused by the release of petroleum hydrocarbon products from their properties and has provided them with an opportunity to submit their written views and recommendations.

The Regional Board, in a public meeting, heard and considered all comments pertaining to the tentative Order.

IT IS HEREBY ORDERED, pursuant to California Water Code 13304, that Powerine Oil Company shall:

1. Cleanup and abate the effects of on-site and off-site soil and ground water contamination originating from its refinery, including its Bloomfield Property, activities associated with two above ground storage tanks on the "Walker Property" located at 11240 Bloomfield Avenue, and its interconnecting pipelines to its former Marine Terminal, located at Berth 73 in the Port of Long Beach, Long Beach, California. In addition, cleanup and abate the effects of on-site and off-site ground water contamination which may have originated from its Lakeland Property, as required by this Regional Board.

2. Submit to this Regional Board by March 15, 1998, a Master Work Plan and time schedule for approval by the Executive Officer, that details all known on-site and off-site ground water and soil contaminated areas for cleanup. The Master Work Plan shall provide a time schedule for cleanup of all detailed ground water and soil contamination. These activities shall be conducted according to approved work plans, the requirements of the State Water Resources Control Board Resolution No. 92-49 "Policies and Procedure", and the time schedule specified in the Master Work Plan. The Master Work Plan shall include at a minimum the following items:

   a. An updated refinery source identification and elimination plan including a plan and time schedule for implementation of the site source identification and elimination program within 90 days of approval of the plan by the Executive Officer. The plan is to detect leakage from above ground tanks and associated piping, identify free phase petroleum hydrocarbon in the vadose zone, and remediate any petroleum hydrocarbon contamination in a timely manner.

   b. A plan and schedule for final site assessment of all soil and ground water contamination to:

      1) Fully delineate the extent of free-phase and dissolved phase ground water contamination in the upper saturated zone and underlying saturated zones. Off-site investigations coordinated to include neighboring facilities are

considered a vital part of this effort. Complete the preliminary investigation and characterization of all known on-site vadose zone contamination. Define the lateral and vertical extent of such contamination, characterize and evaluate contaminant behavior, and evaluate the potential impact on ground water quality.

2) Develop specific aquifer characteristics, such as hydraulic conductivity, for the uppermost saturated zone and any underlying contaminated aquifers;

3) Assess the saturated zone hydraulic characteristics and conductivity (i.e., determine the connection between saturated units or aquitards underlying any soil or ground water contamination).

c. A description of the current facility ground water cleanup strategy to remediate any on-site and off-site free-phase and dissolved phase ground water contamination.

d. A schedule for initiating cleanup of all known ground water contamination.

e. A schedule for initiating cleanup of all known vadose zone contamination. Cleanup levels shall be approved in Waste Discharge Requirements issued by this Regional Board.

3. After completion of any phase of ground water or soil investigation or cleanup, according to the approved time schedule in the Master Work Plan, a detailed report describing the activities and results shall be submitted to this Regional Board. Semi-annual progress reports shall be submitted until all required activities are completed.

4. Pursuant to Section 13267 of the Water Code, the discharger shall submit, under penalty of perjury, to this Regional Board technical reports to include semi-annual progress and ground water elevation gauging and sampling reports until completion of all Regional Board mandated work. These reports must contain, at a minimum, the following information:

a. A summary of all ground water elevation measurements from mean sea level and depths to ground water from all site monitoring wells. Monitoring wells should be sounded for total depth at each gauging event. This information should be presented in tabular form to include well location (latitude/longitude or x/y coordinate system) and on a plot plan depicting the location of the borings/wells with ground water contours depicting groundwater flow direction and gradient information. Also, include a free phase hydrocarbon isothickness map and a dissolved phase contaminant isoconcentration contour map, if applicable.

b. Analyses of ground water collected from selected site monitoring wells during the sampling period, as approved by the Executive Officer, together with an evaluation

of the test results. Ground water sample collection procedures and analyses shall be according to an approved work plan.

c. The above data shall be submitted by hard-copy in a report and if requested, electronically in a format acceptable to the Executive Officer.

d. Investigative and remedial activities completed during the reporting period and activities proposed for the next reporting period.

5. Any request for time extensions of the completion dates, shown in the approved Master Work Plan, must include justification for such time extension and be submitted in writing to the Executive Officer for approval.

6. Abandonment of any ground water well(s) at the site must be reported to the Executive Officer in advance when possible, but no later than 14 days after removal. Any ground water well removed must be replaced within a reasonable time, at a location approved by the Executive Officer. With justification, the Executive Officer may approve of the abandonment of ground water wells without replacement. When a well is removed, all work shall be completed in accordance with all applicable well abandonment requirements.

7. All work, except the source elimination program, performed pursuant to this Order shall be under the direction and supervision of a registered Civil Engineer or Geologist or a Certified Engineering Geologist. The Discharger's contractor or consultant shall have the technical expertise sufficient to adequately perform all aspects of the work for which they are responsible.

8. When required, it is the intent of this Regional Board to issue Waste Discharge Requirements or other Orders pursuant to Section 13260, Section 13304, and/or Section 13350 of the Water Code to facilitate this cleanup and abatement activity.

9. The Regional Board and other Regional Board authorized representative shall be allowed:

a. Entry upon premises where a regulated facility or activity is located or conducted, or where records are kept under the conditions of this Order;

b. Access to copy any records that are kept under the conditions of this order;

c. To inspect any facility, equipment (including monitoring and control equipment), practices, or operations regulated or required under this order; and

d. To photograph, sample, and monitor for the purpose of assuring compliance with this Order, or as otherwise authorized by the California Water Code.

10. Any investigation and cleanup and mitigation activities required by this Order, currently in progress or conducted in the past, shall be included and made a part of the cleanup program.

11. This Order is not intended to permit or allow the discharger to cease any work required by any other Order issued by this Regional Board, nor shall it be used as a reason to stop or redirect any investigation or mitigation activities not required by this Order or any other agency.

12. This Order in no way limits the authority of the Regional Board as contained in the California Water Code, to require additional investigation and cleanup pertinent to this project. It is the intent of this Regional Board to issue Waste Discharge Requirements or other Orders pursuant to Section 13260, Section 13304, and/or Section 13350 of the Water Code when appropriate to facilitate this cleanup and abatement activity. Additionally, continued monitoring of the ground water quality beneath this facility after the completion of this cleanup and abatement activity may be required.

13. Provide to the Regional Board advance notice of any planned physical alterations to the facility or planned changes in the facility's activities that may affect compliance with this Order.

14. This Order does not exempt the discharger from compliance with any other laws, regulations, or ordinances which may be applicable, nor does it legalize these waste treatment and disposal facilities and it leaves unaffected any further restraints on those facilities which may be contained in other statues or required by other agencies.

15. Provide to the Regional Board advance notice of any planned change in name, ownership, or control of the facility; provide notice to any succeeding owner or operator of the existence of this Order by letter; forward a copy of such notification to the Regional Board.

16. Pursuant to Section 13304 of the Water Code, the discharger shall reimburse the State Water Resources Control Board (SWRCB) for all reasonable costs incurred by the State Board and this Regional Board in overseeing the cleanup and abatement activities required by this order.

17. This order may be revised by the Regional Board through its Executive Officer as additional information on this site becomes available. Upon request by the discharger, and for good cause shown the Executive Officer may defer, delete or extend the date of compliance for any action required of the discharger under this Order. The authority of the Regional Board, as contained in the California Water code, to order investigation and cleanup additional to that described herein, is in no way limited by this Order.

Failure to comply with the terms or conditions of this Order may result in the imposition of civil liabilities, either administratively by the Regional Board or judicially by the Superior Court, in accordance with Section 13350, et seq., of the California Water Code, and/or referral to the Attorney General of the State of California for such action as he may deem appropriate.

I, Dennis A. Dickerson, Executive Officer, do hereby certify that the foregoing is a full, true and correct copy of an Order adopted by the California Regional Water Quality Control Board, Los Angeles Region on August 25, 1997.

Dennis A. Dickerson

DENNIS A. DICKERSON
Executive Officer

STATE OF CALIFORNIA
CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
LOS ANGELES REGION

AUGUST 25, 1997
RESOLUTION NO. 97-016

APPROVAL OF A PROSPECTIVE PURCHASER AGREEMENT FOR THE POWERINE OIL COMPANY
(LAKELAND PROPERTY, SANTA FE SPRINGS, CALIFORNIA)

(FILE NO. 96-137)

WHEREAS, THE CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD, LOS ANGELES REGION, FINDS:

1. The Powerine Oil Company refinery is situated on approximately 88 acres, about 75 acres after the Lakeland Property sale, in the City of Santa Fe Springs, County of Los Angeles. The Powerine Oil Company, a California corporation, is currently owned by Energy Merchant Corporation.

2. The Powerine Lakeland Property, a 14.3 portion of the refinery at 12354 Lakeland Road, is bounded by Lakeland Road on the north, the Metropolitan State Hospital on the south, and small businesses on the west and east. The Lakeland Property has been the site of Powerine's administrative office building, warehouse, truck-loading rack, and associated fuel/product storage tanks.

3. In March 1984, Powerine sought Chapter 11 bankruptcy protection and shut down the refinery. In September, 1986, Powerine Oil Company was acquired and subsequently emerged from bankruptcy. From 1986 until 1995, Powerine underwent a series of ownership changes that ultimately resulted in a July, 1995 shutdown of their 49,500 barrel per day refining process and layoff of most of their 400 employees. In early 1996 the Energy Merchant Corporation acquired Powerine with the intent to rehire up to 370 employees, restart the refinery, and reestablish Powerine in the petroleum refining business. The sale of its former administrative building and terminalling facility property located at 12354 Lakeland Road is a key ingredient to the financing of the proposed refinery start-up. To facilitate this sale, Powerine requested that this Regional Board enter into a Prospective Purchaser Agreement for the 12354 Lakeland Road property. The intended uses of the Lakeland Property include industrial warehouses, light manufacturing and possibly retail.

4. The Regional Board has provided oversight for site assessment and remediation completed to date. Specific sources of site contamination include discharges from above ground tanks, loading racks, and associated pipelines. Investigations indicate the presence of up to 27,000 mg/kg total petroleum hydrocarbon (TPH) as gasoline, up to 3.3 mg/kg methyl tertiary butyl ether (MTBE), 200 mg/kg benzene and up to 110 mg/kg naphthalene remain in site soils. A soil column of benzene has been identified in borings PT/PTR-3 from 15 feet to 65 feet below ground surface. Ground water is about 79 feet

below ground surface containing up to 11 mg/l benzene and a sheen of light non-aqueous petroleum liquid. The contamination in the ground water underneath the Lakeland property is stipulated by Powerine to be from the refinery and the refinery accepts liability for this groundwater contamination if remediation is required.

5. The Regional Board has authority to enter into agreements which provide, "covenants not to sue or to assert claims for environmental remediation" against prospective purchasers of polluted properties, pursuant to the Water Code Sections 13000 et seq., the Health and Safety Code Sections 25300 et seq., and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 U.S.C. Section 9613(f)(2), if such agreements are sufficiently in the public interest.

6. Prospective Purchaser Agreements have the consequence of absolving the purchaser from liability for existing contamination, potentially shifting the burden for remediation from that private entity to the public. Accordingly, the criteria used to evaluate the efficacy of a Prospective Purchaser Agreement in this specific case was measured carefully to assure that the risks to the public are minimized and that the public benefits outweigh those risks. An agreement with Powerine Oil Company will result in a public benefit including, but not limited to, the restoration of contaminated land to productive use, creation of 200 to 400 jobs after development of the site, and about 375 refinery jobs from the start-up of the refinery. In addition, about 2.5 support jobs can be anticipated from each job created. The State would receive income taxes from these jobs along with the City of Santa Fe Springs and the County of Los Angeles.

7. The enclosed Prospective Purchaser Agreement, is to be recorded and "runs with the Land". This Agreement includes covenants not to sue this prospective purchaser and subsequent prospective purchasers for any existing contamination or pollution present at the property, if the terms of the Agreement are carried out. This Agreement is consistent with the current State Water Resource Control Board Guidance on Prospective Purchaser Agreements issued by Walt Pettit, the State Water Resources Control Board Executive Officer, on July 9, 1996.

8. The Regional Board has consulted with other interested governmental agencies, including the City of Santa Fe Springs and the Department of Toxic Substances Control, and such agencies support the development of the site under the oversight of this Regional Board's staff.

The Regional Board has notified interested parties of its intent to adopt the tentative Resolution, and has provided them with an opportunity to submit their written views and recommendations. The Regional Board, in a public meeting, heard and considered all comments pertaining to the tentative Resolution.

APPENDIX B

SAMPLING AND ANALYSIS PLAN:

Part I - Field Sampling Plan

Part II - Quality Assurance Project Plan

SAMPLING AND ANALYSIS PLAN
PART I

FIELD SAMPLING PLAN

CENCO OIL REFINERY
SANTA FE SPRINGS, CALIFORNIA 90670

Prepared For:

CENCO REFINING COMPANY
12354 Lakeland Road
Santa Fe Springs, California 90670

Prepared By:

Versar INC
7844 Madison Avenue, Suite 167
Sacramento, CA 95628

January 28, 2000

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Attachment 1 - Project Forms

Boring and Well Log
Fluid Level Measurement Form
Field Sampling Data Form
Monitoring Well Development Form
Chain-of-Custody Record
Drum Inventory Sheet
Hazardous Waste Label
Non-Hazardous Waste Container Label

1.0 INTRODUCTION

This Field Sampling Plan (FSP) is intended to provide the methodology to collect and analyze field data during activities of the Revised Master Work Plan for the CENCO Refining Company facility ("CENCO" or "Site") and surrounding vicinity. The term "Site", as used herein, shall mean the CENCO Facility and the surrounding area where Hazardous Substances released at or from the facility have or may come to be located, or threaten to be released. The CENCO Facility is located at 12345 Lakeland Road in in Santa Fe Springs, California. This FSP was prepared by Versar, Inc. (Versar) under the direction of the Site Project Manager, Dr. Eliana Makhlouf.

This FSP provides detailed descriptions of objectives, methods and procedures to be used during the implementation of field activities at the CENCO Facility. The Site Location Map and Site Plan are respectively shown on Figures 1 and 2 of the Revised Master Work Plan. The FSP is intended for use by the field investigation team, with oversight by the Regional Water Quality Control Board, Los Angeles Region (LARWQCB).

The Revised Master Work Plan describes the specific field activities to be performed at the Site. This FSP is intended to be implemented in conjunction with the entire Revised Master Work Plan and its appendices. In addition, future work at the site will be conducted in accordance with the FSP and quality assurance project plan (QAPP) unless otherwise noted.

2.0 SITE DESCRIPTION AND HISTORY

A physical description of the CENCO Facility and surrounding areas, and the history of the Site and environmental investigations are presented, respectively, in Section 2.0 and Sections 4.0 and 5.0 of the Revised Master Work Plan.

3.0 FIELD ACTIVITIES AND SAMPLING OBJECTIVES

This Revised Master Work Plan was prepared for CENCO by Versar, Inc. (Versar) pursuant to cleanup and abatement order (CAO) 97-118 issued by the LARWQCB. CAO 97-118 requires that Powerine (now CENCO) address petroleum hydrocarbons and associated constituents in soil and groundwater at the CENCO Refinery located at 12345 Lakeland Road in Sante Fe Springs, California.

The objective of the Revised Master Work Plan field activities are to:

- fully delineate the extent of free-phase and dissolved-phase petroleum hydrocarbons and associated constituents groundwater in the upper and lower saturated zones beneath the Site and select adjoining properties;

- characterize all known on-site areas where the vadose zone has been impacted;

- characterize and evaluate petroleum hydrocarbon fate and transport and the potential impact to water quality from releases from the CENCO facility;

- develop specific aquifer characteristics, such as hydraulic conductivity, for the uppermost saturated zone and any underlying aquifers impacted by petroleum hydrocarbons; and

- assess the saturated zone hydraulic characteristics and conductivity (i.e., evaluate the connection between saturated units or aquitards underlying any soil or groundwater contamination).

3.1 Field Work Support

The *Site Technical Coordinator,* or an assigned designee, is responsible for the coordination of all the activities described in Section 4.0. The field work support will provide the necessary tools, scheduling, access, and support communications for all field efforts. These will include providing a field office as necessary, mobilizing to the Site, and demobilizing from the Site after the completion of Revised Master Work Plan field activities. Field work support also includes obtaining sample support items such as sample packaging materials and express delivery services for shipping samples, as well as providing the necessary equipment and communications to conduct the field work in compliance with the *Health and Safety Plan* (HSP). This support function also includes providing a secure storage for investigation-derived wastes (IDW).

3.1.1 Field Team

The Field Team's organization, communication, and experience is the primary field work support mechanism necessary to accomplish the field activities and sampling objectives. Sudhakar Talanki, the *Site Project Manager*, will designate a team who will perform the tasks described in this FSP. A *Field Team Leader* will be designated, and will have responsibility for the on-site activities of the field team. Each member of the field team shall have appropriate background and experience in performing the assigned tasks. Project quality assurance authority is described in the QAPP.

3.1.2 Permits

To perform the field work in a manner consistent with applicable local, state, and federal regulations, one field work support objective is to perform the work under applicable permits which may be required for a particular activity. All necessary permits, such as monitoring well permits, will be obtained through the appropriate regulatory agencies. It is anticipated that well drilling permits will be obtained through the County of Los Angeles Department of Health Services. Permits for encroachment will be obtained from respective property or right-of-way owners. In the event that confined space entry is a required field Work element, a permitting process will be established and carried out within the framework of the *Health and Safety Plan.*

3.1.3 Site Access

On-Site and off-Site access will be controlled according to procedures described in the Health and Safety Plan.

3.1.4 Project Coordination

Project coordination is an essential element of field work support for accomplishment of safe and efficient field work and attainment of sampling objectives. The *Site Project Manager* will maintain primary responsibility for project coordination among the CENCO Facility, the LARWQCB, the field sampling team, subcontractors, and the public.

3.2 Surveying

Surveying will be performed by a licensed surveyor. Existing and new groundwater monitoring wells, extraction wells, soil borings, and other sampling points will be surveyed to determine unique horizontal and vertical coordinates. Horizontal control will be surveyed to Third Order, Class I accuracy (1:10,000) for local surveys. The horizontal locations will be determined using aerial mapping, ETS instrument, or GPS surveying. Ground shots or spot elevations will be measured to the nearest tenth (0.1) of a foot. Vertical control for ground surface elevations will be measured with respect to the mean sea level elevation of a designated Site benchmark elevation.

The elevation of survey control points, top of well casings, and top of well monument covers will be established to the nearest hundredth (0.01) of a foot and ground elevations at those points will be to the nearest tenth (0.1) of a foot using an automatic or precise level. The survey control points will be clearly marked with a surveyed punch mark on the north side of the top of the casing of each of the monitoring wells.

The accuracy of the top of well casings will be verified by randomly checking 10 percent of the spot locations with a double-loop. These loops must close to within one tenth (0.1) of a foot.

Subsurface plumbing features that are investigated, such as storm sewer lines, sanitary sewer lines, water lines, and manholes, will be located and the vertical and horizontal coordinates established. Any subsurface utilities shown on existing maps that cannot be confirmed in the field will be clearly labeled as such on the Site base map. Reference sources for subsurface utility information will be included on the Site base map.

3.3 Groundwater Well Installation

The purpose of the additional groundwater investigation is to obtain additional site specific data including hydrogeological conditions, aquifer characteristics, subsurface bioavailability, etc. This information will be utilized to evaluate remedial alternatives for the groundwater at the CENCO Facility. The monitoring well array is designed to characterize the following in each of the water-bearing units:

- Direction of groundwater flow
- Horizontal hydraulic gradient
- Vertical gradients between water-bearing units
- Presence and magnitude of groundwater contamination, including the presence of immiscible phases
- Vertical and lateral extent of groundwater contamination

- Ambient water quality upgradient from the Site
- Geologic and geotechnical characteristics
- Hydrogeologic parameters such as hydraulic conductivity, porosity, storativity, and transmissivity of aquifers

To accomplish these objectives, the monitoring well network will be evaluated and modified as ncessary. The location and number of monitoring wells is described in Section 6.0 of the Revised Master Work Plan.

3.4 Groundwater Sampling and Analytical Objectives

Groundwater sampling objectives include identification of background water quality and the extent of groundwater impacts at the Site. In addition, sampling and analytical objectives include quality control objectives to assure the validity of the data. Data quality objectives and field sampling protocols which are designed to obtain data of appropriate quality for meeting the project objectives are described in detail in the QAPP.

Groundwater samples will be collected from groundwater monitoring wells, or direct push sampling method, for chemical analysis at a fixed analytical laboratory. Groundwater samples will be analyzed for those analytes identified in Section 6.3 of the Revised Master Work Plan. A more detailed description of the groundwater sample analytical program and the analytical methods to be used is presented in the QAPP.

The existing groundwater monitoring well network consists of 26 monitoring wells, including 22 wells located within or downgradient of the CENCO refinery, and four wells located on the nearby Walker Property (Figure 2 of the Revised Master Work Plan).

3.5 Hydrogeological Investigation Approach

The hydrogeological investigation will characterize the hydrogeologic conditions of the Exposition aquifer at the Site for inclusion in the Conceptual Site Model (CSM). The Revised Master Work Plan will accomplish this objective by biannual monitoring of groundwater elevations and by aquifer testing of the Exposition Aquifer.

4.0 SAMPLING EQUIPMENT AND PROCEDURES

The following subsections describe the equipment, materials, and methodologies that will be used to collect representative samples of sediment and groundwater during Revised Master Work Plan activities.

4.1 Borehole Drilling and Well Installation

Soil borings will be advanced using either hand-driven augers, hydraulic-advance boring equipment (ie.: Geoprobe™), hollow-stem auger drilling, mud-rotary drilling, or other drilling methods as Site conditions and data acquisition require. Borehole drilling and well installation will be performed in a manner consistent with the California Department of Water Resources,

Water Well Standards, Bulletin 74-81. Borings and wells will be grouted with a Type II Portland Cement slurry containing approximately 4 percent or less of bentonite.

All equipment used in drilling boreholes will be washed with high pressure hot water before use at each investigation location. Detailed decontamination procedures are described in Section 6.0.

4.1.1 Drilling Procedures

4.1.1.1 Direct-push Drilling

Direct-push drilling is also known as Geoprobe drilling. The technique utilizes hydraulic hammers mounted on pickup-sized truck platforms to drive sampling materials into unconsolidated sediments. Smaller and larger mobile platforms may be used to access limited spaces or drive larger diameter borings. The hydraulic hammer drives sectioned steel casing containing an inert sample liner, in which a soil core is obtained while driving a selected sample depth interval. Direct-push drilling generates no cuttings, and is rapid and inexpensive to use. Grab groundwater samples can be collected from screens inserted into a saturated zone; the driven casing acting as a barrier to overlying materials impacting the sample. The method is limited to boring diameters of approximately three inches, and depths of less than 60 to 80 feet, depending on subsurface conditions. Use at the Site is limited to the collection of soil samples within 60 to 80 feet of the surface.

4.1.1.2 Hollow-Stem Auger Drilling

Hollow-stem auger drilling is conducted by a truck-mounted drill rig rotating a tubular steel auger that has a hollow axle with steel flights welded on the outside. A hollow drill bit is attached to the first hollow-stem auger that is advanced into the ground. The hole in the bit is plugged during drilling with a plug or a continuous core barrel sampler. As the augers are rotated into the ground, the sediments encountered on the outer edges of the bit and lead auger are cut and conveyed to the ground surface via the outer flights of the auger. The continuous core barrel, which is connected to the ground surface by steel rods or cable, is extracted from the bit and lead auger whenever a new section of auger is added (typically every 5 feet, or more often depending of the soil sampling procedures and on the recovery success experienced). This drilling method allows soil sampling and completion of the monitoring well to be conducted inside the augers while the boring remains open. The augers are slowly removed from the borehole as the monitoring well casing, sand, bentonite, and/or grout are added from the bottom up.

Drilling progress using hollow-stem auger in saturated, unconsolidated sand can be adversely affected by the heaving or sloughing of formation material. Heaving of sand running into the stem of the auger occurs as a result of hydrostatic pressure differences between the formation and the auger. The presence of sand in the auger prevents the soil sampler from being able to access the bottom of the borehole; thus an undisturbed soil sample may not be obtained in such instances. Mitigation of heaving sands inside the auger will depend on the objectives of the drilling program. If it is necessary to obtain soil samples, the augers will be raised to allow the stem to empty. The augers will then be flooded with potable water to equilibrate hydrostatic pressures in the auger with the surrounding formation. Drilling will then continue to the depth at

which the sample is desired. If no sampling is required, the augers will be removed from the borehole and a wooden knock-out plug will be placed to block the bottom of the lead auger. When the appropriate depth is reached, the knock-out plug will be dislodged and the well set.

For soil borings in which wells will not be constructed, the boring will be abandoned and sealed with a cement/bentonite slurry. The slurry will be pumped into the boring through a tremie pipe placed in the bottom of the boring, and the boring will be filled to approximately 1 foot bgs. The remainder of the boring will be filled with asphalt concrete, aggregate concrete, or backfill material to match the surrounding surface conditions.

4.1.1.3 Mud-Rotary Drilling

Mud-rotary drilling is conducted using a truck-mounted drill rig, a rotating tri-cone or drag bit, and hollow drill rods. Drilling mud (a viscous mixture of water and bentonite) is pumped from a mud tank at the surface, down the drilling rods to the drill bit whereupon the mud carries drill cuttings back up to the surface between the outside of the drill rods and the inside of the borehole. The drill cuttings are then screened out of the mud before the mud is recirculated to the mud tank or the cuttings are allowed to settle to the bottom of the mud tank by slowing the velocity of the mud within the tank through a series of baffles. The hydrostatic pressure induced in the borehole by the heavy drilling mud is generally greater than the hydrostatic pressure of the surrounding formation thus the borehole wall is prevented from heaving or sloughing.

Upon reaching the final boring depth, the drill bit and rods are removed, and the monitoring well is constructed inside the borehole which is held opened with the drilling mud. Following completion of well construction and grouting, any remaining drilling mud is pumped out of the well during well development. Waste drilling fluids will be managed, characterized, and disposed according to the IDW plan presented in Section 8.0. Boreholes not used for the construction of groundwater wells will be abandoned using the tremie method, as previously described in section 4.1.1.2.

It is possible that drill fluid could flow into the subsurface by gravity during drilling, if a highly permeable zone is encountered. If the supervising geologist determines that fluid loss has occurred, the supervising geologist will direct the drilling subcontractor to increase the viscosity of the drilling mud until loss of fluid is reduced and circulation of the drilling mud back to the surface is restored. As a last resort, the zone of fluid loss may be cased off to prevent further fluid loss.

The determination of mud weight or viscosity will be determined in the field, based on field conditions. The drilling contractors expertise in the drilling method will be used in the determination of the mud weight or viscosity. Mud viscosity will be varied in order to create a balance between recirculation of fines when mud may be too thick, and non-circulation of coarser materials if mud is too thin.

4.1.1.4 Air-Rotary Casing Hammer Drilling

Air-rotary casing hammer drilling is conducted using a truck-mounted drill rig, a tri-cone or drag bit, and hollow drill rods. In theory, this method is very similar to the mud-rotary drilling method. Rather than drilling mud, however, compressed air is used to convey drill cuttings from the drill bit to the surface. Rather than using drilling mud, the boring is kept open with a steel casing that is advanced behind the bit using a hydraulic or air-driven casing hammer mounted on the top of the drill rig. Compressed air forced down the drilling rods is filtered and desiccated to prevent the introduction of contaminants from the air compressor to the borehole. After reaching the total depth of the boring, the drill bit and rods are removed and the well is constructed inside the temporary steel casing. The temporary casing is slowly removed from the borehole as the monitoring well casing, sand pack, bentonite, and/or grout are added from the bottom up. This drilling method will be used only in areas with low or no concentrations of contaminants in groundwater, as determined previously by groundwater sampling and/or in areas where mud-rotary methods cannot be used, such as areas of large drilling fluid losses.

4.1.2 Drilling, Sampling and Conductor Casing Installation Procedures Below the First-Encountered Aquifer

The installation of groundwater wells below the first-encountered aquifer (the Exposition Aquifer) is not anticipated, as described in 6.3.2 of the Revised Master Work Plan. Therefore, no methods for the isolation of overlying saturated units during drilling and well emplacement are required.

4.1.2.1 Unsaturated and Saturated Zone Sampling Methods

Soil borings in the unsaturated zone and the Exposition Aquifer will be drilled and installed using standard hollow-stem auger or mud rotary drilling techniques. At each location, a boring will be drilled to the total depth using a drill rig equipped with a minimum 8-inch, OD hollow-stem augers, or 6-inch diameter rotary drill bit. During drilling, soil samples will be collected using a modified Dames and Moore, California-type split spoon or solid core barrel sampler. The sampler will contain a minimum of three stainless-steel or brass, thin walled tubes of six-inches in length. Soil samples will be collected down hole by driving the sampler containing the sample liner tubes a distance of 18 to 24-inches into sediments at the bottom of the borehole. The sampler will be driven using a 140-pound hammer having a 30-inch drop. The blow counts required to drive each 6 inches of core barrel advance will be recorded to characterize the density or stiffness of the sampled sediment.

The sampler will then be retrieved from the boring and sediment-filled sample liners removed from the sample barrel. The tubes will then be separated, and the tip of a PID or FID sampler inserted into the separation to allow an initial determination of the presence of VOCs in each soil core and to determine the specific depth interval, if any, that warrants collection of a soil sample for VOC analysis by the laboratory. The core will be examined in a sheltered area, if possible, sampled and lithologically logged either by extruding the soil from the tube or, if the sample cannot be extruded, examining and logging both ends of the tube. Samples collected for chemical or physical analysis will be covered with Teflon™ sheets and capped with plastic caps,

and will not be extruded from the tube. As an alternative to this sample collection method, VOC samples may be collected using a miniature bulk sampler into a hermetically-sealed vial or other suitable container without the use of the preservative solution (U.S. EPA, SW-846 Method 5035). A portion of that sample is removed from the container in the laboratory and is dispersed in a water-miscible solvent to dissolve the volatile organic constituents. An aliquot of the solution is added to 5 mL of reagent water in a purge tube.

When soil sampling has been completed, the boring data will be reviewed by the *Project Manager* or authorized designee to evaluate whether the location is appropriate for installation of a monitoring well, if a well is to be installed. If the location is deemed to be unsuitable for well construction, the boring will be abandoned as described in Section 4.1.1.2. If the boring is deemed suitable for completion as a well, well construction will begin immediately.

If during the course of drilling, a borehole is advanced more than 5 feet beyond the required depth for well construction, that portion of the borehole will be backfilled with bentonite before setting the well casing.

Drill cuttings will be managed as specified in Section 8.0.

4.1.3 Soil Sampling

Subsurface soil samples will be collected during drilling for chemical analysis, physical parameter analysis, field screening using a PID or FID, or to obtain lithologic description. Soil samples for physical parameter or chemical analysis will be collected using a continuous core barrel sampler and/or a modified California sampler lined with clear acetate, brass, or stainless-steel tubes. Soil samples collected for field screening and lithologic description will be collected in an unlined continuous core barrel sampler. All soil samples will be handled so as to minimize sample disturbance. Samples collected for chemical or physical analysis will be covered with Teflon™ sheets, capped with plastic caps, and will not be extruded from the tube.

As an alternative to this sample collection method, VOC samples may be collected using a miniature bulk sampler into a hermetical-sealed vial or other suitable container without the use of the preservative solution (U.S. EPA, SW-846 Method 5035). A portion of that sample is removed from the container in the laboratory and is dispersed in a water-miscible solvent to dissolve the volatile organic constituents. An aliquot of the solution is added to 5 mL of reagent water in a purge tube.

4.1.3.1 Lithologic Logging/Documentation

As described in Section 4.1.3 above, soil cores will be collected for lithologic description. Soil type and characteristics will be examined and described by a geologist or engineer, who will maintain a complete record of these descriptions on a boring log. The boring log form which will be used is included in Attachment 1 to this FSP. Sediments will be described in accordance with the Unified Soil Classification System and ASTM D2499-94 Color Chart. The following information will be recorded, as appropriate, on the log:

- project name and location
- soil boring location
- sampling depth
- sediment classification
- sediment color
- moisture condition of the sediment
- sediment odor (if noticed incidentally and consistent with health and safety precautions)
- PID and FID field measurements
- descriptive comments, including obstacles encountered or other drilling difficulties
- depth to first encountered groundwater
- depth to stabilized groundwater level (if possible)
- depth of fill material (if present and distinct)
- depth to bedrock (if encountered)
- supervising geologist/engineer's signature and date

An appropriately-qualified California Registered Geologist or Professional Engineer will review and approve the lithologic logs.

4.1.3.2 Field Screening

Selected soil samples will be field screened for VOC concentrations with portable field monitoring equipment to provide semi-quantitative data. Portable field monitoring equipment may include, but not be restricted to a PID, or an OVA equipped with a FID. Instruments will be calibrated as discussed in the QAPP.

The selected sample will be packaged and handled for analysis. A portion of the sample from the adjacent 6-inch liner will be placed in a plastic zip-locked bag, sealed, the sample carefully broken up within the bag, and placed in the sun or a warmed area to facilitate volatilization of organic compounds in the sample. After the sample is allowed to stabilize for approximately 5 minutes, the PID or FID probe will be inserted through the bag and measurements of any ionizable VOCs made. The maximum reading detected will be noted in the bound field log book and/or on the lithologic logs at the interval from which the sample was collected.

4.1.3.3 Soil Sampling For VOC Analysis

The core barrel sampler will be decontaminated in accordance with the procedures in Section 7.0 of this FSP. Only new, clean sample tubes will be used for sample collection.

Sampling for TPH as gasoline and VOC analysis will be performed in accordance with ASTM Method D-4547. Samples will be selected for chemical analysis as described in Section 6.3.2 of the Revised Master Work Plan. Final decisions regarding the submittal of soil samples for laboratory analysis will be made by the *Site Technical Coordinator*. Teflon sheets will be placed on both ends of the soil sample tubes selected for chemical analysis and a plastic cap will be

sealed over each end of the tube. The sample orientation from the sampler tip shall be denoted with an arrow on the sample tube to indicate the end to be used for laboratory analysis.

As an alternative to this sample collection method, VOC samples may be collected using a miniature bulk sampler into a hermetical-sealed vial or other suitable container without the use of the preservative solution (U.S. EPA, SW-846 Method 5035) . A portion of that sample is removed from the container in the laboratory and is dispersed in a water-miscible solvent to dissolve the volatile organic constituents. An aliquot of the solution is added to 5 mL of reagent water in a purge tube.

The sample will then be labeled and placed in an ice-chilled cooler for shipment to the laboratory under strict chain-of-custody (COC) protocols. Details regarding the COC procedures to be followed during sample handling, storage, and shipping are specified in the QAPP.

4.1.4 Groundwater Monitoring Well Installation Procedures

Groundwater monitoring wells are currently anticipated to be installed into the Exposition aquifer to depths below ground surface of 90 to 120 feet. To account for the fluctuation of groundwater levels observed over time at the Site, the well screen intervals may range from 20 to 50 feet in length. The lithology of each zone will be characterized and wells will be installed to monitor the chemicals of potential concern. All wells will be constructed, including depth of annular seal, annular space around casing, and wellhead protection, according to the minimum standards specified in State of California Water Well Standards Bulletin 74-81 as well as standard specified by the County of Los Angeles Department of Health Services (CLADHS). Prior to performing any grouting of wells, well annulus volume calculations will be performed to determine if sufficient sealing material has been pumped into the well to seal the annulus and casing, or if a significant amount of seal has been lost to permeable formation material.

Well casings will be constructed of 4-inch diameter poly-vinyl chloride (PVC) pipe. Well casing diameter may be increased based upon the potential utility for groundwater extraction for aquifer testing at the proposed location. Screens will be machine slotted PVC. The filter pack will be sized to avoid passage of filter material through the screen and inhibit movement of fines from the formation into the well. One to two grain size distribution curves will be performed to assess design of the filter pack and well screen before installation. The filter pack will extend no more than 2 feet above the top of the screened interval. One to two feet of bentonite pellets will be placed on top of the filter pack and the remaining annular space above the sand pack will be completely filled by tremie grouting with a cement/bentonite seal for the entire length of the borehole.

All well casing materials will be washed with high-pressure hot water before use, or will be certified clean by the manufacturer, and be delivered boxed or bagged to the Site. Well construction information will be recorded on the lithologic log form. Fluids generated during groundwater monitoring well installation will be handled in accordance with the IDW management procedures described in Section 8.0.

4.1.4.1 Well Construction

Groundwater Monitoring Wells. Groundwater monitoring wells will be constructed in the following manner when using hollow-stem auger drilling equipment. Once the nominal 10- to 12-inch diameter borings reach the total desired depth, monitoring wells will be constructed by suspending the well casing and screen inside the hollow-stem auger. Well backfill materials consisting of filter sand, bentonite, and cement bentonite grout will be added as the hollow-stem auger is removed from the boring. The annular space between the well casing and the inside of the hollow-stem augers will act as a tremie pipe for the placement of the sand pack and bentonite pellets. The cement seal will be pumped into place through the use of a tremie pipe. This process will ensure that the boring is held open and well materials are properly placed in the boring. Well construction specifications will be measured in the field and documented on a Well Log. The Well Log which will be used is included as Attachment 1 to this FSP.

Groundwater monitoring wells will be constructed in the following manner when using mud rotary drilling equipment. Once the nominal 6- to 8-inch diameter borings reach the total desired depth, monitoring wells will be constructed by inserting and suspending the well casing and screen inside the drilling mud-filled boring. (The drilling mud is required to remain in the boring to prevent sloughing or collapse of the side walls). The well will be centered in the boring using centralizers placed along every 15 to 20 feet of well casing. Well backfill materials consisting of filter sand, bentonite, and cement bentonite grout will be added to the boring using the tremie method. The annular space will be filled from the bottom up to displace the boring mud upward and out of the boring. Well construction specifications will be measured in the field and documented on a Well Log.

4.1.4.2 Monitoring Well Development

All newly installed wells will be developed a minimum of 24 hours after well installation. In wells installed by mud-rotary method, residual drilling mud within the boring and well will be flushed from the well with potable water prior to further development. Wells will be developed by first surging the screen interval with the use of a vented surge block and bailing or pumping to remove suspended sediment. This process will be repeated until the wells show significant decrease in sediment production.

Wells will then be purge-pumped with temporary 3- or 4-inch diameter submersible pumps. During well development, field parameters (pH, temperature, conductivity, and turbidity) will be monitored at every purged casing volume. Development will be discontinued when pH, temperature, and conductivity have stabilized (within 10 percent of the previous measurement), and the purge water is relatively clear of sediment. Information will be recorded on a Well Development Log included in Attachment.

Well development fluids will be temporarily contained at the well site prior to storage in the area identified in the IDW management procedures described in Section 8.0. The well development fluids will be inventoried and characterized prior to disposal.

Pumps and other downhole tools will be decontaminated between wells using high pressure hot water to reduce the possibility of cross contamination. If free-phase product is encountered, equipment decontamination will be as described in Section 7.0 of this FSP.

4.1.4.3 Well Abandonment

If existing monitoring wells located at the Site or water supply wells on or surrounding the Site pose a significant potential for the migration of contamination into deeper water bearing units, it may be necessary to abandon these wells. Following are procedures for two methods of well abandonment which may be utilized.

Drill Out Site Monitoring Wells. When using hollow-stem augers to drill out the well materials (PVC casing, sand pack, bentonite, and cement grout). Drilling rods will be placed inside the PVC casing to the bottom of the well as a guide to keep the 10- or 12-inch, OD hollow-stem augers from veering off of the well during drilling. As the drilling proceeds, fragments of well materials will be conveyed to the surface by the rotation of the augers. A field geologist will use well boring logs to assess when the bottom of the boring is encountered, and drilling will be terminated. The remaining well materials and soil will be removed from the borings when the augers are removed.

Once the well materials have been drilled out, a cement-bentonite slurry will be pumped into the boring through a tremie pipe placed to the bottom of the boring, and the boring will be filled to approximately 1 foot bgs. The remainder of the boring will be filled with topsoil or pavement consistent with site-surface conditions.

Pressure grouting may be proposed for abandonment of wells where feasible and cost effective. Pressure grouting involves pumping cement grout under pressure into the well from the bottom to the top to seal the well in place. Pressure grouting will comprise the following steps:

- Placement of grout into the well casing from the bottom of the well to approximately 5 feet bgs;
- Installation of a pressure grouting cap to top of well casing;
- Injection of approximately 50 gallons of grout into the well casing through the fitting to a pressure of approximately 60 pounds per square inch, thus sealing the well casing slots and filling the interstices in the sand pack;
- Drilling out the top 5 feet of well casing and well seal; and
- Grouting the remaining 5 feet of open hole to the surface and the abandoned well finished to grade with material to be consistent with surface conditions.

Materials generated during well abandonment activities will be stored in appropriate containers and managed in accordance with the IDW management procedures presented in Section 8.0.

4.2 Groundwater Sample Collection

Groundwater samples will be collected initially following installation and development and periodically thereafter from each well installed during the Revised Master Work Plan for the purposes of groundwater monitoring. Additionally, existing site monitoring wells will be sampled on a biannual basis. As new wells are installed, they will be added to the groundwater monitoring program. Based on results of groundwater monitoring, wells may be deleted from the monitoring network. Monitoring wells will be sampled no sooner than 24 hours after well development. Performing water level measurements will be the first step in the process of groundwater sample collection.

4.2.1 Monitoring Well Inspection

The field crew will examine the well noting the presence or absence of the protective cover, lock and sanitary seal, the condition of the surface seal, and any obvious damage to the well. If there is damage to the well, the protective cover, or the lock, the field crew will note such damage on a well inspection report form and report it to the Site Technical Coordinator who will notify the Site Project Manager of the damage within 24 hours. If repairs are required, a plan describing the means of repair will be prepared and submitted to CLADHS for approval and/or permitting before the repairs are performed.

4.2.2 Opening the Well

Before opening each well, the ground around the well-box will be swept of debris. The cover of the well-box will be removed to allow access to the top of the well casing. The cap or lid on top of the well casing will be removed to allow access to the monitoring well. In the event that the monitoring well vault is flooded with surface water or upwelling groundwater, the vault will be purged of water prior to opening the well casing. The water from the vault will be handled in the same manner as purged groundwater, according to the IDW management procedures. PID readings will be measured in the breathing zone upon opening each well. Breathing zone VOC measurements are described in the Health and Safety Plan.

4.2.3 Measurement of Groundwater Levels

The groundwater elevation monitoring program, in conjunction with surface water elevation monitoring, will evaluate the interrelationship of the Exposition and Gage aquifers. This information is critical in characterizing Site subsurface conditions for the purpose of contaminant fate and transport modeling.

Water levels will be measured quarterly at all wells included in the groundwater monitoring program. Immiscible phases in groundwater wells will also be measured, if present.

All groundwater elevations will be measured in as short a time period as possible and in no case will the measurements exceed a 8-hour interval. The depth to groundwater in the well will be measured using a conductivity based electric water-level measurement device with a minimum of

a 100-foot tape, mounted on a hand-cranked reel and equipped with an alarm and light signal that indicates when the probe has encountered groundwater. The probe at the bottom of the tape will be lowered into the well to the point at which the alarm or signal device indicates groundwater. The water level (depth from the surveyed datum) will then be recorded to the nearest ±0.01 foot, with the measurement time on the fluid-level measurement form. Duplicate measurements will be taken at each well and will be recorded on the Fluid Level Measurement Form.

4.2.4 Measurement of NAPL

The presence and thickness of light and dense non-aqueous phase liquid (NAPL), if present, will be measured with an electronic interface probe, which is a measuring tape with a probe that is capable of distinguishing between fluids of different electrical and physical properties. With this type of measuring tape, it is possible to measure thicknesses of different fluids.

The interface probe will be lowered down the monitoring well to the point where the alarm or signal device indicates the first fluid level, and the depth of the interface probe will be recorded. The interface probe will then be lowered further down the monitoring well to the point where the alarm or signal device indicates a second fluid level, if any, and the depth of the interface probe recorded.

If the interface probe responds positively to NAPL, the depth (to ±0.01 feet accuracy), and the time of measurement will be recorded on the fluid-level measurement form included in Attachment 1. If no measurable thickness of NAPL is present in the well, but a sheen, substantial odor, discontinuous NAPL, or other evidence of NAPL is observed, the field crew will note their observations on the fluid-level measurement form. If NAPL is present, a sample of the product will be collected, if possible, and the specific gravity of the fluid will be measured in order to calculate the pizeometric water surface elevation in the well.

The interface probe will also be used to measure the total open depth of the well, by lowering the interface probe into the well as deep as it will go. This depth will be recorded to the nearest ±0.01 feet on the fluid-level measurement form. The probe will be decontaminated as described in Section 7.0.

4.2.5 Well Purging

To assure representative sample collection, the monitoring wells will be purged a minimum of three well casing volumes of water, using a submersible pump, before sampling. The tubing fitted to the pump will be laboratory grade polyethylene or reinforced PVC, and will be dedicated to the specific well in which it is used. The pump position during purging will be at the top of the water column and lowered as necessary to remove stagnant water from the well column. The pumps will be lowered to the minimum depth at which they will purge the well without going dry to minimize disturbance of sediment in the well and pump intake zone. A safety line will be secured to the pump for raising and lowering the pump down the well. Cumulative discharge from each well will be determined either manually (e.g., by periodically filling a bucket of known volume), through the use of a flow meter attached to the pump's discharge tubing, or by

use of a measuring stick if discharge is directly into a tanker truck or barrel of known volume. The pumps will be of appropriate design to purge the well given the hydraulic conditions encountered. All well sampling equipment will be decontaminated in accordance with methods and procedures outlined in Section 6.0 of this FSP.

Prior to groundwater sample collection, the initial depth-to-water and total well depth is recorded for each well on a field data sheet and used to estimate the volume of groundwater within the well casing. Each well is then purged using a 2-inch diameter, submersible Grundfos® pump.

During purging, field measurements of pH, temperature, specific conductance, and turbidity will be made. During well purging, periodic field measurements of temperature, electrical conductivity, pH, turbidity, DO, and redox potential will be collected using a Data Sonde® meter fitted with an in-line, flow-through sampler. Three sets of field measurements will be collected for each well-casing volume of groundwater removed. Purging of the well continued until at least three well-casing volumes had been removed from the well, and field parameters had stabilized to within 5 percent of the previous reading. If the field parameters have not stabilized after five well casing volumes have been removed, purging will stop and the water samples will be collected. The field parameters will be recorded on the Field Sampling Data Form which is included as Attachment 1 of this FSP.
Purged water will be stored in 55-gallon drums or a polyethylene tank at each well head during purging and transported to the storage area described in the IDW management procedures when the sampling day is complete. For wells that will generate large volumes of purge water, the water may be discharged directly into a vacuum truck during the purging process.

4.2.6 Sample Collection

Following completion of well purging, the pumps, tubing, and safety line will be removed from the well. The primary groundwater sampling method will use a cleaned Teflon, stainless steel, or new disposable polyethylene bailer lowered into the well using a length of new nylon rope.

Samples will be collected from the monitoring wells as soon as 80 percent of the original volume of the well has recovered, or within a maximum of 12 hours. The time required to purge a well will be recorded on the Field Sampling Data Form included in Attachment 1.

Sampling will be performed from wells having the least impact to the greatest impact. Samples will be collected from each well in the order of analyte volatility, with VOCs (BTEX and HVOC) collected first. The depth of VOC sample collection within the well's screened interval will correspond with relative density to water of the constituent of concern. The preservative, hydrochloric acid (HCl), will be added to the VOC sample bottle prior to introducing the sample water. The sample will be poured from a bailer or pumped directly using a slow, controlled pour down the side of a tilted sample vial to minimize volatilization. The sample vial will be filled until a meniscus is present, then immediately sealed. When the bottle is capped, it will be inverted and gently tapped to ensure that no air bubbles are entrained in the vial. Vials with trapped air will be carefully refilled until no bubbles are present. These samples will not be composited, homogenized, or filtered.

Following collection of VOC samples, remaining water samples will be collected in inverse order to their volatility. Samples collected for TPH, TRPH, and semi-volatile compounds will be collected as described above, and decanted into one liter, amber glass containers having screw caps with Teflon liners. The samples will be preserved as appropriate. Samples collected for metals analysis will be filtered in the field prior to introduction into sample bottles and prior to preservation. Samples will be filtered by pumping the sample through an unused, disposable, 0.45-micron filter directly into the sample bottle. The sample will be acidified in the sample bottle with nitric acid. Specific requirements regarding constituent of concern-specific containers, and sample preservation are presented in the QAPP.

Sampling NAPL - If a sample of NAPL is desired the sample will be collected using the following protocol. The NAPL sample will be collected by means of a double check valve bailer secured and lowered with clean nylon cord. The NAPL sample will be collected, preserved, handled, stored, and shipped in a manner consistent with the collection of groundwater samples for VOC analysis. The COC form for the NAPL sample shall include the description of the sample as "pure-phase organic material".

Samples designated for laboratory analysis will be collected in appropriate containers according to the QAPP. Collected samples will be recorded on the Field Sampling Data Form. All samples will be labeled with the collector's initials, a unique sample identification number (well identification), time of sampling, date, location, sample type, analytical method, and preservative used. Complete COC forms will accompany the samples to the designated laboratory as described in Sections 6.4 of this FSP and in the QAPP.

4.3 CPT Borings Sampling Procedures

Cone Penetrometer (CPT) boring and groundwater sampling for the Revised Master Work Plan may be conducted at the Site.

4.3.1 CPT Borings

CPT provides identification of lithologic units using an instrumented probe, with a conical tip and friction sleeve, to measure various geologic, geotechnical, and hydrologic parameters, by correlating penetrative resistance on the cone tip, frictional resistance along the cylindrical friction sleeve, probe inclination, and pore water pressure. The data generated from the CPT measurements can be used to identify changes in subsurface lithology and aid in assessing potential intervals for the collection of groundwater samples.

The CPT probe, which is attached to a string of steel pipe segments, can be pushed into the ground using a truck-mounted, hydraulic ram with a maximum reaction of 25 tons. The probe can be advanced at an approximate rate of 2 centimeters per second, while measurements are recorded continuously and relayed directly to an on-board computer. Lithologic and hydrologic data based on cone tip resistance, sleeve friction, probe inclination, and pore water pressure measured by the cone-tipped probe are printed out by the computer as the probe advances. The CPT boring will be grouted to approximately 1 foot bgs with a cement/bentonite slurry using a

tremie pipe. The remainder of the boring will be filled with topsoil or pavement to be consistent with site surface conditions.

5.0 AQUIFER TESTING

The following tests and procedures will be used to evaluate the hydraulic indices associated with the Exposition Aquifer at the Site. The data collected during these tests will be incorporated into the CSM.

5.1 Slug Tests

Rising head slug tests will be conducted in a select number of monitoring wells to assess variations in hydraulic conductivity in the water bearing zone. This information will be utilized to characterize preferential groundwater flow pathways and to produce estimates of the rate of contaminant movement in groundwater.

5.2 Step Drawdown Tests

The first stage of each aquifer test is a step drawdown test during which the rate of well discharge is increased in steps. The purpose of this test is to provide an estimate of the maximum rate of sustainable groundwater discharge for the well. During each step, the depth of groundwater is monitored until a preliminary equilibrium is apparent between the rate of discharge and the rate of groundwater recharge. When a discharge rate exceeds the recharge rate for a given well, the water level continues to drop and the test is stopped. A backflow prevention valve will be used in the discharge pipe to prevent water within the test discharge pipe from flowing back into the well when pumping is ended. Data from the step drawdown test are used to estimate a groundwater pumping rate for the continuous discharge test.

5.3 Constant-Rate Discharge Test

The second stage of each aquifer test is a continuous discharge pumping test. This test is not conducted until the aquifer surrounding the test well has recovered to within one percent of the static water level measured before the beginning of the step drawdown test. During the second stage, the well is pumped at a maintainable constant rate as determined from the step drawdown test. Water levels are measured in nearby observation wells at predetermined time intervals using transducers and an electronic data logger, by manual water level measurements using a conductivity based electric sounder, or a combination of both.

The aquifer tests will be conducted using a submersible pump and appropriate plumbing to achieve a consistent sustainable discharge throughout the test. Pumping will continue until data analysis indicates the water level has stabilized in the pumping and observation wells (an estimated duration of 24 to 72 hours). Following completion of the continuous discharge test, the well recoveries will be monitored in the same manner as the drawdown until pre-pumping water levels have been attained.

Data will be analyzed using appropriate techniques to estimate aquifer transmissivity, storativity, and hydraulic conductivity. Aquifer characteristics will be calculated and incorporated into the Site CSM to assess groundwater flow and contaminant movement in the saturated subsurface.

6.0 SAMPLE HANDLING AND ANALYSIS

Sample handling and analysis procedures consist of sample preparation, sample designation, sample chain of custody, sample shipping procedures, and interaction with the analytical laboratory. With the assistance of the field Work support function, the sampling team will be responsible for collecting samples, preparing samples for shipment, completing all necessary paperwork, decontaminating sampling equipment, properly labeling samples, and completing sample collection data forms and COC forms. These forms will be completed using indelible ink. Any correction to a form will be made by drawing a line through the error and reentering the correct information, without obliterating the original entry. Anyone correcting an original form will initial and date all changes. Field documentation is described in detail below.

6.1 Quality Control Samples

Quality assurance/quality control (QA/QC) samples for the Revised Master Work Plan will consist of trip blanks, field equipment blanks, field duplicate blanks, and laboratory quality control samples. QA/QC samples will be collected and analyzed to establish quality control of laboratory analytical results. A discussion of field QA/QC samples is presented and a summary of the different QA/QC samples that will be collected during Revised Master Work Plan activities is presented in the QAPP.

Trip blanks will be collected to indicate potential field contamination associated with volatile organic sampling. Trip blanks will be included at a frequency of one per shipment of water VOC samples each sampling event. A trip blank is a volatile organic compound (VOC) sample vial filled in the laboratory with ASTM Type II reagent grade water, transported to the site, handled like a sample, and returned to the laboratory for analysis.

Equipment blanks will be used to provide information on the extent of potential cross-contamination at the Site. Equipment blanks will be collected at a frequency of one per day, per team, per matrix. Additional equipment blanks may be collected after decontamination of suspected highly contaminated samples. An equipment blank consists of commercially-distilled grade water that is poured through or over the sampling device, transferred to a sample bottle, and transported to the laboratory for analysis. The equipment blank should be poured immediately after the equipment has been decontaminated.

One field duplicate sample will be collected for every 10 water samples collected. Field duplicates are two samples collected independently from one sampling location during a single act of sampling.

A discussion of laboratory QA/QC procedures is presented in the QAPP.

6.2 Sample Preparation

6.2.1 Sample Containers, Preservation, and Holding Times

Sample containers, preservation methods, and holding times for the various analyses are presented in the QAPP. All samples prepared in the field will follow these protocols. All sample vials and bottles containing preservatives must be so labeled by the laboratory before samples are collected. With the exception of samples that require special handling and preservation, all samples will be stored in coolers chilled to 4 degrees Celsius for shipment to the appropriate analytical laboratory. Sample containers will not be reused. Samples will be shipped to the laboratory within a time frame to allow for extraction and analysis to be performed within the holding times described in the QAPP.

6.2.2 Sample Labels

A sample label will be completed and attached to each sample container for every sample collected. Labels are made of a waterproof material backed with a water-resistant adhesive. Labels are to be filled out using waterproof ink, and are to contain at least the following information:

- sampling date and time
- sample identification number
- investigation location
- sampler's initials
- analyses to be conducted

6.2.3 Sample Collection Data Forms

During well development, well purging, groundwater sampling, and fluid level measurement field activities, appropriate field log forms will be completed by the individual collecting the data for each sample. These forms will contain pertinent project, boring, sample station or well location information.

The following information will be entered on the each respective sample collection data form at the time of sampling:

- project name and number
- investigation location
- well, boring, surface water sample station, sediment sample station, or drainage sample identification number
- sampler's initials
- time and date of sampling
- sampling method
- sample identification number
- volume of each sample container
- laboratory analyses requested

- purged volume (wells)
- purge time (wells)
- well depth and diameter
- observable water conditions (e.g., color, odor, clarity)
- groundwater level before and after sampling
- field conditions (e.g., recent precipitation, ambient temperature)
- equipment used
- indicator parameter measurements (pH, temperature, specific conductance, redox, turbidity, dissolved oxygen)

6.2.4 Field Activities Log Book

A bound field log book will be used to record daily field activities. This bound field log book will provide a general chronology of each day's field activities, and a record of personnel present at the Site. In addition, a description of all samples obtained will be included. This description may reference other documents prepared during the sampling day such as boring logs, and other sample collection forms.

6.3 Sample Designation

6.3.1 Primary, Duplicate, or Split Samples

Each primary, duplicate, or split soil, sediment, and water sample collected will be identified with an alphanumeric code. The first sequence of characters will be letters, and will identify the sample source:

Sample Source Code	Sample Source
SB	soil boring
MW	groundwater monitoring well

The next sequence of characters will be numbers, and will identify location number. The next sequence of characters will also be numbers, and will identify the depth from which the sample was collected. For example, a soil sample collected from a soil boring 01 at a depth of 5 feet will be SB-01-05. Depth indication code will not be used for groundwater monitoring well samples.

The next sequence of characters for groundwater samples will identify the type of sample, as described below:

Sample Type Code	Sample Type
(no code)	field sample
B	duplicate sample
C	trip blank

Sample Type Code	Sample Type
D	equipment blank
F	filtered sample

For example, SB-01-05 would denote the first soil sample at 5 feet, collected as a field sample. All information necessary to identify each sample, and the corresponding sample code, will be recorded on the appropriate field forms. Identification of duplicate samples must not be made obvious on the sample label. These will be submitted blind to the laboratory.

6.4 Chain of Custody

COC will be prepared for groups of samples collected at a given location on a given day. Each COC will be prepared in triplicate and will accompany every shipment of samples to the laboratory.

One of the three copies will accompany the samples to the laboratory. One copy will be kept in the QA/QC file, and the one copy will be retained in the project file. The COC form makes provision for documenting sample integrity and the identity of any persons involved in sample transfer. Information entered on the COC will consist of the following:

- project name and number
- field logbook number
- COC serial number
- project location
- sample numbers
- sampler/recorder's signature
- date and time of collection of each sample
- collection location
- sample type
- analyses requested
- inclusive dates of possession
- name of person receiving the sample
- date of receipt of sample
- name, address, and telephone number of laboratory

A custody seal will be used when the samples are shipped through a common carrier (ie. Federal Express). As no chain-of-custody signature will document the shipment, a custody seal will be affixed to the outside of each cooler across the container opening.

6.5 Sample Shipping Procedures

The method of shipment may be hand delivery by field personnel, laboratory courier, or commercial shipping services (such as UPS or Federal Express). The method of sample shipment will be noted on the COC. If samples to be kept cool are to be held for longer than 24 hours, the samples will be placed in a refrigerator or similar insulated cooling container and maintained at approximately 4 degrees Celsius.

6.6 Interaction with the Laboratory

The *Field Team Leader,* or their designee, will interact with the laboratory for sampling schedules and to coordinate adequate laboratory availability. The Field Team Leader is responsible for laboratory coordination. Field sampling activities will not start until the necessary laboratory equipment and personnel availability has been arranged. Once a shipment has been made, the laboratory will be contacted to provide specific information about the sample shipment, including the number of samples, types of samples, destination of samples, and analysis to be performed.

7.0 SAMPLING EQUIPMENT DECONTAMINATION

All equipment used during Revised Master Work Plan activities that could possibly come into contact with potentially chemically-affected materials will be thoroughly cleaned, before and after each use, by washing with high pressure hot water and/or washing with Alconox® (a laboratory-grade detergent), and de-ionized or distilled water.

Drilling equipment, including drill pipe, samplers, etc., will be washed with high pressure hot water prior to use at the Site. At the Site, high pressure hot water washing will be performed at the decontamination area where the rinsate will be collected for disposal.

Between soil sampling intervals, the soil samplers will be cleaned with an Alconox solution and rinsed with potable water. Before each drilling operation, any portions of the rig that may come in contact with sampling materials will be washed with high pressure hot water. Groundwater sampling and field equipment will be decontaminated as follows:

- Accessible exterior and interior portions of groundwater pumps will be washed using high pressure hot water or washed with an Alconox solution before use at each sampling location. Unreachable interior pump areas will be cleaned either by flushing near-boiling clean water through the pump and discharge lines, or by flushing the pump and discharge lines with an Alconox solution and rinsing with de-ionized or distilled water.

- Teflon or stainless steel bailers will be washed with high pressure hot water or washed with an Alconox solution and triple-rinsed with clean water before use at each sampling location. Bailer ropes will be replaced after use in each boring or well/piezometer and, while in use, will be protected from contact with the ground or chemically affected equipment and/or skin.

- Between boreholes, electric water-level meters, interface probes, transducers, and water quality meters which may be used in the borehole will be decontaminated as follows:

- If particulate matter or other debris is present on the equipment, a tap water rinse may be applied to remove the debris.
- If particulates or other debris are still present, or if the probe has come into contact with NAPL, it will be scrubbed or washed with Alconox.
- The probe will be rinsed with a solution of Alconox and de-ionized or distilled water.
- The probe will be triple rinsed with de-ionized or distilled water.
- The tapes for the interface probe and the water-level meter will be decontaminated using the same steps, but will be wiped with paper towels and rinsed with potable water.

- Any re-usable filter apparatus, if necessary, will be washed with Alconox and triple rinsed with distilled water. New fittings and new 0.45-micron filters will be used at each sampling location, and factory-new Tygon or polyethylene tubing will be dedicated for use in each well.
- Borehole probes used by the CPT or Geoprobe rig will be washed with high pressure hot water before use. If NAPL, or relatively "high" concentrations of chemical constituents, are encountered an Alconox wash will be used on the probe.
- Decontamination fluids will not be reused in between wells. After each decontamination round, the tubs and/or splash containers will be emptied into appropriate containers for appropriate waste management.

8.0 WASTE DISPOSAL

The following subsections describe the procedures that will be used to characterize and handle waste materials generated during Revised Master Work Plan activities at the Site.

8.1 Introduction

Field activities are planned that will generate both solid and liquid wastes that will require handling, testing, treatment, storage, disposal, and/or other on- and off-site management. Managing IDW wastes requires classification for each investigation-derived residual. Hazardous Wastes are identified and managed in the context of the following applicable relevant and appropriate requirements (ARARs). RCRA Subtitle C regulations for management of IDWs if RCRA Subtitle C hazardous wastes are also identified below. California statutes and regulations are also identified and observed herein. Specifically, California Hazardous Waste Control Law (HWCL; Health and Safety Code 25100), (1) if RCRA Subtitle C hazardous wastes are identified, or (2) if non-RCRA hazardous wastes are identified (California Hazardous Wastes).

The term "Hazardous Waste" as used in this IDW Plan refers to regulated hazardous waste as identified in Subtitle C of RCRA and 40 CFR Part 261. IDW containing the above listed "Hazardous Wastes" will be reclassified as non-hazardous prior to disposal in the event that it is determined that IDW does not meet criteria of a "characteristic waste" as defined in 40 CFR 261.1 Subpart C or of a "listed waste" as defined in 40 CFR 261.1 Subpart D.

While it remains on-Site, IDW will be managed in compliance with the requirements of 40 CFR 262.34 and Part 265, Subpart I for container management. IDW will then be transported to an off-Site facility for management in accordance with applicable state and federal Hazardous Waste regulations and other requirements. Versar and CENCO will implement all other appropriate management procedures for IDW classified as Hazardous Waste in accordance with applicable laws.

The field activities that are expected to produce wastes will include, but not be limited to, drilling of soil borings; groundwater monitoring well installations; soil sampling; groundwater monitoring well development and sampling; aquifer testing; implementation of interim remedial measures; field work related to treatability studies (TS); and any other field activities which require the use of personal protective equipment (PPE). Wastes generated from these activities will include, but not be limited to, soil; aqueous fluids (e.g, groundwater, drilling fluids); decontamination fluids; and solids (e.g., PPE). This IDW Plan describes storage, characterization, management, and treatment and/or disposal procedures for each type of waste, and is organized by waste type.

8.2 Investigation-derived Solid Waste

8.2.1 Investigation-Derived Soils

Drilling, soil sampling, and well construction are anticipated to generate investigative-derived waste soils. Soil waste may also be generated during interim remedial work (e.g., trenching), if conducted. Additional sources of soil wastes may also be generated from currently unforeseen sources. Soil wastes generated will be stored, characterized, and managed according to the soil characterization and management procedures discussed in this section.

8.2.2 Waste Storage

Soil wastes will be stored in Department of Transportation (DOT)-type 17H 55-gallon drums or other watertight containers (e.g., drop boxes or lined and covered roll-off bins) appropriate for Hazardous Waste. Alternative storage containers might be utilized if conditions require such use. A label will be affixed to each container which will provide the following information:

- drum/container number
- media of waste (soil, purge water, drill cuttings, etc.)
- sampling locations from which the waste was derived
- date of collection
- name of the generator
- contact information in the event of an emergency

The label to be used for containerized soils is included in Attachment 1.

In addition, pertinent information will be documented for each container on a Drum Inventory Sheet (see Attachment 1). The following information will be recorded on the Drum Inventory Sheet.

- sampling location(s)
- approximate volume of waste
- date collected
- characterization sample designation and date collected
- name of person filling the container
- comments (relevant observations)
- characterization results

At the end of each work day, all wastes generated will be moved to the on-Site Investigation-Derived Waste Storage Area (IDW Storage Area), located adjacent to the CENCO facility On-site laboratory in Operational Area 2. All IDW will be properly disposed within 90 days.

8.2.3 Waste Characterization

Chemical characterization will determine whether or not the waste soils are Hazardous Wastes according to the following procedures. A single composite sample from each sampling location (e.g., each soil boring) will be submitted to a certified laboratory for characterization analysis. Each composite sample will be composed of mixing grab samples equal in number to the approximate number of cubic yards of material from each sampling location. For sampling locations with a residual soil volume requiring containment within more than one drum, a composite sample will consist of a grab sample from each drum. Composite samples will be placed into coolers as specified in the QAPP and appropriately labeled. The characterization samples will then be transported using chain-of-custody procedures to the analytical laboratory for analysis as described below.

Soil containing detectable concentrations of Hazardous Substances and meeting the definition of a "listed waste" will be classified as RCRA Subtitle C listed Hazardous Waste. Samples not classified as "listed" Hazardous Waste based on total VOCs will be analyzed as described below, and classified as characteristic Hazardous Waste if the appropriate regulatory threshold is exceeded.

Parameter	Analytical Method	Regulatory Threshold
Total Metals	EPA Method 6010	TTLC[1]
Soluble Metals	TCLP[2], WET[3], EPA Method 6010	TC[4], STLC[5]
Soluble VOCs	TCLP[2], WET[3], EPA Method 8240	STLC[6]

Notes:

1. TTLC for Inorganic Persistent and Bioaccumulative Toxic Substances specified in 22 CCR 66261.24(a)(2)(A)
2. Toxicity Characteristic Leaching Procedure (TCLP), EPA Method 1311, specified in 22 CCR, Division 4.5, Chapter 18, Appendix VIII and 40 CFR 261.24(a)

3. California Waste Extraction Test (WET) specified in 22 CCR, Division 4.5, Chapter 11, Appendix II
4. Toxicity Characteristic (TC) level specified in 22 CCR 66261.24(a)(1)(B) and 40 CFR 261.24(a)
5. Soluble Threshold Limit Concentration (STLC) for Inorganic Persistent and Bioaccumulative Toxic Substances specified in 22 CCR 66261.24(a)(2)(A)
- STLC for Organic Persistent and Bioaccumulative Toxic Substances specified in 22 CCR 66261.24(a)(2)(B)

If soil not otherwise classified as Hazardous Waste based on the analyses described above is suspected of containing petroleum constituents based on odor, discoloration, or elevated PID readings, samples may be analyzed for TPH by EPA Method 8015M. Although TPH values are not directly applicable to Hazardous Waste classification they are useful in selecting an appropriate disposal facility.

The frequency of the analyses described above may be reduced when sufficient analytical information is obtained to allow classification of the waste based on knowledge of its hazardous characteristics, pursuant to 22 CCR 66262.11 and 40 CFR 262.11.

8.2.4 Hazardous Soil Management

During the placement of wastes in containers, certain wastes or portions of wastes exhibiting potential indicators of significant contamination (e.g., elevated PID readings, discoloration, odor) will be segregated from the remaining soil under the direction of supervising field personnel to minimize the amount of Hazardous Waste that may need to be managed.

Upon classification of the waste material, the waste will be manifested accordingly, and transported for off-Site treatment and/or disposal within 90 days of generation in accordance with applicable regulations including, but not limited to: RCRA, California HWCL, CERCLA, and Department of Transportation (DOT) regulations. Waste manifests will be accompanied by a land disposal restriction (LDR) notification of certification, to the extent that LDR requirements are applicable. The container will be appropriately labeled and the Drum Inventory Sheet will be updated. An example of the label to be placed on containers with Hazardous Waste is included in Attachment 1. Hazardous Waste will be manifested under the name "CENCO Refining Company". An authorized representative of CENCO will sign all manifests on behalf of and as agent for CENCO, which will be the sole generator of IDW during the field activities. The transporter of this material will be a fully licensed Hazardous Waste transporter having adequate insurance policies in effect for environmental impairment liability, workers compensation and comprehensive general liability. Each vehicle will carry the required documentation and display the appropriate material placards. Hazardous Waste solids will be treated or disposed at an appropriately permitted Hazardous Waste facility.

Soil that has been determined to be Hazardous Waste will be sent for off-Site treatment and/or disposal at a permitted RCRA Subtitle C or State-permitted facility, as appropriate, depending on the waste classification. A record of pertinent information for handling and management of each waste container shall be completed by the Facility Characterization Team Leader or his/her designee on a Drum Inventory Sheet.

8.2.5 Non-Hazardous Soil Management

Soil that has been determined not to be Hazardous Waste may be classified and managed as non-hazardous and/or solid waste. These wastes will be sent for off-Site management at a permitted RCRA Subtitle D or Class III waste facility. Alternatively, pending the soil volume, logistics, and cost, the Project Manager may decide to manage the non-hazardous waste as a Hazardous Waste (e.g., where minimal quantities are involved) where it is clearly shown to be more cost effective, for example when the cost of classification exceeds the cost of off-Site Hazardous Waste management. A record of pertinent information for handling and management of each waste container shall be completed by the Field Team Leader or his/her designee on a Drum Inventory Sheet.

8.2.6 Disposable Sampling Equipment, Personal Protective Equipment (PPE), and Other Discarded Solids

Other solids which require appropriate waste handling and off-Site management include disposable sampling equipment, disposable PPE, drilling supply wastes (unused sand, bentonite, cement, concrete, pipe, and empty materials containers), and residuals from a treatability study (TS), if conducted, or from interim remedial measures (IRMs).

Disposable sampling equipment, PPE, and other discarded solids which do not meet the criteria of a Hazardous Waste will be sent for off-Site management at a permitted RCRA Subtitle D or Class III waste facility. Contact wastes described herein include material and equipment which are exposed to environmental contaminants and have the potential to become contaminated during the field work. Such contact wastes may require decontamination to meet the requirements of a non-hazardous classification. Non-contact wastes described herein include discarded materials and trash which is not exposed to environmental contaminants.

8.2.7 Contact Wastes

Contact wastes described in this IDW Plan include disposable equipment and materials which come into direct or indirect contact with contaminated IDW materials. The following subsections describe storage, characterization, and management of solid Contact Wastes.

8.2.7.1 Waste Storage

Contact wastes will be stored in DOT-type 55-gallon drums or equivalent watertight containers. These wastes will be stored in the near the on-Site laboratory in Operational Area 2 for a period not exceeding 90 days.

8.2.7.2 Waste Characterization

Contact wastes will be classified using the procedure described in Section 2.1.2 of this IDW Plan, with the exception of any PPE, disposable sampling equipment, or other solids that are classified as "hazardous debris" pursuant to 22 CCR 66260.10 or 40 CFR 268.2(g). These excepted materials may be rendered non-hazardous by treatment using a technology specified in 22 CCR 66268.45 or 40 CFR 268.45, pursuant to 22 CCR 66261.3(e)(1) or 40 CFR 261.3(f)(1).

Hazardous debris treated in this manner may then be classified as non-hazardous waste, placed in appropriate containers, and transported to a permitted RCRA Subtitle D or Class III waste management facility.

8.2.7.3 Waste Management

At the end of each field work day, Contact Wastes will be transported to the IDW Storage Area near the on-Site laboratory in Operational Area 2. Any PPE, disposable sampling equipment, or other solids that are determined to be Hazardous Waste or that are classified as hazardous debris, and that are not treated in accordance with the procedures described above, will be temporarily stored in 55-gallon drums and managed in accordance with applicable federal and state Hazardous Waste regulations until transported to an appropriately permitted Hazardous Waste treatment or disposal facility within 90 days. A record of pertinent information for handling and off-Site management of each waste container shall be completed by the Field Team Leader or his/her designee on a Drum Inventory Sheet.

8.2.8 Non-Contact Wastes (Trash)

Non-Contact Wastes such as normal refuse which does not directly or indirectly contact contaminated media generated during the RI/FS investigation will be properly contained, stored, and disposed of at a permitted RCRA Subtitle D or Class III waste management facility. The waste will be placed in a dumpster or other appropriate receptacle for solid waste and picked up as part of the regular trash service for the Site.

8.2.9 Management of Empty Containers

Any drums or drum liners used for interim storage of IDW will be managed according to procedures set forth in 40 CFR 261.7 and 22 CCR 66261.7. The drums will then either be sent to a drum reconditioner or will be disposed at a permitted RCRA Subtitle D or Class III waste management facility. Empty containers that have been utilized to store Hazardous Wastes will be stored in the IDW Storage Area for no longer than 90 days.

8.3 Investigation-derived Liquid Wastes

8.3.1 Groundwater and Drilling Mud

Liquid wastes will be produced by field activities such as completion of soil borings from air rotary and mud rotary methods, development of newly installed groundwater monitoring wells, purging wells before sampling, and from aquifer tests. Additional sources of potentially liquid wastes which have not been identified at this time may be produced.

8.3.1.1 Waste Storage

Upon collection, liquid wastes will be placed into either DOT-type 17E or 17H 55-gallon drums (closed top with 2-inch bung) or other appropriate containers (mobile tank, tanker truck, or watertight polyethylene tank). If liquid wastes are not transferred directly into tanker trucks, any

55-gallon drums will be temporarily stored at the IDW Storage Area pending waste classification before final handling and disposal. Larger storage containers will be utilized on an as-needed basis, which may be placed outside the IDW Storage Area based on practicality considerations. Liquid wastes will be stored, labeled, and handled according to the procedures described in this section.

8.3.1.2 Waste Characterization

For liquid waste, one characterization sample will be collected per storage container, unless multiple containers are used to store liquid waste from the same source (e.g., a monitoring well), in which case a subsample will be collected from each container and combined to form a single sample for analysis. All samples will be analyzed for VOCs using EPA Method 8240. If PCBs are detected in soil samples collected from suspected PCB source areas or IDW soils, IDW liquids will also be analyzed for PCBs by EPA Method 8080. The potential presence of PCBs in soil may indicate their presence in groundwater. Liquid wastes containing detectable Hazardous Substances will be classified as Hazardous Waste. Liquids wastes that do not contain detectable Hazardous Substances will be classified as a characteristic Hazardous Waste if they contain other VOCs above the following levels:

STLC for Organic Persistent and Bioaccumulative Toxic Substances specified in 22 CCR 66261.24(a)(2)(B) TC level specified in 22 CCR 66261.24(a)(1)(B)

Samples not containing VOCs above these limits may be analyzed for the metals specified in 22 CCR 66261.24(a)(2)(A) using EPA Method 6010. Fluids will be classified as a characteristic Hazardous Waste if the following levels are exceeded:

- STLC for Inorganic Persistent and Bioaccumulative Toxic Substances specified in 22 CCR 66261.24(a)(2)(A)

- TC level specified in 22 CCR 66261.24(a)(1)(B) and 40 CFR 261.24(a)

If liquid wastes not otherwise classified as Hazardous Wastes based on the analyses described above are suspected of containing petroleum constituents based on odor, discoloration, or elevated PID readings, samples may be analyzed for total petroleum hydrocarbons (TPH) by EPA Method 8015M.

The frequency of analyses described above may be reduced when sufficient analytical information is obtained to allow classification of the waste based on knowledge of its hazardous characteristics, pursuant to 22 CCR 66262.11 and 40 CFR 262.11.

8.3.1.3 Non-Hazardous Liquid Management

If liquid wastes are either non-hazardous or treatable on-Site, they may be treated on-Site using a temporary, stationary, or mobile water treatment unit. Non-hazardous or treated liquid wastes may then be discharged to the local publicly owned treatment works (POTW) via the sanitary

sewer. All required permits will be obtained prior to discharge. If liquid wastes are transferred directly into tanker trucks, the trucks will transport the liquid wastes to a permitted off-Site treatment or disposal facility at the end of the work shift, and the liquid wastes will be characterized and appropriately managed. Containers will be labeled and handled in the manner described in Section 8.3.1.1. An example of the label to be placed on containerized liquid wastes is included in Attachment 1.

8.3.1.4 Hazardous Liquid Management

Liquid IDW will be stored, handled, and otherwise managed as if it were a Hazardous Waste, except for being labeled as such, until laboratory results are received. Containers will be labeled as described in Section 8.3.1.1.

Hazardous Waste liquids that are temporarily stored on-Site at the IDW Storage area will be managed in a manner similar to that of hazardous soils, according to protocols described in Section 2.1.3. An example of the label to be placed on containers with Hazardous Waste is included in Attachment 1.

8.3.2 Decontamination Rinsate

Decontamination rinsate will be generated when cleaning drilling equipment with high-pressure hot water, rinsing drums, and decontaminating sampling equipment, PPE, and possibly from other sources. The liquid waste from decontaminating the equipment may contain some quantity of solvents and detergents used during the decontamination process. The following sections discuss the management of these wastes.

8.3.2.1 Waste Storage

Upon collection, the decontamination liquid wastes will be placed into either DOT-type 17E or 17H 55-gallon drums (closed top with 2-inch bung) or other appropriate containers (e.g., mobile tank, tanker truck, or watertight polyethylene tank). If liquid wastes are not transferred directly into tanker trucks, they will be temporarily stored at the IDW Storage Area pending waste classification before final handling and disposal. Decontamination liquids derived from equipment and PPE decontamination will be contained during decontamination and transferred to 55-gallon drums (such as DOT type 17E, closed top with 2-inch bung or type 17H), liquid containers, or other containment devices such as watertight polyethylene tanks. Decontamination liquids may be mixed with other liquids, such as purge water. Decontamination liquids will be stored in the IDW Storage Area pending characterization and disposal according to protocols for handling described in Section 8.3.1.1. Based upon the results of media characterization results, liquid wastes may be discharged to the CENCO clarifier adjacent to the laboratory in Operational Area 2.

8.3.2.2 Waste Characterization

Decontamination fluids will be characterized according to procedures described in Section 8.3.1.2.

8.3.2.3 Steam Cleaning Fluids

A decontamination area will be constructed in proximity to Site work areas. The area will be bermed, will be lined with a minimum thickness of 20-mil plastic sheeting, and will be large enough to decontaminate drilling and other large equipment. The 20-mil plastic sheeting will be inspected regularly in order to maintain integrity during completion of the described activities. Decontamination procedures are described in Section 6.0. Steam cleaning liquids will be stored, characterized and managed in a manner consistent with other IDW liquids. If drillers or other subcontractors have decontamination systems as part of their services, Versar will evaluate the system prior to use at the Site. Based upon the results of media characterization results, liquid wastes may be discharged to the CENCO clarifier adjacent to the laboratory in Operational Area 2.

8.3.2.4 Equipment/PPE Decontamination Liquids

Small sampling equipment such as Modified California Samplers, soil core barrels, electric sounders, and geophysical tools will usually be decontaminated at the soil boring or well site. Other equipment such as submersible pumps, well casings, and large bailers will be decontaminated within the work area decontamination area described above. PPE may be decontaminated at the sampling site contamination reduction zone, or in the Decontamination Area. Decontamination procedures are described in Section 6.0. Decontamination liquids will be stored, characterized and managed in a manner consistent with other IDW liquids. Based upon the results of media characterization results, liquid wastes may be discharged to the CENCO clarifier adjacent to the laboratory in Operational Area 2.

8.4 Reporting Requirements

8.4.1 Hazardous Materials Manifests

EPA Hazardous Waste Manifests will be properly completed and signed by authorized representatives/agents of the generator, hauler, and appropriately permitted treatment, storage or disposal (TSD) facility. Manifests will be maintained and handled in strict compliance with all requirements of RCRA. Waste logs completed during Revised Master Work Plan activities will be maintained by CENCO for a minimum period of three (3) years or through the duration of project activities following treatment or disposal of all Hazardous Wastes.

8.4.2 Non-Hazardous Materials

Non-hazardous Waste Manifests will be properly completed and signed by authorized representatives/agents of the generator, hauler, and appropriately permitted treatment, storage or

disposal (TSD) facility. Non-hazardous Waste Manifests and Waste logs completed during Revised Master Work Plan activities will be maintained by CENCO for a minimum period of three (3) years or through the duration of project activities following treatment or disposal of all Hazardous Wastes.

ATTACHMENT 1 - PROJECT FORMS

Boring and Well Log
Fluid Level Measurement Form
Field Sampling Data Form
Monitoring Well Development Form
Chain-of-Custody Record
Drum Inventory Sheet
Hazardous Waste Label
Non-Hazardous Waste Container Label

Versar INC | **BORING AND WELL LOG** | PROJECT NO. _____

Supervising Geologist: Tim Berger, R.G. 5225	Site Name:
Log By:	Boring No:
Date:	Boring Diameter:
Drilling Contractor:	Boring Depth:
Contractor Lic. No.	Boring Location:
Rig Type:	
Driller:	

Depth (ft)	Advanced/Recovered	Retained	Blow Counts	First Water/ Water Table	Well Construction	USCS Group	Lithology	USCS SOIL DESCRIPTION SOIL CONDITION AND GEOLOGIC INTERPRETATION SOIL TYPE, COLOR, MOISTURE, STAINING, DENSITY, ODOR, SORTING, PERCENT FINES, ROUNDING, SECONDARY POROSITY GEOLOGY: FILL, ALLUVIUM, BEDROCK	Headspace (ppm)

FLUID LEVEL MEASUREMENT FORM

Project Number:	Site Name:
Date:	Measure Device/ID No.:

Monitoring Well ID	Time	Depth to Water	Free Product Measurement			Notes
			First Fluid Level	Second Fluid Level	Thickness	

FIELD SAMPLING DATA FORM

Project Number: 3917-	**Site Name:** Cenco Refining Company
Well Number:	**Date(s) Purged:**
OVM - Ambient:	**Purge Method:** Submersible Pump
OVM - Vault:	**Purge Rate:**
OVM - Casing:	**Date & Time Sampled:**
Water Level - Initial:	**Purged & Sampled:**
Water Level - Final:	**Sampling Method:** Disposable Bailer
Well Depth:	**Free Product:**
Well Diameter: 4 inch	**Sheen:**
Well Casing Volume:	**Odor:**

Time	Purge Water Removed (gal)	Temperature (degrees Fahrenheit)	pH	Electrical Conductivity (µmhos)	Oxidation - Reduction Potential (mV)	Dissolved Oxygen (mg/L)	Turbidity (NTU)

Notes:

MONITORING WELL DEVELOPMENT FORM

Project Number:	**Site Name:**
Well Number:	**Date(s) Developed:**
OVA - Ambient:	**Development Method:**
OVA - Vault:	**Development Rate:**
OVA - Casing:	**Developed By:**
Water Level - Initial: @	**Free Product:**
Water Level - Final: @	**Sheen:**
Well Depth:	**Odor:**
Well Diameter:	**Well Casing Volume:**

Time	Purge Water Removed (gal)	Temperature (degrees Fahrenheit)	pH	Electrical Conductivity (umhos/cm)	Dissolved Oxygen (mg/l)	Turbidity

Field Notes:

Versar INC.

CHAIN OF CUSTODY RECORD

PROJECT NO.	PROJECT NAME	PARAMETERS	INDUSTRIAL HYGIENE SAMPLE Y / N
SAMPLERS: *(Signature)*	(Printed)		

FIELD SAMPLE NUMBER	DATE	TIME	COMP.	GRAB	STATION LOCATION	NO. OF CONTAINERS									REMARKS

Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*	Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*
(Printed)		(Printed)	(Printed)		(Printed)

Relinquished by: *(Signature)*	Date / Time	Received for Laboratory by: *(Signature)*	Date / Time	Remarks
(Printed)		(Printed)		

Distribution: Original Plus One Accompanies Shipment (white and yellow); Copy to Coordinator Field Files (pink).

Drum Inventory Sheet

Project Number:	**Date:**
Client:	**Versar Contact:**
Site Address:	**Client Contact:**
24-hour Contact Telephone Number:	

Drum Number	Date of Generation	Type of Waste	Description of Waste

HAZARDOUS WASTE

STATE AND FEDERAL LAW PROHIBITS IMPROPER DISPOSAL

IF FOUND, CONTACT THE NEAREST POLICE, OR PUBLIC SAFETY AUTHORITY, OR THE U.S. ENVIRONMENTAL PROTECTION AGENCY OR THE CALIFORNIA DEPARTMENT OF HEALTH SERVICES

PROPER D.O.T. SHIPPING NAME _____ UN or NA# _____

GENERATOR INFORMATION:

NAME _____

ADDRESS _____

CITY _____ STATE _____ ZIP _____

EPA ID NO. / MANIFEST DOCUMENT NO. _____ / _____

EPA WASTE NO. _____ CA WASTE NO. _____ ACCUMULATION START DATE _____

CONTENTS, COMPOSITION: _____

PHYSICAL STATE: ☐ SOLID ☐ LIQUID

HAZARDOUS PROPERTIES: ☐ FLAMMABLE ☐ TOXIC ☐ CORROSIVE ☐ REACTIVITY ☐ OTHER _____

HANDLE WITH CARE!

CONTAINS HAZARDOUS OR TOXIC WASTES

CARLTON INDUSTRIES INC. LA GRANGE, TEXAS STOCK NO. 1402CA

NON-HAZARDOUS WASTE

OPTIONAL INFORMATION:

SHIPPER _____

ADDRESS _____

CITY, STATE, ZIP _____

CONTENTS _____

_____

NON-HAZARDOUS WASTE

CARLTON INDUSTRIES INC. 1-800-231-5988 LA GRANGE, TX 10402

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SAMPLING AND ANALYSIS PLAN
PART II

QUALITY ASSURANCE PROJECT PLAN

CENCO OIL REFINERY
SANTA FE SPRINGS, CALIFORNIA

Prepared For:

CENCO REFINING COMPANY
12354 Lakeland Road
Santa Fe Springs, California 90670

Prepared By:

Versar INC
7844 Madison Avenue, Suite 167
Sacramento, CA 95628

January 28, 2000

2026-00/3917-014/JAN28'00

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Attachment 4 - Laboratory Quality Control Manual

1.0 INTRODUCTION

The CENCO Refining Company facility ("CENCO" and "Site") is located at 12345 Lakeland Road in in Santa Fe Springs, California. The term "CENCO" and "Site", as used in this Work Plan, includes the land, buildings, and equipment within the established property boundary at the aforementioned location.

1.1 Purpose and Scope

This Quality Assurance Project Plan (QAPP) describes the policy, organization, functional activities for quality assurance and quality control. Quality assurance (QA) refers to the overall system of activities providing assurance that reliable data have been generated during sampling and analysis. Quality control (QC) is defined as the specific actions taken to ensure that system performance is consistent with established limits. Quality control actions ensure the precision, accuracy, and completeness of analytical data.

The primary objectives of this QAPP are to describe the overall QC measures that will be implemented to ensure that field and laboratory activities will generate reliable data, to recognize deficiencies that may affect the quality of data, and to provide corrective actions where necessary. The QAPP will be used to ensure that proper quality assurance and quality control procedures are implemented during all phases of data acquisition, analysis, and evaluation for the Site and vicinity. The QAPP contains the following sections:

- Section 1.0 - Introduction
- Section 2.0 - Project Organization and Responsibilities
- Section 3.0 - Data Quality Objectives (DQOs) For Measurement Data
- Section 4.0 - Sampling Procedures
- Section 5.0 - Sample Custody
- Section 6.0 - Analytical and Quality Control Procedures
- Section 7.0 - Data Quality Management
- Section 8.0 - Quality Assurance Oversight
- Section 9.0 - References
- Attachment 1 - Laboratory Reporting Limits
- Attachment 2 - Field Measurement and Test Equipment List
- Attachment 3 - Laboratory Precision and Accuracy Goals
- Attachment 4 - Laboratory Quality Control Manual

1.2 Site Background

The CENCO facility is bounded by Florence Avenue to the north, Santa Fe Rail Road to the east, former CENCO facility's office and truck-loading facilities and Lakeland Road to the south, and industrial facilities and Norwalk Boulevard to the west. The CENCO facility is situated in the vicinity of an industrial/commercial area and surrounded by a residential neighborhood. A Site location map is shown on Figure 1 in the Revised Master Work Plan.

The CENCO facility occupies approximately 74 acres and consists of two main areas: 1) Bloomfield Property, and 2) Refinery. Other local facilities formerly operated by Powerine

include: 1) Former Lakeland Property, and 2) Former Aboveground Storage Tank (AST) Area - Walker Property. In addition, Powerine also operated a crude oil transferring pipeline interconnecting the Marine Terminal in Long Beach, and its refinery in Santa Fe Springs, California. Figure 2 of the Revised Master Work Plan shows the CENCO facility layout and operational areas.

2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

This section describes the organizational structure, levels of authority among key personnel, and lines of communication for activities affecting QA/QC.

2.1 Project Organization

The specific responsibilities of the key staff are presented below:

Site Project Manager:	Sudhakar Talanki, P.E.
Site Characterization Team Leader:	Tim Berger, R.G.
Risk Assessment Team Leader:	(to be determined)
Remedial System Team Leader:	Sudhakar Talanki, P.E.
Quality Assurance Managers:	Tim Berger, R.G.
Health and Safety Manager:	Mr. Kurt Martin
Laboratory QA Manager:	Mr. Larry Kleinecke

2.2 Responsibilities

The following subsections describe the responsibilities of key personnel for this QAPP.

2.2.1 Site Project Manager

Mr. Sudhakar Talanki, P.E. is the *Site Project Manager*. He is responsible for providing technical direction to the other Leaders and Managers, and managing the technical project activities. Mr. Talanki has direct management responsibility and authority for cost, schedule, quality, and technical performance of activities performed in support of this program and is responsible for implementing this QAPP. The *Site Project Manager* is the primary point of contact for all project communication and correspondence.

2.2.3 Site Characterization Team Leader

Mr. Tim Berger, R.G., C.E.G., H.G., is the Site Characterization Team Leader. He reports to the *Site Technical Coordinator*, and is responsible for activities associated with the characterization of environmental conditions for use in development of the Conceptual Site Model (CSM) and remedial designs. Mr. Berger has direct responsibility for field crews and management of resources used in characterization investigations.

2.2.4 Risk Assessment Team Leader

(To be determined)

2.2.5 Remedial Systems Team Leader

Mr. Sudhakar Talanki, P.E., will be the *Remedial Systems Team Leader*. He will be responsible for activities conducted in support of remedial system selection, development, and design. He will coordinate with the *Site Characterization Team Leader* to collect the information necessary to assess remedial technologies applicable to the Site. Remedial system selection and pilot studies will be designed, coordinated, and executed with Mr. Talanki's oversight.

2.2.6 Quality Assurance Managers

Quality Assurance (QA) Manager - Tim Berger is the *QA Manager. They* report to the *Site Project Manager and Site Technical Coordinator,* and provide direction and assistance to the *Team Leaders* in establishing, implementing, and verifying compliance with the QAPP. The *QA Managers*, or their representative, shall approve QA and technical procedures and contract QA deliverables. *QA Managers* shall be responsible for auditing project activities to verify conformance with QA objectives and for informing the *Site Project Manager and Site Technical Coordinator* of audit results, including QA deficiencies. The *QA Managers* have the authority and organizational freedom to identify problems, initiate or provide solutions, verify implementation of solutions, and order work stoppage, if necessary.

2.2.7 Health and Safety Manager

Health and Safety Manager - Mr. Kurt Martin, R.E.A., C.A.C is the *Health and Safety Manager* and is responsible for implementing the Health and Safety Plan (HASP). He is also responsible for establishing, implementing, and verifying QA/QC compliance with the site-specific HASP.

2.2.8 Laboratory QA Manager

Laboratory QA Manager - Mr. Larry Kleinecke, is the *Laboratory QA Manager* and is responsible for ensuring that the laboratory implements the requirements of this QAPP. Mr. Kleinecke will coordinate with the contract laboratory on QA/QC requirements, review laboratory QA/QC reports, identify potential problems, and ensure the proper use, maintenance, and storage of field and analytical equipment.

2.3 Training

The *Site Project Manager* and *Characterization and Remedial Team Leaders* will review the capabilities and qualifications of the consultants' and contractors' personnel to perform the assigned task. If personnel qualifications, including education, experience, and training, do not meet project needs, appropriate training will be performed or other appropriately qualified individuals will be assigned to perform the task. Personnel qualifications shall be reviewed by the *Site Project Manager* and *Characterization and Remedial Team Leaders* for approval to work on a given task.

3.0 SAMPLE ANALYTICAL PROGRAM

3.1 Soil Sampling

Soil samples will be collected and analyzed for chemical specific compounds as outlined in Section 4 of the Work Plan, in accordance with the methodology set forth in EPA, *Test Methods for Evaluating Solid Waste, Physical and Chemical Methods,* (SW-846), Third Edition of SW-846 with Update I (pages dated September 1992), Update IIA (pages dated August 1993), Update II (pages dated September 1994), Update IIB (pages dated January 1995), and Update III (pages dated December 1996). Soil samples will be analyzed for constituents of concern using the the following federal and state approved methods:

Constituent of Concern	Analytical Method
Volatile Organic Compounds (VOCs)	EPA Method 8260
Aromatic Hydrocarbons	EPA Method 8020
Polynuclear Aromatics (PNA)	EPA Method 8310
Total Petroleum Hydrocarbons as diesel fuel (TPH-d), gasoline (TPH-g), and jet fuel (TPH-j)	EPA Method 8015M and DHS Method
Total Reportable Petroleum Hydrocarbons (TRPH)	EPA Method 418.1
Heavy Metals	EPA Methods 6000/7000

Analytes and reporting limits (RLs) for these methods are listed in Attachment 1.

Soil samples will also be collected for physical parameters, as outlined in Section 6.3.3 of the Work Plan, in accordance with the methodology set forth in American Standard of Test Materials (ASTM). Selected soil samples may be tested for:

Constituent of Interest	Analytical Method
Dry Density	ASTM D2937 or D1188
Moisture Content	D2216
Total Organic Carbon	SM 5310-C, EPA M9060
Specific Gravity	ASTM D854 and C127
Atterburg Limits	ASTM D4318
Grain Size Distribution (Sieves)	ASTM D421-58
Grain Size Distribution (Hydrometer)	ASTM D422-63
Instrinsic Permeability	ASTM D5084

3.2 Groundwater Sampling

Groundwater samples from monitoring wells and grab samples collected from exploratory borings will be collected and analyzed for chemical specific compounds as outlined in Section 4 of the Work Plan, in accordance with the methodology set forth in EPA, *Test Methods for Evaluating Solid Waste, Physical and Chemical Methods,* (SW-846), Third Edition of SW-846 with Update I (pages dated September 1992), Update IIA (pages dated August 1993), Update II (pages dated September 1994), Update IIB (pages dated January 1995), and Update III (pages dated December 1996). Groundwater samples will be analyzed for constituents of concern using the the following federal and state approved methods:

Constituent of Concern	Analytical Method
VOCs	EPA Method 8260B
Aromatic Hydrocarbons	EPA Method 8020
PAHs	EPA Method 8310
TPH-d, TPH-g, and TPH-j	EPA Method 8015M and DHS Method 5030B
TRPH	EPA Method 418.1
Heavy Metals	EPA Methods 6000/7000

Analytes and reporting limits (RLs) for these methods are listed in Attachment 1.

Groundwater is monitored for intrinsic bioremediation parameters to assess if degradation of constituents of concern is occurring, and the rate of degradation, by in-situ micro-biological organisms. The analyses and methods are tabulated below:

Bioremediation Parameter	Analytical Method
Dissolved Oxygen	Direct-reading Field Instrumentation, utilizing a flow cell
Oxygen Reduction Potential (Redox)	Direct-reading Field Instrumentation, utilizing a flow cell
Total heterotrophic bacteria	Standard Methods for the Examination of Water and Wastewater, Section 9215A-B, 9213E, APHA, WEF, 18TH Edition, 1992
Total *Pseudomonas* bacteria	Standard Methods for the Examination of Water and Wastewater, Section 9215A-B, 9213E, APHA, WEF, 18TH Edition, 1992
Methane	EPA RSKSOP-175
Nitrate	EPA Method 353.2
Sulfate	EPA Method 375.4
Ferrous iron	Method SM 3500 Fe D
Alkalinity	EPA Method 310.1

4.0 DATA QUALITY OBJECTIVES (DQOs) FOR MEASUREMENT DATA

Data Quality Objectives (DQOs) are qualitative and quantitative statements developed by data users to specify the quality of data needed from a particular data collection activity to support specific decisions or regulatory actions. The process for developing DQOs is described in *Data Quality Objectives for Remedial Activities*, EPA 1987.

Data gathered during CENCO facility investigations will be used to determine whether remediation measures are necessary, and if so, what remedial measures are appropriate. To support this decision, data must be provided that is scientifically sound, defensible, and of known, acceptable and documented quality. To provide data of this quality, the following will take place:

- Use standard operating procedures for sampling, chain-of-custody, calibration, preventive maintenance, laboratory analysis, reporting, validation, internal QC, audits, and corrective action.
- Set quantitative goals and units of expression for precision, accuracy, and completeness for each measurement parameter.
- Set quantitative goals for representativeness and comparability.

The specific operating procedures to be used during Revised Master Work Plan activities are described in detail in the Field Sampling Plan. A qualitative description of precision, accuracy, representativeness, completeness, and comparability parameters are discussed below. The quantitative description of precision, accuracy, representativeness, completeness, and comparability parameters are discussed in Section 8.3.

4.1 Accuracy

A measurement of the bias in a system. Accuracy will be assessed through the evaluation of the percent recoveries associated with laboratory control samples, and matrix spikes.

4.2 Precision

A measurement of the reproducibility of data under a specified set of conditions. Precision is a quantitative measure that will assess the variability of a data set in reference to the calculated average value. Precision will be assessed by the evaluation of the day-to-day variances in the laboratory control samples. Control charts will be used to monitor the variations in the precision.

4.3 Completeness

The percentage of measurements evaluated and judged to be valid. For this project, the QA objectives for completeness are 95 and 90 percent for each analyte by matrix by analytical method, for water and soil, respectively.

4.4 Representativeness

A qualitative measure used to determine the degree to which obtained data correlate to the population sampled. The evaluation of this parameter will be measured through the precision of the analysis of field duplicate samples. If the precision of field duplicates is high, it can be determined that the samples collected were representative of the site. However, if the media sampled is naturally heterogeneous, then the precision of field duplicates may be poor, but the data may still be representative of the sites condition. Generally though, when precision is poor, additional samples may need to be collected.

4.5 Comparability

A qualitative measure assessing the confidence with which data sets obtained for similar samples and sample conditions can be correlated. Comparability is determined by the adherence of different laboratories and different sampling teams, to standard sampling protocols and analytical methods, as well as the use of traceable calibration standards, and the same reporting units. By having the various laboratories participate in a performance evaluation program, comparability can be determined.

4.6 Method Reporting Limits

Method reporting limits for the media and analysis methods proposed are summarized in Attachment 1.

5.0 SAMPLING PROCEDURES

Proposed field activities to be conducted in support of the Revised Master Work Plan at the Site include: collection/analysis of soil, groundwater, sediment, and surface water samples; air monitoring; and drum sampling. Detailed descriptions of sampling procedures, and drum and investigation derived waste (IDW) sampling procedures are included in the FSP. Air monitoring activities are discussed in the HASP.

5.1 Sampling Protocols

Field activities shall be conducted in accordance with the methods specified in the FSP. Sampling locations, and analytical parameters for the Revised Master Work Plan activities will be determined based on field observations, background documentation, and/or field screening results. A detailed discussion of the environmental media, sampling procedures, and specific sampling locations is fully documented in the Work Plan and FSP. The FSP outlines the general methodologies to be followed for each activity on a project-wide basis.

5.2 Sample Handling

5.2.1 Sample Containers and Preservation

Containers will be cleaned by the selected project laboratory in accordance with procedures dictated by the specific method of analysis to be performed. Appropriate preservatives will be added to samples that require preservation to inhibit degradation of sample constituents during transport and storage. Coolants will also be used to maintain internal cooler temperatures required for preservation during transport. The clean sample containers will be accompanied by a chain-of-custody (COC) form, and the receptacle used to ship the containers will be custody-sealed.

5.2.2 Labeling

Each sample will be assigned a unique sequential number at the time of sampling as discussed in the FSP. The number will be affixed to the sample container with an adhesive label. The labels will be covered with clear tape to help prevent damage to the label during shipment and will include the following information when applicable:

- Sample number
- Sampling date
- Preservative
- Filtered or unfiltered
- Analyte(s)
- Sampler's name
- Project name

5.2.3 Sample Documentation

Bound logbooks with sequentially numbered pages will be used for all record keeping in the field and laboratory. The use of the bound logbook will result in a chronological sequence of data entries. Entries will be recorded using indelible ink. Correction to entries will be made by drawing a single line through the incorrect entry, recording the correct information, and initialing and dating the corrected entry. If computerized information is used or original field forms, a hard copy, which has been permanently affixed to the logbook, will be acceptable as an original record of sampling and laboratory logging.

The following information shall be recorded for field activities:

- Location
- Date and time
- Identity of persons performing the activity
- Weather conditions

The following information shall be recorded for field measurements:

- The numerical value and units of each measurement
- The calibration results for each field instrument

The following information shall be recorded for sampling activities:

- Sample type and method
- Sample identification number and depth(s) of sample, if applicable
- Time of measurement
- The quantity/volume of each sample
- Sample description (e.g., color, odor, and texture)
- Type of sampling device used
- Discussion of conditions that may affect the representativeness of a sample (e.g., damaged casing)

5.2.4 Data Management

A relational database computer system will be designed to store data in a readily retrievable manner. To ensure that the data collection and field documentation procedures for this investigation meet the data management requirements, the information provided below will be included in the field logbook or appropriate data entry forms. Field personnel will familiarize themselves with the data management requirements before initiating any field activities. Copies of each of the following forms can be found in the FSP in Attachment 1.

Data pertaining to the installation of monitoring wells shall include:

- Site identification
- Location identification
- Field Personnel
- Date and time
- Well type
- Completion method
- Geologic completion zone (A-zone, B-zone, etc.)
- Measuring point elevation
- Total casing depths, including conductor casing
- Seal end depth
- Screen beginning depth
- Filter pack length
- Screen length
- Screen slot size
- Casing inside diameter
- Screen diameter
- Casing material
- Screen slot size
- Remarks

Groundwater level data shall include (whenever applicable):

- Location identification
- Date and time
- Field Personnel
- Dynamic depth
- Static depth
- Production rate
- Pump depth
- Recovery depth
- Recovery time
- Sounding
- Remarks

Hydrologic parametric data calculated from aquifer tests, such as pump tests and slug tests, shall include:

- Location identification
- Date and time
- Field Personnel
- Weather during test
- Change in weather during test
- Method used to calculate parameter
- Type of parameter calculated
- Calculated parameter value
- Units of measure
- Remarks

Information pertaining to lithologic descriptions of cuttings and cores taken from borings and test pits shall include:

- Location identification
- Date and time
- Field Personnel
- Beginning depth
- Ending depth
- Stratigraphic order
- Visual description
- American Society for Testing and Materials (ASTM) classification including the USCS classification
- Remarks

Field data pertaining to environmental sampling events shall include:

- Location identification
- Date and time
- Field Personnel

- Sample matrix
- Sample designation
- Sample method
- Beginning depth
- Ending depth
- Sample type
- Remarks

5.2.5 COC Documentation

Evidence of sample custody will be traceable from the time the sample is collected until the filled sample bottles are in the possession of the laboratory and the requested analysis has been performed. To achieve this accountability, field personnel will complete COC forms (triplicate copies) and affix COC seals to each sample shipment container. Field personnel will not leave samples unattended and will relinquish samples only to the laboratory sample custodian or an authorized shipping agent. A custody seal on the sample cooler will be used when the samples are shipped through a common carrier (ie., Federal Express). As no COC signature documents this shipment, a custody seal will be used on the outside of each cooler.

6.0 SAMPLE CUSTODY PROCEDURES

6.1 Field Custody Procedures

Sample custody will begin, in all cases, at the time of sample collection. Samples will be placed into an iced cooler, or appropriate container, in the possession of the field leader or appropriate designee. A line item on the field COC form will be completed immediately after sample collection and initialed by the designated field sample custodian.

Upon completing the line items, or after sample pickup, the samplers will sign, date, list the time, and confirm the completeness of all descriptive information contained on the COC form. Each individual who subsequently assumes responsibility for the samples will sign and date the COC form, and will record the reason for assuming custody. The field COC form terminates upon laboratory receipt of samples.

One copy of the COC forms will be given to the laboratory sample custodian when samples are submitted to the laboratory. One copy will be retained by the Team Leader. The original copy will be transmitted by the laboratory once the laboratory has received the samples. The field personnel will retain the original with the project files and will submit the information as a deliverable at the completion of the project.

When samples are shipped to the laboratory, a COC form must accompany each shipment. When shipping chilled samples in coolers, the sample containers will be packed securely, sample documentation (i.e., COC forms) will be placed in a sealed plastic bag, coolers will have COC seals affixed and be well sealed, and the cooler containing the COC papers will be marked (e.g., the master air bill will be affixed to the cooler containing the COC forms).

6.2 Laboratory Custody Procedures

Samples delivered to the approved laboratory will be accepted by the laboratory sample custodian or an appropriate designee during laboratory operating hours. The laboratory sample custodian will be responsible for maintaining custody of the samples and all associated paperwork documenting custody. Laboratory sample management will be initiated using the following sequence of events:

1. The carrier and the time of arrival will be documented in the daily receipt log. The number of items on the air bill will be checked with the actual number received to ensure that all coolers arrived.

2. Notation will be made as to whether the sample cooler was sealed.

3. The cooler will be opened, the internal ambient temperature of the cooler taken and noted on the COC, and the samples itemized. All deviations from the COC form will be noted and reported to the *Laboratory QA Manager*.

4. Samples will be assigned a unique sample laboratory identification number. The laboratory identification number and corresponding field identification number will be logged into a laboratory custody log.

5. Once the samples have been transmitted into the laboratory, the following sequence of events will occur:

   a. The samples will be recorded on the Sample Log-in Form to summarize all the information pertaining to the sample/order and to instruct the laboratory on the proper analysis and reporting of samples.

   b. After the samples are logged in, they will be assigned to the appropriate storage refrigerator.

   c. The laboratory sample custodian will be responsible for ensuring that all transfers of samples into and out of storage will be documented in the sample custody log. The laboratory project coordinator, or appropriate designee, will be responsible for reviewing the sample custody log at the end of each day to ensure that appropriate sample custody procedures have been maintained.

   d. Samples will remain in secured storage until removed for analysis. Whenever samples are removed for analysis, the names of the individuals who receive the samples will be entered in the sample custody log by the laboratory sample custodian, including the date and time the transfer occurred.

   e. To ensure refrigerators are operating at the appropriate temperature, a refrigeration log will be maintained. Refrigerator temperature will be checked daily, seven days per week. The log will indicate the ambient internal temperatures as well as the initials of the person recording the reading and the

date. Should the temperature fluctuate outside of the specified temperature range, corrective action will be taken immediately.

After the sample has been analyzed, a laboratory lot control number will be assigned to the sample. All samples within a given laboratory analysis group (i.e., samples sharing the same QC samples) will have the same laboratory lot control number.

7.0 ANALYTICAL AND QUALITY CONTROL PROCEDURES

Collection of representative field samples require strict adherence to established procedures. The following subsections discusses analytical and quality control procedures to ensure high quality data.

7.1 Analytical Procedures and Detection Quantitation Limits

During the Revised Master Work Plan activities conducted for the Site, chemical analysis and physical characteristics will be measured by on-Site field sampling teams and off-Site analytical chemistry and geotechnical laboratories. Off-Site analytical chemistry and geotechnical laboratories will be appropriately certified and will be approved by the *Site Project Manager.*

Personnel conducting field screening analysis will follow all field screening protocols outlined within Section 4 of the FSP. Parameters for which the FSP has not established procedure will be analyzed with a method that meets the objectives of this project.

7.1.1 Analytical Methods

Analytical procedures will generally be conducted in accordance with the methodology set forth in EPA, *Test Methods for Evaluating Solid Waste, Physical and Chemical Methods,* (SW-846), Third Edition of SW-846 with Update I (pages dated September 1992), Update IIA (pages dated August 1993), Update II (pages dated September 1994), Update IIB (pages dated January 1995), and Update III (pages dated December 1996. In some instances, the analytical methods contained in SW-846 may not meet the project-specific DQOs (e.g., detection limits may be greater than applicable or relevant and appropriate requirements). If the use of alternate analytical methods is deemed necessary, the modified method(s) will be included in the site-specific SAP. Table 2 provides a summary of the analytical methods that will typically be used for analyses of concern.

7.1.2 Method Detection Limits

The method detection limit (MDL) is the lowest concentration at which a particular analyte can be measured and reported with a 99 percent confidence that the analyte concentration is greater than zero. The MDL should be determined by multiplying the appropriate one-sided 99 percent t-statistic by the standard deviation obtained from a minimum of seven analyses of a matrix spike containing the analyte of interest at a concentration of three to five times the estimated MDL. MDLs for each target analyte will be determined by the analytical laboratory using the applicable SW-846 protocol or the method specified in *40 Code of Federal Regulations (CFR) Part 136,*

Appendix B. The laboratory then develops individual Reporting Limits (RLs) which represent concentration levels that can be consistently obtained by the specified method, and are generally two to five time the applicable MDLs. RLs specific to the selected project laboratory and analytical methods are provided in Attachment 1.

7.1.3 Practical Quantitation Limits

As specified in SW-846, practical quantitation limits (PQLs), also referred to as the estimated quantitation limits (EQLs), are defined as the lowest level of quantitation that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions. The PQL or EQL is generally five to ten times the MDL, but may be nominally selected within these guidelines to simplify data reporting. The laboratories must demonstrate that PQLs are routinely and reliably achieved by analyzing a calibration standard that is below the PQL for each analyte. Certified laboratories are expected to routinely achieve PQLs for SW-846 analytical methods.

7.1.4 Method Calibration

At a minimum of once daily or if the instrument exceeds calibration limits, chemical calibration of each target analyte will be performed to ensure that the analytical instrumentation is functioning within the established sensitivity range. All analytes specified in the FSP must be present in the initial and continuing calibrations, and these calibrations must meet the acceptance criteria specified by the respective method. The laboratories must demonstrate that PQLs are routinely and reliably achieved by analyzing a calibration standard that is below the PQL for each analyte. An accepted variance will allow the lowest standard to be equal to the PQL for SW846 Methods 8260B. Calibration standards and solutions will be of known concentration and purity to achieve the criteria necessary for validation of the analytical results. Inorganic standards must conform to the National Institute of Standards and Technology (NIST) Central QA Laboratory. Organic standards must conform to materials certified by the Cooperative Research and Development Agreement (CRADA), NIST, or Contract Laboratory Program-Standard Reference Material.

Standards used in this program will be prepared and maintained under the normal laboratory standards tracking system, which ensures preparation, checking, documentation, storage, and disposal of standards according to method specified procedures and schedules.

7.2 Calibration Procedures And Frequency

Calibration procedures establish the relationship between a calibration standard(s) and the measurement of that standard by an instrument or analytical procedure.

All field equipment will be calibrated according to the manufacturer's schedule or, at a minimum, prior to use in the field. If a schedule is not provided by the manufacturer, the calibration group servicing the equipment will provide a written calibration and maintenance frequency. Calibrations will follow the manufacturer's instructions for equipment calibration and maintenance. A record of the instrument calibration will be maintained by the Team Leader. Calibration procedures and frequency for field equipment is outlined in Attachment 2. Procedures for calibrating any additional or different field equipment will be included in the FSP.

7.3 Preventative Maintenance

A preventive maintenance plan allows for periodic instrument checks for problems that occur frequently. The objective of a preventive maintenance plan is to rectify equipment problems before they become serious. Preventive maintenance also brings attention to those areas of the instrument susceptible to degradation from aging, toxic/corrosive effects, and clogging due to environmental factors.

Procedures for preventive maintenance are contained in each instrument's manual under the maintenance/troubleshooting sections. Each piece of equipment will have an associated SOP detailing the calibration/maintenance instructions. Equipment failing calibration specifications will be identified with a red warning label and will not be used for sample analysis.

Equipment requiring calibration will have an assigned record number that is permanently affixed to the instrument. A label will be affixed to each instrument containing the following information:

- Description
- Manufacturer
- Model number
- Serial number
- Date of last calibration or maintenance
- Name of person who performed calibration or maintenance
- Date of next servicing

Should the selected contract laboratory have a more stringent preventive maintenance plan, then the *Laboratory QA Manager or the Site Project Manager* may approve the laboratories plan.

7.4 Internal Quality Control Checks and Frequency

Field and Laboratory QC data are necessary to determine precision and accuracy of the analyses. At least 10 percent of each data set generated will be composed of field and laboratory QC data. Field QC samples for this project will consist of trip blanks, ambient condition blanks, equipment blanks, duplicates/splits, replicates, and laboratory quality control samples. Laboratory QC samples will consist of method blanks, standards, laboratory control samples, matrix spikes, and surrogate spikes.

A discussion of field and laboratory control samples including frequency of analysis is provided in the following sections. A summary of laboratory internal quality control procedures including acceptance criteria and corrective action is presented in Attachment 1.

7.4.1 Field Quality Control Samples

Quality control samples ensure that the sampling and analytical systems used in support of project activities are in control, and verify the quality of the data generated from these activities. Quality control samples for this project will consist of trip blanks, ambient condition blanks, equipment blanks, duplicates/splits, replicates, and laboratory quality control samples.

- Trip blanks will be collected to indicate any potential field contamination associated with volatile organic sampling. Trip blanks will be included at a frequency of one per container (cooler) of soil and water samples during the course of volatile organic sampling. A trip blank is a volatile organic compound (VOC) sample vial filled in the laboratory with ASTM Type II reagent grade water, transported to the site, handled like a sample, and returned to the laboratory for analysis. The trip blank for soils is identical to the one used for water.

- Ambient condition blanks will be collected by pouring an ASTM Type II reagent grade water sample into a 40-mil glass vial in the field whenever there is an active VOC source upwind of the sample location(s). The *Team Leader* will direct where this sample will be poured. The *Team Leader* will attempt to select an area that is most likely to be affected by ambient conditions (i.e., downwind of a source of airborne volatile chemicals).

- Equipment blanks will be used to provide information on the extent of potential cross-contamination at the Site. Equipment blanks will be collected at a frequency of one per day, per team, per matrix or a minimum of 10% of the samples collected. Additional equipment blanks may be collected after decontamination of suspected highly contaminated samples. An equipment blank consists of ASTM Type II reagent grade water that is poured through or over the purging or sampling device, transferred to a sample bottle, and transported to the laboratory for analysis. The equipment blank should be poured immediately after the equipment has been decontaminated.

- One field duplicate/split sample will be collected for every 10 water samples collected. Field duplicates are two samples collected independently from one sampling location during a single act of sampling. One field replicate sample will be collected for every 10 soil or sediment samples collected. A field replicate sample consists of a single sample divided into two equal parts for analysis. When volatile organic analysis (VOA) replicate soil samples are collected, they will be sampled from adjacent locations (i.e., collocated) to reduce volatile losses resulting from sample handling. Field duplicate relative percent difference (RPD) will be calculated as detailed in section 8.3. Field duplicate RPD goals are defined as within 25% for detections of chemicals in both samples of the duplicate set at concentrations greater then the lowest standard used to define the laboratory calibration curve. The lowest standard on the laboratory calibration curve shall be run at the method detection limits detailed in Attachment 1.

- One matrix spike/matrix spike duplicate (MS/MSD) sample will be collected for every 20 samples per matrix. It is necessary to collect triplicate sample volume in the field for the laboratory to analyze MS/MSD samples.

7.4.2 Field Measurements

Numerous field measurements will be performed as part of the Revised Master Work Plan activities. These field measurements and associated QC checks are listed below.

- pH/Conductivity/Temperature - Ten percent will be measured in duplicate.

- Total organic vapor screening (headspace using a PID) - Ten percent will be measured in duplicate.

- Water levels - One hundred percent will be measured in duplicate.

7.4.3 Off-Site Laboratory

Laboratory QC samples will consist of method blanks, standards, laboratory control samples, matrix spikes, matrix spike duplicate, and surrogate spikes.

- Method blanks are used to detect laboratory-related contamination. These blanks identify and minimize interferences caused by solvents, reagents, glassware, or other equipment used in the laboratory's sample preparation and analytical measurement process. A method blank consists of a volume of deionized or distilled laboratory water for organic water samples and inorganic soil samples, or a purified solid matrix for organic soil/sediment samples, which is carried through the entire analytical process. The method blank volume or weight must be approximately equal to that of the samples being processed. Method blanks will be analyzed at a minimum frequency of one per batch. The concentration of target compounds in the blank must be less than the PQL. If the blank exceeds the above criteria, the source of the contamination must be identified and appropriate corrective action taken, including reanalysis of the sample group.

- Laboratory control samples (LCSs) consist of blank spikes. Blank spikes are used to determine the accuracy of the analytical procedure by measuring a known concentration of an analyte of interest. LCSs will be analyzed at a minimum frequency of one per batch.

- Surrogate spike analyses are used to determine the efficiency of analyte recovery in organic sample preparation and analyses. Surrogate standard determinations are performed for all organic standards, samples, and blanks. Each organic standard, sample, matrix spike, matrix spike duplicate, LCS, and blank, is spiked with surrogate compounds prior to purging or extraction. The surrogate spiking compounds are used to fortify the sample(s) with the proper concentrations. Surrogate spike recoveries must fall within the limits established by the laboratory QA plan and the analytical method. If a surrogate spike recovery is outside of acceptable ranges, corrective action must be taken.

- MS/MSD analyses are conducted to evaluate the matrix effect of the sample on the analytical method. The MS/MSD consists of a pair of samples with a known amount of analyte added in the laboratory. MS/MSD analyses must be performed at a minimum frequency of one per each group of 20 samples of the same matrix. To perform MS/MSD analyses, it is necessary to collect triplicate sample volume in the field for one sample out of every 20. Two volumes of the sample will be spiked with a standard solution containing all the target analytes; the third sample volume will be analyzed normally, without spiking. The samples are analyzed and the concentrations found in the spiked samples are used to determine the precision as measured by the percent difference. If the relative percent difference is greater than 20 percent, appropriate corrective action should be taken, including reanalysis, if necessary. Accuracy is also measured by determining

the percent recovery of the spiked compound compared to the actual level that was spiked. The percent recovery must fall within the range established by the laboratory.

7.5 Data Reduction and Reporting

In order to ensure proper data management activities and provide an accurate and controlled flow of data, it is important that data is handled and reported in a concise and useable format. Data management procedures are applicable to field- and laboratory-generated data.

7.5.1 Field Data Reduction

Data generated in the field will be recorded in task-specific field notebook or on customized field data sheets. Should separate data sheets be used, then the sheets shall be attached to the field notebook. Should calculations be performed in the field, then they shall be clearly recorded. The respective *Team Leader* will be responsible for the review of all field documentation to ensure completeness and legibility.

Field data parameters will be reduced into the following units:

- Water Levels - Reported to the nearest 0.01 foot after two field measurements agree
- pH - Digital readings rounded to 0.1 pH units
- Conductivity - Reported in 100 microohms per centimeter
- Survey Data - Well casing elevations surveyed to 0.01 foot, and well location to 0.5 feet
- Water Temperature - Degrees Fahrenheit reported to 0.1 degree units

7.5.2 Off-Site Laboratory Data Reduction

The analytical data are initially collected, converted to standard reporting units, and recorded in standard formats by the project analysts. These project analysts conduct preliminary data analysis using a variety of methods and procedures. Because many analytical instruments are microprocessor controlled, some of the requisite analyses can be performed directly in the instrument's operating or outputting mode. Those instruments interfaced to stand-alone computers or microprocessors often permit data analysis programs to be written and modified to produce data formats specifically suited to end user requirements.

Data requiring manual recording, integration, and/or analysis may be converted to a more appropriate format prior to subsequent analyses. Through all stages and aspects of data processing, the data are double checked for translation or transcription errors and are initialed by both the recorder and the checker. The *Laboratory QA Manager*, or other designated individual not directly involved in the analysis, will review the data for acceptability.

Data reduction frequently includes computation of analytical results from raw instrument data and summary statistics, including standard errors, confidence intervals, test of hypothesis relative to the parameters, and model validation.

Data reduction procedures used by the laboratory will address the reliability of computations and the overall correctness of the data reduction. The numerical transformation algorithms used for data reduction will be verified against a known problem set to ensure that the reduction methods are correct.

The equations and the typical calculation sequence that is followed to reduce the data to the acceptable format is instrument- and method-specific. Where standard methods are modified, data reduction techniques will be described in a report accompanying the data.

Auxiliary data produced for internal records and not reported as part of the analytical data include the following: laboratory worksheets, laboratory notebooks, sample tracking system forms, instrument logs, standard records, maintenance records, calibration records, and associated quality control records. These sources will document data reduction and will be available for inspection during audits and to determine the validity of data.

Outliers will be identified according to laboratory control charts, and the rationale used for data acceptance or rejection will be described and documented.

7.5.3 Field Data Reporting

Field data will be reported in the appropriate formats including field logbooks, sample tags, COC forms, and field data sheets. As a general guideline the following minimum standards will be maintained:

- Documentation will be completed in permanent black ink.
- Entries will be legible.
- Errors will be corrected by crossing out with a single line, dating, and initialing.
- Any serialized documents will be maintained on-site and referenced in the Site Logbook.
- Final field data will be reviewed by the *Team Leader* prior to database entry.

7.5.4 Off-Site Laboratory Data Reporting

All analytical results will be reported in the laboratories' approved format. In addition to the reported data, the laboratory data report will, at a minimum, include a narrative that will discuss any problems or discrepancies, and sufficient calibration and QC information to determine that the method was in control at the time that the samples were analyzed. In addition to the hard-copy report requirements the laboratory will provide electronic deliverables conforming to an ASCII comma-delimited format.

Laboratory data will be reported in the appropriate unit of concentration depending upon the matrix and type of analysis. Generally, concentrations in liquids will be reported in milligrams per liter (mg/l) for metals and inorganics or micrograms per liter (µg/l) for organics, and concentrations in solids will be reported in milligrams per kilogram (mg/kg). Air results will be reported in parts per billion by volume (ppbv). Premature rounding of intermediate results can significantly affect the final result. Therefore, the reported results will be rounded to the correct number of significant figures only after all calculations and manipulations are completed. As many significant figures as are warranted by the analytical method will be used in pre-reporting calculations.

Before being released by the laboratory, all analytical data and quality control data generated by the laboratory will be reviewed by the analyst. The data are checked for the following: transcription errors, calculation accuracy and dilution factors, and compliance with QC requirements. Failure to meet method performance QC criteria will result in the reanalysis of the sample or lot. After the data have been reviewed, they are assembled into a data package. The final laboratory data package will be reviewed by the Laboratory QA Manager before delivery.

8.0 DATA QUALITY MANAGEMENT

This section discusses the data management scheme, data validation, and procedures for statistical evaluation of the data quality.

8.1 Project Data Management Scheme

The project data management scheme to be adopted for this QAPP conforms to the guidelines set for the QAPP data management as indicated in the *Guidance for Conducting RI/FS under CERLCA* (EPA 1988). Specific aspects of the data management scheme are discussed below.

8.2 Data Validation

The data validation process is used to screen data and accept, reject, or qualify data on the basis of sound criteria. Data will be validated, as appropriate, based on holding times, initial calibration, continuing calibration, blank results, and other QC sample results.

8.2.1 Field Data Validation

To ensure the validity of data gathered in conjunction with the Site field activities, all situations need to be in control for all aspects of the project. Periodic audits will be conducted to monitor adherence to SOPs, QC protocols, and general program policies and protocols.

Factors affecting out-of-control conditions can usually be traced to sampling or laboratory activities. The following sections are examples of specific conditions that result in out-of-control situations. Corrective action requirements are discussed in Section 8.2.

Areas in which out-of-control situations have the potential to occur include:

- Improper sampling techniques
- Inappropriate sample identification
- Improper sample storage and preservation
- Nonconformance to appropriate COC protocols

8.2.2 Laboratory Data Validation

Data validation is the process of reviewing data and accepting, qualifying, or rejecting data on the basis of sound criteria using established EPA guidelines. An analyst at the laboratory, other than the original data processor, will be responsible for reviewing all steps of data processing. All input parameters, calibrations, calculations, and transcriptions will be carefully checked prior to the laboratory reporting the results. The analyst's supervisor at the laboratory will check a minimum of 10 percent of all calculations from the raw to final data prior to releasing the analytical report.

The QC sample results (e.g., laboratory control standards, surrogates, initial calibration standards, continuing calibration standards, etc.) will be compared against project specific accuracy and precision criteria. The QC data must meet acceptance levels prior to processing the analytical data. If QC standards are not met, the cause must be ascertained and appropriate corrective action must be taken. If the noncompliant situation can be rectified without affecting the integrity of the data, data processing will proceed. If resolution of the problem will jeopardize the integrity of the data, the sample in question must be re-analyzed. If re-analysis fails to correct the problem, the data will be flagged to indicate that the data are out of control. The internal review checks will be documented in the batch report and data review form in each data package.

A minimum of 25 percent of the data generated during the RI will be validated by an independent data validator, designated by the *Site Project Manager*. The data validation approach will consist of a systematic review of the analytical results, associated QC methods and results, and all of the supporting data. Best professional judgement in any area not specifically addressed by EPA guidelines will be utilized as necessary.

The following items may be reviewed by the *Laboratory Data Validator* to validate the data:

- Sample holding times
- Documentation that the analytical results are in control and within the certified range
- Documentation that data and calculations were checked by a reviewer who was not involved in the performance of sampling, analysis, or data reduction
- Calibration of methods and instruments
- Routine instrument checks (e.g., calibration, control samples, etc.)
- Documentation on traceability of instrument standards, samples, and data
- Documentation on analytical methodology and QC methodology
- The potential presence of interferences in analytical methods (check of reference blanks and spike recoveries)
- Documentation of routine maintenance activity to ensure analytical reliability
- Documentation of sample preservation and transport

All data generated will be assessed for accuracy, precision, and completeness. Data assessment techniques will include routine quality control checks and system audits. Precision will be assessed from analysis of duplicates and/or replicates of the same parameter at different times. Control charts will be maintained to provide a timely assessment of precision for measurement function. Accuracy will be assessed from analysis of samples spiked with known concentrations of reference materials. The assessment for accuracy will be independent of the routine calibration process (i.e., reference materials will be obtained from independent sources and will be prepared independently).

If an analyte is detected above the PQL in a method blank, that analyte will be flagged with a "B" for every sample in that batch. The batch will then be assessed to determine if that analyte data is usable or not, taking into consideration the type of contaminant (i.e., known lab contaminant) and its level.

The tables in SW-846, ASTM, and EPA methods will be used to validate the definitive data. Professional judgment will be applied in accordance with these guidelines. A data validation summary that describes all validated data will be prepared and submitted to the *Laboratory QA Manager* for each set of validated analytical data.

8.3 Statistical Assessment of Data Quality

The routine procedures used to assess data are precision, accuracy, and completeness. Specific formulas used to quantitatively define these parameters are presented in the following sections.

8.3.1 Precision

Precision is a measurement of the reproducibility of data under a specified set of conditions. For this project, precision will be evaluated in conjunction with accuracy for the LCS samples. If the accuracy is good, the precision is good. Precision will be determined for matrix effects using the MS/MSD samples. Precision will be expressed as relative percent difference (RPD) or relative standard deviation (RSD).

RPD is defined as:

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

where C_1 and C_2 are the larger and smaller of the two duplicate values, respectively.

RSD is defined as:

$$RSD = \frac{s}{y_{mean}} \times 100\%$$

where s = standard deviation and y_{mean} = mean of replicate analyses.

Acceptable levels of precision vary with the sample matrix, analytical method, and sample concentration. EPA precision data will be used as a basis for developing acceptance criteria for assessing precision; however, laboratory control charts must be developed and used to determine acceptance criteria for the LCS samples. The acceptance criteria for precision are included in Attachment 3.

8.3.2 Accuracy

Accuracy is a measurement of the bias in a system. The accuracy of sampling data for this project will be determined through the use of laboratory control samples. Accuracy is generally expressed as percent recovery (%R), which is defined as:

$$\%R = 100\% \times \left[\frac{s - U}{C_{sa}} \right]$$

where,

s = measured concentration of spiked aliquot
U = measured concentration of unspiked aliquot
C_{sa} = actual concentration of spike added.

If a standard reference material (SRM) is used instead of or in addition to laboratory control samples, accuracy is defined as:

$$\%R = 100\% \times \left[\frac{C_m}{C_{srm}} \right]$$

where, C_m = measured concentration of SRM in the spiked sample and C_{srm} = actual concentration of SRM.

The degree of accuracy and the recovery of the analyte is dependent on the matrix, method of analysis, and compound being measured, as specified in Attachment I. The objective for accuracy is to equal or exceed the accuracy demonstrated for the analytical method for samples of similar matrix and contaminant concentration. Accuracy will be controlled by comparing percent recoveries to the acceptable tables in this QAPP to make sure it falls within the control limits. Control charts will be maintained for all surrogates. Also, all analytes of interest shall be charted for each method for percent recovery and RSD. The charts shall be used to help show any adverse trends or drifts in the QC data, so corrections can be made.

8.3.3 Data Completeness

Data completeness represents the percentage of measurements evaluated and judged to be valid measurements. In order to meet the completeness objective for this project, valid results will be defined as all results not qualified with an "R" flag. Data completeness is expressed as percent completeness (%C) and is defined as:

$$\%C = 100\% \times \left[\frac{V}{n} \right]$$

where, V = number of measurements judged valid
n = total number of measurements

The quality assurance objective for completeness is 95 percent for water and 90 percent for soil analyses.

9.0 QUALITY ASSURANCE OVERSIGHT

Audits are tools used to evaluate the effectiveness of the QA program with respect to the QA requirements of the sampling and analysis activities. Two types of audits may be performed, performance audits and system audits.

9.1 Performance and System Audits

Performance audits are normally conducted after the data production systems are operational and are generating data. These audits consist of the collection of measurement data by using performance evaluation samples to determine the accuracy of the total measurement system or portions thereof.

All laboratories participating in this projects may be audited by the *Laboratory QA Manager*, or individual designated by the *Laboratory QA Manager* or *Site Project Manager*. Additionally, the *Laboratory QA Manager* will be responsible for verifying that standards, procedures, records, and charts are properly maintained and that QA records are adequately filed and maintained in a retrievable fashion.

System audits are on-site qualitative inspections and reviews of the QA system, and encompass all aspects of the project. These audits are concerned with evaluations of all components of the applicable measurement systems to determine if they have been properly selected and implemented. System audits typically consist of on-site reviews of both field and laboratory systems and facilities for sampling, calibration, and measurement protocols.

The *Laboratory QA Manager* or designated personnel may audit all laboratories regularly. In addition to the lab's internal auditing and auditing by *Laboratory QA Manager*, audits may be performed by the *Site Project Manager*, and other applicable governmental and private agencies. These audits are performed to verify the following conditions:

- Standards, procedures, records, charts, software, etc., have been properly maintained.
- QA records have been adequately filed and maintained, and documents are protected and retrievable.
- Results of QC sample analyses have been assessed.

Formal audit reports will be distributed to the *Site Project Manager, the Laboratory QA Manager,* and CENCO. Results of the audit will be documented in a bound logbook, or permanently attached and maintained as part of the QA documentation.

A *QA Manager* will conduct an internal field audit, during approximately 5 % of all field activities, in conjunction with field sampling events at the Site. The audits' objectives are to ensure that the work plan is followed, that QC measures have been implemented and maintained, and that sample integrity has not been compromised.

Upon completion of the audit, a report documenting the findings will be given to the *Site Project Manager,* the *Laboratory QA Manager*, and CENCO. Deficiencies encountered will be listed in the report. Corrective action will be initiated as appropriate.

9.2 Corrective Action Procedures

Corrective action will be initiated through the development and implementation of routine internal QC checks. Corrective action requirements will be implemented in response to deficiencies encountered during system audits or failure to adhere to the QAPP.

To enhance the timeliness of corrective action and thereby reduce the generation of unacceptable measurement data, problems identified by assessment procedures will be resolved by the laboratory at the lowest possible management level. All problems requiring corrective action will be documented on a corrective action documentation form and will be included in the appropriate data package. The *Laboratory QA Manager* will be immediately notified of any major collective problems, such as the need to resample. Otherwise, progress reports to the *Laboratory QA Manager* will detail all problems and subsequent resolutions.

Steps comprising a closed-loop corrective action system include:

- Defining the problem
- Assigning responsibility for problem investigation
- Investigating and determining the cause of the problem
- Assigning responsibility for problem resolution
- Verifying that the resolution has corrected the problem

9.3 Quality Assurance Reports to Management

The *Laboratory QA Manager* will be responsible for reporting any laboratory QA/QC issues to the *Quality Assurance Officer* and/or *Site Project Manager*. For those issues that may adversely impact the quality of the project or require immediate corrective action, the *Laboratory QA Manager* will provide the *QA Manager* with a verbal report. In all cases, a written summary in the form of a memorandum, letter, or report of the laboratory QA/QC issues will be forwarded to the *QA Manager*. Laboratory QA/QC issues may include, but are not limited to: responses to findings of internal or external audits; missed holding times or problems with laboratory acceptance criteria; situations arising causing a deviation from the procedures specified in the QAPP; and out-of-control conditions and associated corrective actions.

It is the responsibility of the *Team Leader* or appropriate designee to notify the *QA Manager* or *Site Project Manager* of out-of-control events encountered in the field and corrective action taken, and conditions that require a modification of the procedures set forth in the QAPP.

The following QA/QC documents and deliverables will be submitted to the *Project Manager* in support of the project work conducted at the Site:

- Audit reports
- Monthly status reports of QA/QC activities (including an assessment of DQOs, significant QA/QC problems and resolution, and changes in the QAPP).
- Laboratory data package (including QC data)
- Logbooks
- Final QA report.

10.0 REFERENCES

EPA (United States Environmental Protection Agency). 1983. *Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans.*

EPA. 1986. *Test Methods for Evaluating Solid Waste, Physical and Chemical Methods (SW-846).* Third Edition of SW-846 with Update I (pages dated September 1992), Update IIA (pages dated August 1993), Update II (pages dated September 1994), Update IIB (pages dated January 1995), and Update III (pages dated December 1996)

EPA 1988. *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA.* Interim Final.

EPA. 1992. *Test Methods for Evaluating Solid Waste, Physical and Chemical Methods (SW-846).* Final Update I.

EPA. 1993. *Data Quality Objectives Process for Superfund: Interim Final Guidance.* EPA 540-R-93-071.

EPA. 1993a. *EPA Presumptive Remedy for CERCLA Municipal Landfill Sites.* Directive No. 9355.0-49FS.

EPA. 1994. *USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review.*

EPA. 1994a. *Test Methods for Evaluating Solid Waste, Physical and Chemical Methods (SW-846).* Final Update II.

EPA. 1994b. *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review.*

Office of the Federal Register National Archives and Records Administration.1994. *40 Code of Federal Regulations (CFR) Part 136, Appendix B.*

ATTACHMENT 1

LABORATORY REPORTING LIMITS

Calscience Environmental Laboratories, Inc.

ANALYTICAL REPORT

Versar, Inc.
7844 Madison Avenue, Suite 167
Fair Oaks, California 95628

Date Sampled:
Date Received:
Date Analyzed:

Work Order No.: 00-01-0236
Method: EPA 310.1
Page 1 of 1

Attn: Dale Anderson
RE: CENCO/3917-015

All concentrations are reported in mg/L (ppm).

Sample Number	Total Alkalinity Concentration	Reporting Limit
MW-605		5
MW-205		5
MW-606		5

ND denotes not detected at indicated reportable limit.

Each sample was received by CEL chilled, intact, and with chain-of-custody attached.

Calscience Environmental Laboratories, Inc.

ANALYTICAL REPORT

Versar, Inc.
7844 Madison Avenue, Suite 167
Fair Oaks, California 95628

Date Sampled:
Date Received:
Date Analyzed:

Work Order No.: 00-01-0236
Method: EPA 375.4
Page 1 of 1

Attn: Dale Anderson
RE: CENCO/3917-015

All concentrations are reported in mg/L (ppm).

Sample Number	Sulfate Concentration	Reporting Limit
MW-605		20
MW-205		2
MW-606		20
Method Blank		2

ND denotes not detected at indicated reportable limit.

Each sample was received by CEL chilled, intact, and with chain-of-custody attached.

7440 Lincoln Way, Garden Grove, CA 92841-1432 • TEL: (714) 895-5494 • FAX: (714) 894-7501

Calscience Environmental Laboratories, Inc.

ANALYTICAL REPORT

Versar, Inc.
7844 Madison Avenue, Suite 167
Fair Oaks, California 95628

Date Received:
Work Order No: 00-01-0236
Preparation: N/A
Method: EPA 353.3

Project: CENCO/3917-015

Client Sample Number:	Lab Sample Number:	Matrix:	Date Collected:	Date Prepared:	Date Analyzed:	QC Batch ID:
MW-605	**00-01-0236-7**	**Aqueous**	**01/11/00**	**N/A**	**01/12/00**	**000112NO31**

Parameter	Result	RL	DF	Qual	Units
Nitrate-N		1.0	10		mg/l

MW-205	**00-01-0236-8**	**Aqueous**	**01/11/00**	**N/A**	**01/12/00**	**000112NO31**

Parameter	Result	RL	DF	Qual	Units
Nitrate-N		0.10	1		mg/l

MW-606	**00-01-0236-9**	**Aqueous**	**01/11/00**	**N/A**	**01/12/00**	**000112NO31**

Parameter	Result	RL	DF	Qual	Units
Nitrate-N		1.0	10		mg/l

Method Blank	**099-05-001-185**	**Aqueous**	**N/A**	**N/A**	**01/12/00**	**000112NO31**

Parameter	Result	RL	DF	Qual	Units
Nitrate-N		0.10	1		mg/l

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

Calscience Environmental Laboratories, Inc.

ANALYTICAL REPORT

Versar, Inc.
7844 Madison Avenue, Suite 167
Fair Oaks, California 95628

Date Received:
Work Order No: 00-01-0236
Preparation: N/A
Method: SM3500D

Project: CENCO/3917-015

Client Sample Number:	Lab Sample Number:	Matrix:	Date Collected:	Date Prepared:	Date Analyzed:	QC Batch ID:
MW-605	**00-01-0236-7**	**Aqueous**	**01/11/00**	**N/A**	**01/12/00**	**000112FE21**

Parameter	Result	RL	DF	Qual	Units
Iron + 2		0.10	1		mg/l

MW-205	**00-01-0236-8**	**Aqueous**	**01/11/00**	**N/A**	**01/12/00**	**000112FE21**

Parameter	Result	RL	DF	Qual	Units
Iron + 2		0.10	1		mg/l

MW-606	**00-01-0236-9**	**Aqueous**	**01/11/00**	**N/A**	**01/12/00**	**000112FE21**

Parameter	Result	RL	DF	Qual	Units
Iron + 2		0.10	1		mg/l

Method Blank	**099-05-001-184**	**Aqueous**	**N/A**	**N/A**	**01/12/00**	**000112FE21**

Parameter	Result	RL	DF	Qual	Units
Iron + 2		0.10	1		mg/l

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

Calscience Environmental Laboratories, Inc.

ANALYTICAL REPORT

Versar, Inc.
7844 Madison Avenue, Suite 167
Fair Oaks, California 95628

Date Received:
Work Order No: 00-01-0236
Preparation: EPA 5030B
Method: EPA 8015M

Project: CENCO/3917-015

Client Sample Number:	Lab Sample Number:	Matrix:	Date Collected:	Date Prepared:	Date Analyzed:	QC Batch ID:
MW-105	**00-01-0236-1**	**Aqueous**	**01/10/00**	**N/A**	**01/12/00**	**00011201sa**

Parameter	Result	RL	DF	Qual	Units
TPH for Gasoline		500	1		ug/L

Surrogates:	REC (%)	Control Limits	Qual
1,4-Bromofluorobenzene	107	57-128	

MW-101	00-01-0236-2	Aqueous	01/10/00	N/A	01/12/00	00011201sa

Parameter	Result	RL	DF	Qual	Units
TPH for Gasoline		500	1		ug/L

Surrogates:	REC (%)	Control Limits	Qual
1,4-Bromofluorobenzene	98	57-128	

MW-603	00-01-0236-3	Aqueous	01/11/00	N/A	01/12/00	00011201sa

Parameter	Result	RL	DF	Qual	Units
TPH for Gasoline		500	1		ug/L

Surrogates:	REC (%)	Control Limits	Qual
1,4-Bromofluorobenzene	95	57-128	

MW-604	00-01-0236-4	Aqueous	01/11/00	N/A	01/12/00	00011201sa

Parameter	Result	RL	DF	Qual	Units
TPH for Gasoline		500	1		ug/L

Surrogates:	REC (%)	Control Limits	Qual
1,4-Bromofluorobenzene	147	57-128	2

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

Calscience Environmental Laboratories, Inc.

ANALYTICAL REPORT

Versar, Inc.
7844 Madison Avenue, Suite 167
Fair Oaks, California 95628

Date Received:
Work Order No: 00-01-0236
Preparation: N/A
Method: EPA 8260B

Project: CENCO/3917-015

Client Sample Number:	Lab Sample Number:	Date Collected:	Matrix:	Date Prepared:	Date Analyzed:	QC Batch ID:
TB-1	00-01-0236-5	01/11/00	Aqueous	N/A	01/14/00	000113BW

Parameter	Result	RL	DF	Qual	Units	Parameter	Result	RL	DF	Qual	Units
Acetone		10	1		ug/L	1,3-Dichloropropane		1.0	1		ug/L
Benzene		0.50	1		ug/L	2,2-Dichloropropane		1.0	1		ug/L
Bromobenzene		1.0	1		ug/L	1,1-Dichloropropene		1.0	1		ug/L
Bromochloromethane		1.0	1		ug/L	c-1,3-Dichloropropene		0.50	1		ug/L
Bromodichloromethane		1.0	1		ug/L	t-1,3-Dichloropropene		0.50	1		ug/L
Bromoform		1.0	1		ug/L	Ethylbenzene		1.0	1		ug/L
Bromomethane		1.0	1		ug/L	2-Hexanone		10	1		ug/L
2-Butanone		10	1		ug/L	Isopropylbenzene		1.0	1		ug/L
n-Butylbenzene		1.0	1		ug/L	p-Isopropyltoluene		1.0	1		ug/L
sec-Butylbenzene		1.0	1		ug/L	Methylene Chloride		10	1		ug/L
tert-Butylbenzene		1.0	1		ug/L	4-Methyl-2-Pentanone		10	1		ug/L
Carbon Disulfide		10	1		ug/L	Naphthalene		10	1		ug/L
Carbon Tetrachloride		0.50	1		ug/L	n-Propylbenzene		1.0	1		ug/L
Chlorobenzene		1.0	1		ug/L	Styrene		1.0	1		ug/L
Chloroethane		1.0	1		ug/L	1,1,1,2-Tetrachloroethane		1.0	1		ug/L
Chloroform		1.0	1		ug/L	1,1,2,2-Tetrachloroethane		1.0	1		ug/L
Chloromethane		1.0	1		ug/L	Tetrachloroethene		1.0	1		ug/L
2-Chlorotoluene		1.0	1		ug/L	Toluene		1.0	1		ug/L
4-Chlorotoluene		1.0	1		ug/L	1,2,3-Trichlorobenzene		1.0	1		ug/L
Dibromochloromethane		1.0	1		ug/L	1,2,4-Trichlorobenzene		1.0	1		ug/L
1,2-Dibromo-3-Chloropropane		5.0	1		ug/L	1,1,1-Trichloroethane		1.0	1		ug/L
1,2-Dibromoethane		1.0	1		ug/L	1,1,2-Trichloroethane		1.0	1		ug/L
Dibromomethane		1.0	1		ug/L	Trichloroethene		1.0	1		ug/L
1,2-Dichlorobenzene		1.0	1		ug/L	Trichlorofluoromethane		10	1		ug/L
1,3-Dichlorobenzene		1.0	1		ug/L	1,2,3-Trichloropropane		1.0	1		ug/L
1,4-Dichlorobenzene		1.0	1		ug/L	1,2,4-Trimethylbenzene		1.0	1		ug/L
Dichlorodifluoromethane		1.0	1		ug/L	1,3,5-Trimethylbenzene		1.0	1		ug/L
1,1-Dichloroethane		1.0	1		ug/L	Vinyl Acetate		10	1		ug/L
1,2-Dichloroethane		0.50	1		ug/L	Vinyl Chloride		0.50	1		ug/L
1,1-Dichloroethene		1.0	1		ug/L	p/m-Xylene		1.0	1		ug/L
c-1,2-Dichloroethene		1.0	1		ug/L	o-Xylene		1.0	1		ug/L
t-1,2-Dichloroethene		1.0	1		ug/L	Methyl-tert-Butyl Ether		1.0	1		ug/L
1,2-Dichloropropane		1.0	1		ug/L						

Surrogates:	REC (%)	Control Limits	Qual	Surrogates:	REC (%)	Control Limits	Qual
Dibromofluoromethane	104	86-118		Toluene-d8	97	88-110	
1,4-Bromofluorobenzene	90	86-115					

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

ATTACHMENT 2

FIELD MEASUREMENT AND TEST EQUIPMENT LIST

CENCO Field Measurement and Test Equipment List

1 Liquinox laboratory detergent
2 Gelman Sciences capsule 0.45µm disposable groundwater filters (ferrous iron samples)
3 3/4" LDPE flexible tubing
4 1/2" LDPE poly tubing
5 HDPE 1.2 liter disposable bailers
6 Solinist Water Level Indicator
7 85-gal salvage drums
8 Hydrolab DataSonde 3 multiprobe (DO, redox, pH, turbidity, T readings)
9 Thermo Environmental Model 580B OVM Photo-ionization Detector
10 KECK interface probe
11 Grundfos Reel EZ Controller / submersible pump

ATTACHMENT 3

LABORATORY PRECISION AND ACCURACY GOALS

Calscience Environmental Laboratories, Inc.

Quality Control - Spike/Spike Duplicate

Versar, Inc.
7844 Madison Avenue, Suite 167
Fair Oaks, California 95628

Project: CENCO/3917-015

Date Received: (
Work Order No: 00-01-0236
Preparation: N/A
Method: EPA 353.3

Spiked Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	MS/MSD Batch Number
MW-605	**Aqueous**	**8453**	**N/A**	**01/12/00**	**000112NO31**

Parameter	MS %REC	MSD %REC	%REC CL	RPD	RPD CL	Qualifiers
Nitrate-N	82	89	70-130	5	0-25	

Calscience Environmental Laboratories, Inc.

QUALITY ASSURANCE SUMMARY

Method SM 3500D

Versar, Inc.
Page 1 of 1

Work Order No.: 00-01-0236
Date Analyzed:

Matrix Spike/Matrix Spike Duplicate

Sample Spiked: MW-606

Analyte	MS%REC	MSD%REC	Control Limits	%RPD	Control Limits
Ferrous Iron	92	94	70 - 130	3	0 - 25

7440 Lincoln Way, Garden Grove, CA 92841-1432 • TEL: (714) 895-5494 • FAX: (714) 894-7501

Calscience Environmental Laboratories, Inc.

Quality Control - Spike/Spike Duplicate

Versar, Inc.
7844 Madison Avenue, Suite 167
Fair Oaks, California 95628

Project: CENCO/3917-015

Date Received:
Work Order No: 00-01-0236
Preparation: EPA 5030B
Method: EPA 8015M

Spiked Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	MS/MSD Batch Number
00-01-0214-1	**Aqueous**	**GC 1**	**N/A**	**01/12/00**	**00011201ms**

Parameter	MS %REC	MSD %REC	%REC CL	RPD	RPD CL	Qualifiers
TPH for Gasoline	98	99	68-122	1	0-14	

Calscience Environmental Laboratories, Inc.

Quality Control - Spike/Spike Duplicate

Versar, Inc.
7844 Madison Avenue, Suite 167
Fair Oaks, California 95628

Project: CENCO/3917-015

Date Received:
Work Order No: 00-01-0236
Preparation: N/A
Method: EPA 8260B

Spiked Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	MS/MSD Batch Number
00-01-0024-2	**Aqueous**	**GC/MS M**	**N/A**	**01/14/00**	**000100242**

Parameter	MS %REC	MSD %REC	%REC CL	RPD	RPD CL	Qualifiers
Benzene	102	101	72-127	0	0-25	
Carbon Tetrachloride	114	112	70-130	2	0-25	
Chlorobenzene	105	105	72-131	0	0-25	
1,2-Dichlorobenzene	101	102	70-130	1	0-25	
1,1-Dichloroethene	100	99	69-127	0	0-25	
Toluene	104	103	75-124	1	0-25	
Trichloroethene	104	104	60-137	0	0-25	
Vinyl Chloride	94	97	70-130	3	0-25	
Methyl-tert-Butyl Ether	89	89	80-120	0	0-25	

ATTACHMENT 4

LABORATORY QUALITY CONTROL MANUAL

SECTION 1: TITLE

UNCONTROLLED COPY

QUALITY ASSURANCE PROGRAM MANUAL

for

ENVIRONMENTAL ANALYTICAL SERVICES

Revision 8.1
August, 1999

Prepared by:

Calscience Environmental Laboratories, Inc.
7440 Lincoln Way
Garden Grove, CA 92841-1432

Telephone: (714) 895-5494
Facsimile: (714) 894-7501

PROPRIETARY INFORMATION STATEMENT

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Approval by:

William H. Christensen
QUALITY ASSURANCE MANAGER

Steven L. Lane
LABORATORY DIRECTOR

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SECTION 3: INTRODUCTION

Calscience Environmental Laboratories, Inc. (Calscience) is committed to providing the highest quality environmental analytical services available. To ensure the production of scientifically sound, legally defensible data of known and proven quality, an extensive Quality Assurance program has been developed and implemented. This document, Calscience's Quality Assurance Program Manual, presents an overview of the essential elements of our Quality Assurance program. Calscience has modeled this manual after EPA guidelines as outlined in "Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans", Office of Monitoring Systems and Quality Assurance, Office of Research and Development, U.S. EPA, EPA-600/4-83-004, February, 1983. Calscience's QA Program is closely monitored at the Corporate, Divisional, and Group levels, and relies on clearly defined objectives, well-documented procedures, a comprehensive quality assurance/quality control system, and management support for its effectiveness.

This QA Program Manual is designed to control and monitor the quality of data generated at Calscience. The essential elements described herein are geared toward generating data which is in compliance with federal regulatory requirements specified under the Clean Water Act, the Safe Drinking Water Act, the Resource Conservation and Recovery Act, the Comprehensive Environmental Response, Compensation, and Liability Act, and applicable amendments, and state and DoD/DoE equivalents. Although the quality control requirements of these various programs are not completely consistent, each of the programs base data quality judgments on the following three types of information, the operational elements of each being described elsewhere in this manual.

- ⇨ Data which indicates the overall qualifications of the laboratory to perform environmental analyses;
- ⇨ Data which measures the laboratory's daily performance using a specific method; and
- ⇨ Data which measures the effect of a specific matrix on the performance of a method.

It is important to note that the QA guidelines presented herein will always apply unless adherence to specific Quality Assurance Project Plans (QAPPs) or client and/or regulatory agency specific requirements are directed. In these cases, the elements contained within specified direction or documentation shall supersede that contained herein.

This manual is a living document subject to periodic modifications to comply with regulatory changes and technological advancements. All previous versions of this document are obsolete. Users are urged to contact Calscience to verify the current revision of this document.

SECTION 4: ORGANIZATION, RESPONSIBILITY, AND TRAINING

Executing an effective QA Program depends on the total commitment and attention of both management and staff at all levels. In addition, the organization must ensure that its personnel are free from any commercial, financial and other pressures which might adversely affect the quality of their work.

The QA effort at Calscience is managed by the Laboratory Director through the Quality Assurance Manager. The QA Manager operates independently from all personnel, except the Laboratory Director, and of all laboratory areas associated with the production of analytical data. This independence ensures his or her complete objectivity (Figures 4.1 and 4.2).

The responsibilities of each position associated with Calscience's QA Program are outlined below.

Laboratory Director

- ⇨ Ensure that Calscience remains current with all regulations which affects operations and disseminate all such changes in regulatory requirements to the QA Manager, Technical Director, and Group Leaders;
- ⇨ Develop and implement Calscience's QA Program which assures that all data generated will be scientifically sound, legally defensible, and of known precision and accuracy;
- ⇨ Conduct annual reviews of Calscience's QA Program;
- ⇨ Routinely monitor the QA Program to ensure compliance;
- ⇨ Develop and implement new and revised QA procedures to improve data quality;
- ⇨ Coordinate all laboratory accreditation efforts;
- ⇨ Develop and implement project specific QA plans (QAPPs); and
- ⇨ Monitor in-house training on quality assurance and control.

Calscience's Laboratory Director, through its President, is the final authority on all issues dealing with data quality and has the authority to require that procedures be amended or discontinued, or analytical results voided or repeated. He or she also has the authority to suspend or terminate employees on the grounds of non-compliance with QA/QC procedures.

Quality Assurance Manager

- ⇨ Implement Calscience's QA Program;
- ⇨ Monitor the QA Program within the laboratory to ensure complete compliance with its objectives, QC procedures, holding times, and compliance with client or project specific data quality objectives;
- ⇨ Distribute performance evaluation (PE) samples on a routine basis to ensure the production of data which meets the objectives of its QA Program;
- ⇨ Maintain all SOPs used at Calscience;
- ⇨ Maintain records and archives of all PE results, audit comments, and customer inquiries concerning the QA program;
- ⇨ Perform statistical analyses of QC data and establish controls which accurately reflect the performance of the laboratory;
- ⇨ Conduct periodic performance and system audits to ensure compliance with the elements of Calscience's QA Program;
- ⇨ Prescribe and monitor corrective action;
- ⇨ Serve as in-house client representative on all project inquiries involving data quality issues;

- ⇨ Coordinate data review process to ensure that thorough reviews are conducted on all project files;
- ⇨ Development of new or revisions to existing SOPs;
- ⇨ Report the status of in-house QA/QC to the Laboratory Director;
- ⇨ Distribute new SOPs to all applicable lab areas;
- ⇨ Maintain records and archives of all QA/QC data including but not limited to method detection limit (MDL) studies, accuracy and precision control charts, and completed log books; and
- ⇨ Conduct and/or otherwise ensure that an adequate level of QA/QC training is conducted within the laboratory.

The QA Manager has full authority through the Laboratory Director in matters dealing with data within the laboratory. He or she can make recommendations to the Laboratory Director regarding the suspension or termination of employees on the grounds of non-compliance with QA/QC procedures.

Technical Director

- ⇨ Implementation of Calscience's training program to ensure that all personnel are properly trained for the tasks being performed;
- ⇨ Resolution of technical difficulties encountered during normal operations;
- ⇨ Oversight of all method developmental activities within Calscience;
- ⇨ Ensure compliance with approved methodologies, standard operating procedures (SOPs), this manual, QAPPs, and all other governing documents; and
- ⇨ Implement a system of continual improvement within Calscience to include reviews of new technologies which may potentially improve quality.

The Technical Director has full authority through the Laboratory Director in matters dealing with technical proceedings within the laboratory. He or she can make recommendations to the Laboratory Director regarding the suspension or termination of employees on the grounds of non-compliance with QA/QC procedures.

An alternate QA Manager is always assigned. In the absence of the primary designate, the alternate will act in the QA Manager's capacity with the full authority of the position as allowed by Calscience governing documents.

Group Leaders

- ⇨ Actively support the implementation of Calscience's QA Program;
- ⇨ Ensure that their employees are in full compliance with Calscience's QA Program;
- ⇨ Maintain accurate (by recommending changes to) SOPs and enforce routine compliance with SOPs;
- ⇨ Conduct technical training of new staff and when modifications are made to existing procedures;
- ⇨ Perform secondary QC reviews on all data generated within their respective groups;
- ⇨ Maintain a work environment which emphasizes the importance of data quality; and
- ⇨ Provide support to all levels of Calscience Management.

The Group Leaders have the authority to accept or reject data based on pre-defined QC criteria. In addition, with the approval of the QA Manager, the Group Leaders may accept data which falls outside of normal QC limits if, in his or her professional judgment, there are technical justifications for the acceptance of such data. The circumstances must be well documented and any need for corrective action identified must be defined and initiated. The authority

of the Group Leaders in QC related matters results directly from the QA Manager.

Analysts and Technicians

- ⇨ Maintain a working knowledge of Calscience's QA Program;
- ⇨ Ensure that all data is generated in compliance with Calscience's QA Program;
- ⇨ Perform work in strict accordance with the SOPs;
- ⇨ Ensure that all documentation related to their work is complete, accurate, and legible; and
- ⇨ Immediately inform their supervisors of data quality problems.

Laboratory staff members have the authority to accept or reject data based on compliance with well-defined QC acceptance criteria. The acceptance of data which falls outside QC criteria must be approved by their supervisor.

Training

Quality control begins prior to sample(s) receipt at the laboratory. The selection of well qualified personnel, based upon education and/or experience is the first step in successful laboratory management. A thorough screening of job applicants and selection of the best candidate to fulfill a well defined need is as important an aspect of a successful QA/QC program as a careful review of analytical data.

Employee training and approval procedures used at Calscience are specified in SOP-T010, "Employee Training", and includes but is not limited to the following:

- ⇨ A thorough understanding of the applicable regulatory method and Calscience SOP;
- ⇨ A review of Calscience's QA Program Manual and thorough understanding of the specifics contained therein that are directly related to the analysis to be performed;
- ⇨ Instruction by the applicable Group Leader on all aspects of the analytical procedure;
- ⇨ Performance of analyses under supervision of experienced laboratory personnel which shall include analysis of blind QC check samples, when deemed appropriate;
- ⇨ Participation in in-house seminars on analytical methodologies and procedures;
- ⇨ Participation in job related seminars outside of the laboratory; and
- ⇨ Participation in conventions and meetings, i.e., ACS, etc.

FIGURE 4.1: ORGANIZATIONAL CHART

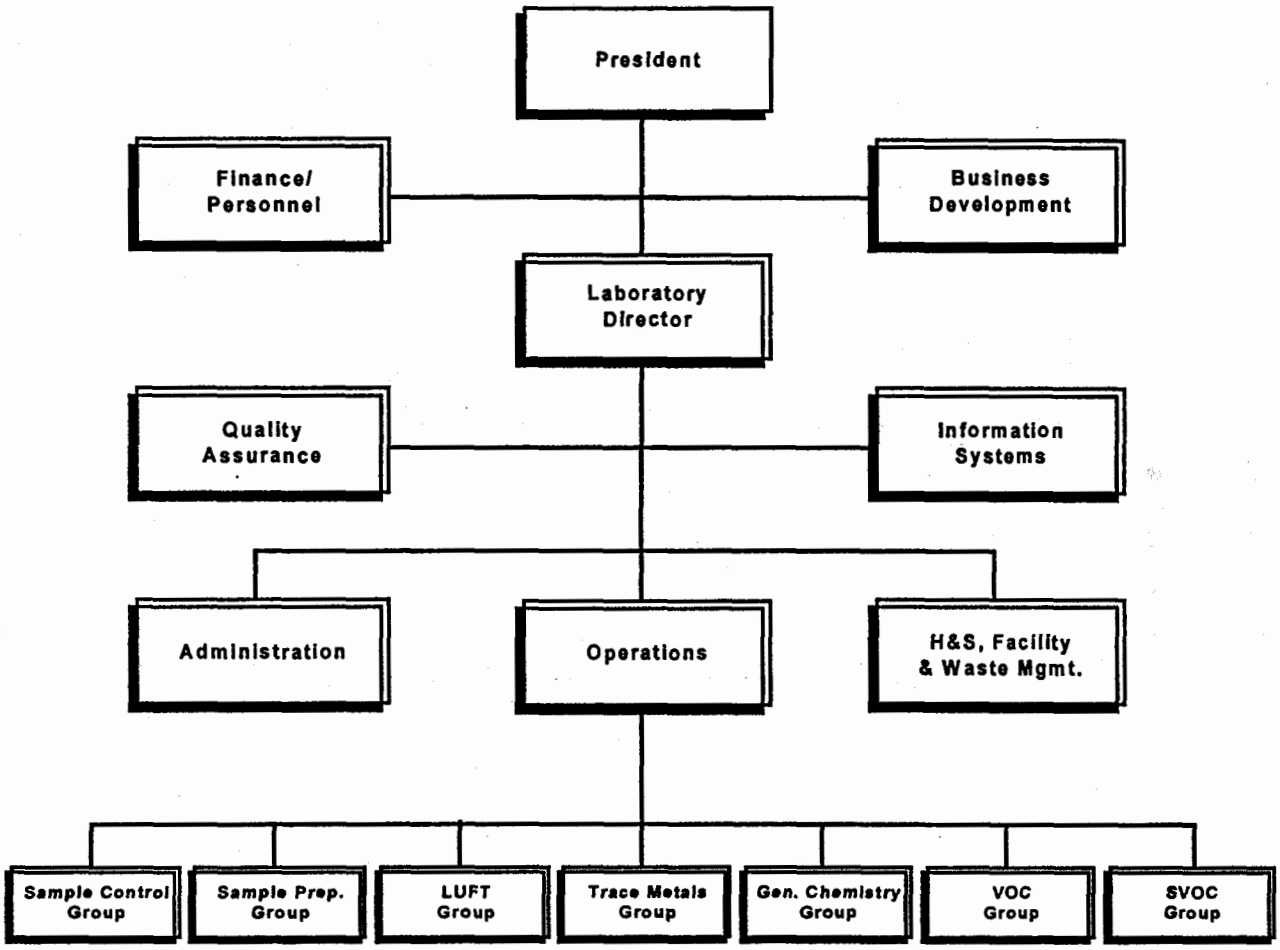
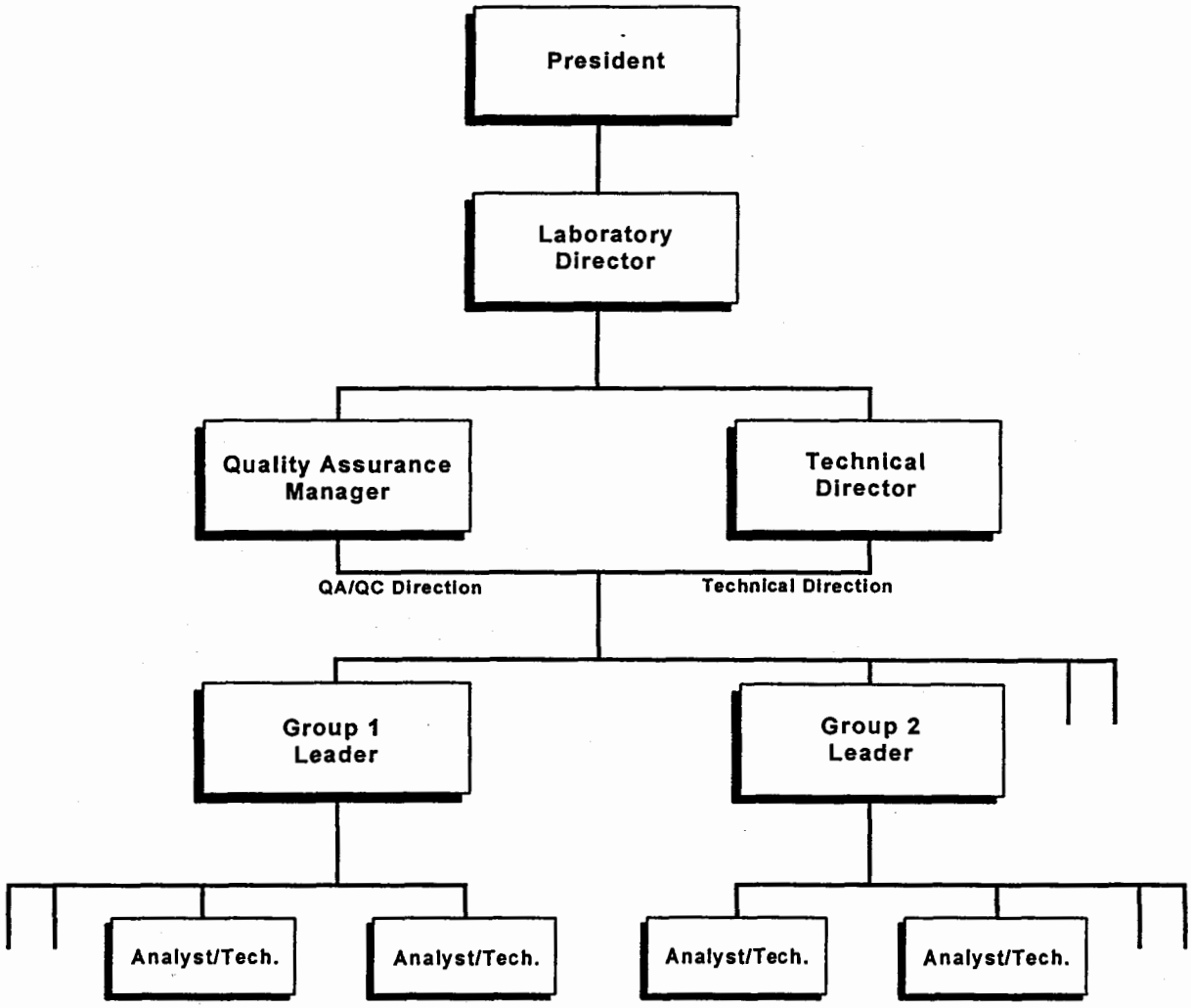


FIGURE 4.2: QA RESPONSIBILITY CHART



SECTION 5: QA OBJECTIVES FOR MEASUREMENT DATA

Calscience is committed in every respect to the production of quality analytical data and the continuous improvement in all factors which have the ability to adversely impact its production. The objective of Calscience's QA Program and the procedures contained therein is to assure, assess, and document the precision, accuracy, and adequacy of the generated data. This ensures the technical correctness of analytical work performed such that it is scientifically sound, legally defensible, and of known and proven quality.

The specific objectives of Calscience's QA Program are to:

- ⇨ Establish the quality level of each analytical system;
- ⇨ Establish processes for the early detection and avoidance of deficiencies which may adversely impact the quality of analytical data produced;
- ⇨ Enable laboratory personnel to take that action which is necessary to assure the validity of analytical data produced; and
- ⇨ Require sufficient documentation to verify the credibility of the quality of analytical data produced.

Calscience's QA objectives, as outlined above, are fully supported by all Calscience personnel, from top management to the technician level.

SECTION 6: SAMPLING PROCEDURES

The generation of quality analytical data begins with the collection of the sample and, therefore, the integrity of the sample collection process is of importance to Calscience. Samples must be collected in such a way that foreign material is not introduced into the samples and that analytes of interest do not escape from the samples or degrade prior to their analysis. To ensure sample integrity and representativeness, the following items must be considered:

- ⇨ Samples must be collected in appropriate containers. In general, glass containers are used for organic analytes and polyethylene for inorganic/metal analytes;
- ⇨ Only new sample containers which are certified and documented clean in accordance with U.S. EPA OSWER Directive No. 9240.0-0.05 specifications shall be provided by Calscience for sample collection;
- ⇨ If required, samples must be preserved to ensure that analytes of interest are not lost due to adsorption, chemical or biological degradation, or volatilization during transportation, handling or storage;
- ⇨ Sufficient volume of sample must be collected to ensure that required reporting limits can be met and quality control samples can be analyzed; and
- ⇨ Samples must be properly packaged to prevent breakage or degradation and forwarded to the laboratory in a timely manner to ensure that holding times for the analyses are not exceeded.

Calscience can assist in the sample collection process by providing consultation and assistance to clients designing sampling programs. Additionally, when requested, Calscience provides properly preserved sample containers and sampling instructions.

SECTION 7: LABORATORY SECURITY, SAMPLE CUSTODY AND DISPOSAL

Laboratory Security

Calscience maintains a secure facility. The laboratory has two primary entrances. One entrance is at the front of the facility in the main lobby for use by clientele, guests, and vendor/service representatives. The other entrance is at the side of the facility for use by sample/other deliveries and laboratory personnel. This delivery area is located adjacent to, but separate from, the main laboratory. Unauthorized entry into the facility is prevented by continuous monitoring of both entrances during operating hours and engaged door locks thereafter. A log is maintained at the front entrance to document entrance into the main laboratory by visitors.

Service doors to the warehouse in the rear of the facility are kept closed and locked from external entry unless under supervised use. Sensitive internal and external areas are also monitored continuously by a suite of security cameras with all activities recorded on electronic media.

Unauthorized entry into the facility during non-operating hours is prevented through use of a centrally-monitored security system activated each day at the close of operation. Monitoring is performed off-site by a professional security operation which shall alert the proper authorities and key Calscience personnel of system detections.

The system also provides continuous (irrespective of system activation status) monitoring of smoke/fire throughout the facility and abnormal temperature conditions in the two main sample storage units. The system will alert the monitoring station should the temperature in either storage unit progress beyond the predetermined setpoints.

Sample Custody

Calscience's chain-of-custody document is used to forward samples from the client to the laboratory. As the basic elements of most all chain-of-custody documents are similar, clientele may choose to use their own chain-of-custody document to forward samples to Calscience.

Upon receipt by Calscience, samples proceed through an orderly processing sequence designed to ensure continuous integrity of both the sample and its documentation from sample receipt through its analysis and beyond.

All coolers which are received by the Sample Control Group undergo a preliminary examination in accordance with Part A of the Sample Receipt Form. Specifically, each sample is carefully examined for label identification, proper container (type and volume), chemical preservation when applicable, container condition, and chain-of-custody documentation consistency with sample labels. Discrepancies are noted on the Sample Receipt Form, the chain-of-custody and, if possible, discussed with the client prior to his or her departure. If this is not possible, the discrepancies are communicated to the client for resolution prior to the completion of the log-in process. The temperature of the cooler is measured and, with other observations, is recorded in Part B of the Sample Receipt Form. Additional comments are recorded in Part C of the Sample Receipt Form.

During the log-in process each sample is assigned a unique laboratory identification number through a computerized Laboratory Information Management System (LIMS), which stores all essential project information. Calscience maintains multiple security levels of access into LIMS to

prevent unauthorized tampering/release of sample and project information.

Once all analyses for a sample have been completed and the sample container is returned to Sample Control, it shall remain in refrigerated storage for a period not less than 30 days following sample receipt unless return/forwarding of the sample is requested by the client. Following the 30 day refrigerated storage period, the samples are placed into ambient storage for another period not less than 30 days after which the samples are bulked into drums for later disposal.

Sample Disposal

All spent samples to be disposed by Calscience are placed into the laboratory's hazardous waste stream and treated as hazardous waste. Detailed categorization of the various waste streams and the disposal procedures are located in SOP-T005, "Disposal of Laboratory Sample and Wastes".

Federal RCRA regulations require that bulked hazardous waste not be stored on premises for a period exceeding 90 days. Calscience contracts only with approved hazardous waste management companies for hazardous waste removal in such a manner such that compliance with all applicable regulations is ensured. Calscience's waste is disposed of or treated only at approved facilities.

SECTION 8: CALIBRATION PROCEDURES AND FREQUENCY

Standard/Reagent Preparation

A critical element in the generation of quality data is the purity/quality and traceability of the standard reference materials and reagents used during analytical processing. Calscience continually monitors the quality of reagents and standard solutions through a series of documented procedures.

To ensure the highest possible purity, all primary reference and standard solutions received by Calscience are obtained, when available, from the National Institute of Standards and Technology (NIST) or other reliable commercial sources whose standards are traceable to the NIST. All pertinent information associated with each standard is entered into Calscience's Chemical Receipt Logbook.

All pertinent information associated with each standard prepared in-house is entered into Calscience's Standard Preparation Logbook. Care is exercised in the proper storage and handling of standard solutions and all containers are labeled with a standard ID, expiration date, compound(s), concentration(s), solvent, initials of the preparer, and preparation date.

All standard solutions are validated prior to use. Depending upon the complexity of the solution prepared, validation procedures can range from a check for chromatographic purity to verification of the concentration of the standard using a standard prepared at a different time or obtained from a different source. Stock and working standards are checked regularly for signs of deterioration, such as discoloration, formation of precipitates, or significant change in concentration.

Reagents are analyzed for purity by subjecting an aliquot to the analytical method corresponding to its intended use. When available from the vendor, quantities of a validated lot of chemicals are sequestered to minimize variations between procurements.

Instrument Calibration and Tuning

Instrument calibration is required to ensure that the analytical system is operating correctly and functioning at the proper sensitivity such that required reporting limits can be met. Each instrument is calibrated with standard solutions appropriate to the type of instrument and the linear range established for the analytical method. The frequency of calibration and the concentration of calibration standards are determined by the manufacturer's guidelines, the analytical method, and/or the requirements of special contracts, whichever is most applicable. The following are very general guidelines and are not meant to be all inclusive. Detailed calibration procedures are specified in the SOP for each method performed.

Gas Chromatography/Mass Spectrometry (GC/MS)

Each day prior to analysis of samples, all GC/MS instruments are tuned with 4-bromofluorobenzene (BFB) for VOCs and decafluorotriphenylphosphine (DFTPP) for SVOCs in accordance with the tuning criteria specified in the applicable methods. Samples are not analyzed until the method-specific tuning requirements have been met.

After the tuning criteria is met, the instrument is then calibrated for all target analytes and an initial multipoint calibration curve established. Alternatively, the previous calibration curve may be used if validated by a calibration verification (CV)

standard. All target analytes are represented in the calibration and certain key target analytes referred to as system performance calibration compounds (SPCCs) and calibration check compounds (CCCs) are used for curve acceptance determination. For the initial calibration to be deemed acceptable, the SPCCs and CCCs must meet established acceptance criteria and must be re-evaluated and meet the acceptance criteria, at a minimum, every twelve (12) hours thereafter.

Non-GC/MS Chromatography

The field of chromatography involves a variety of instrumentation and detectors. While calibration standards and control criteria vary depending upon the type of system and analytical methodology required for a specific analysis, the general principles of calibration apply uniformly. Each chromatographic system is calibrated prior to sample analysis. An initial multipoint calibration curve is generated using all target analytes. All target analytes must meet the acceptance criteria for the calibration to be deemed acceptable. The continued validity of the initial multipoint calibration is verified every 12 hours using a calibration verification (CV) standard containing all target analytes. If the CV fails to meet the acceptance criteria, the system is re-calibrated and all samples analyzed since the last acceptable CV must be re-analyzed.

Inductively Coupled Plasma Emission Spectroscopy

Initial calibration consists of a calibration blank (CB) plus one calibration standard. The calibration is verified by the re-analysis of the standard and an initial calibration verification (ICV) standard. If the standard and the ICV fail to meet the acceptance criteria, the initial calibration is considered invalid and is re-performed.

Continuing calibration verification (CCV) consists of a mid-concentration standard plus a calibration blank (CB) analyzed every 10 samples and at the end of the sequence. If the CCV and/or CB fails to meet the acceptance criteria, the instrument must be re-calibrated and all samples analyzed since the previous acceptable CCV and/or CB must be re-analyzed.

ICP/MS Spectroscopy

Each day prior to the analysis of samples, all ICP/MS instruments undergo mass calibration and resolution checks prior to initial calibration.

Initial calibration consists of a calibration blank (CB) and at least one calibration standard. The calibration is verified by the re-analysis of the standard and an initial calibration verification (ICV) standard. If the standard and the ICV fail to meet the acceptance criteria, the initial calibration is considered invalid and is re-performed.

Continuing calibration verification (CCV) consists of a mid-concentration standard plus a calibration blank (CB) analyzed every 10 samples and at the end of the sequence. If the CCV and/or CB fails to meet the acceptance criteria, the instrument must be re-calibrated and all samples analyzed since the previous acceptable CCV and/or CB must be re-analyzed.

Flame and Graphite Furnace Atomic Absorption Spectroscopy

Initial calibration consists of a calibration blank plus a low, medium, and high calibration standard.

Continuing calibration verification (CCV) consists of midpoint calibration standard plus a calibration blank (CB) analyzed every 10 samples and at the end of the sequence. If the CCV and/or CB fails to meet the

acceptance criteria, the instrument must be re-calibrated and all samples analyzed since the previous acceptable CCV and/or CB must be re-analyzed.

If the calibration blanks contain target analyte concentrations exceeding the acceptance limits, the cause must be determined and corrected.

General Inorganic Analyses

General inorganic (non-metal) analyses involve a variety of instrumental and wet chemistry techniques. While calibration procedures vary depending on the type of instrumentation and methodology, the general principles of calibration apply universally. Each system or method is initially calibrated using standards prior to analyses being conducted with continual verification that the calibration remains acceptable throughout analytical processing. If continual calibration verification fails to meet the acceptance criteria, the instrument must be re-calibrated and all samples analyzed since the previous acceptable CCV must be re-analyzed.

SECTION 9: ANALYTIC PROCEDURES

Procedures

The majority of analyses performed by Calscience are conducted in accordance with procedures set forth by various federal and state regulatory agencies. The following references are applicable:

1. "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods", EPA SW-846, 3rd Edition, Office of Solid Waste and Emergency Response, U.S. EPA, September, 1989 (including Final Updates I, II, IIA, and III).
2. "Guidelines Establishing Test Procedures for the Analysis of Pollutants", 40 CFR, Part 136, Appendix A (Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater), Revised July 1, 1988
3. "Methods for Chemical Analysis of Water and Wastes", EPA-600/4-79-020, Revised March 1983
4. "Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater", EPA-600/4-82-057, July 1982
5. "Standard Methods for the Examination of Water and Wastewater", 18th Edition, APHA, AWWA, WPCF, 1992
6. "Annual Book of ASTM Standards", Various Volumes, ASTM, 1987
7. "Handbook for Analytical Quality Control in Water and Wastewater Laboratories", EPA-600/4-79-019, March 1979
8. "Manual for the Certification of Laboratories Analyzing Drinking Water - Criteria and Procedures/Quality Assurance", EPA QAMS-005/80, Interim Guidelines, EPA 570/9-90-008, April 1990
9. "Leaking Underground Fuel Tank Field Manual: Guidelines for Site Assessment, Cleanup, and Underground Storage Tank Closure", State of California Water Resources Control Board, Revised April, 1989
10. "Compendium of Method for the Determination of Toxic Organic Compounds in Ambient Air", Second Edition, EPA 625/R-96/010b, January 1997
11. "Methods of Air Sampling and Analysis", James P. Lodge, Jr., 3rd Edition, 1990
12. "NIOSH Manual of Analytical Methods", 3rd Edition, PB85-179018, February 1984
13. "Official Methods of Analysis", 15th Edition, AOAC, 1990
14. "Test Methods for Nonconventional Pesticides", EPA 440/1-83/079C, January 1983
15. "Pesticide Analytical Manual", PB88-911999, US Food and Drug Administration, 1987
16. "Manual of Analytical Methods", State of California Air Resources Board, June 1983
17. "Static Acute Bioassay Procedures for Hazardous Waste Samples", State of California Department of Fish and Game, Water Pollution Control Laboratory, November 1988
18. "Methods for Measuring the Acute Toxicity of Effluents to Freshwater and Marine Organisms", EPA 600/4-85/013, March 1985

Calscience also performs analytical work in accordance with requirements set forth by other professional organizations. The choice of analytical method is dependent on the project's data quality objectives (DQOs) to include qualitative certainty, quantitative sensitivity, precision, and accuracy. Analytical methods which are routinely employed at Calscience are documented in an SOP which all analysts must adhere to during the conduct of their work. Each SOP

contains detailed information regarding the scope and application, method summary, comments and interferences, hazards and precautions, sample collection-preservation-containers-holding times, apparatus and materials, reagents and standards, procedures, quality control, calculations, data reporting, and references.

Method Departures

Calscience's SOPs are in substantial conformity with the method references cited above. Departure from approved SOPs shall be approved if necessary or appropriate due to the nature or composition of the sample or otherwise based on the reasonable judgment of Calscience's Laboratory Director, Technical Director, or QA Manager. Departures shall be made on a case-by-case basis consistent with recognized standards of the industry. In no case shall departures be approved without written communication between Calscience and the affected client.

Method Validation

Prior to any method being used for routine analyses, it must be validated. Validation criteria consist of:

- ⇨ Method selection by the Technical and/or Laboratory Director with concurrence by the QA Manager.
- ⇨ Method development which includes but is not limited to instrument configuration/setup, retention time studies, MDL studies, linear range determination, and verification of ability to generate data of known accuracy and precision;
- ⇨ Establishment of quality control acceptance criteria which must be approved by the QA Manager; and
- ⇨ Documentation of the method performance requirements in a SOP.

Gas Chromatographic Confirmation

Due to the technological limitations of gas chromatography, qualitative assessment relies heavily upon comparison of retention times between reference standards and the unknown. In order to minimize the possibility of reporting mis-identified sample results, Calscience confirms, by second column or GC/MS, all positive gas chromatographic results unless specifically exempted. The exemptions allowed include:

- ⇨ The analyte of interest is a multipeak component exhibiting a chromatographic profile characteristic of the reference standard. Polychlorinated biphenyls (PCBs), hydrocarbon fuels, chlordane, and toxaphene are representative of this category;
- ⇨ Aromatic gasoline constituents do not require confirmation when gasoline is determined to be present in the sample. The applicable SOP specifies the exact confirmation requirements.
- ⇨ The samples meet <u>all</u> of the following conditions:
  1. All samples come from the same source, i.e., groundwater samples from the same well for continuous monitoring. However, samples of the same matrix from the same site but from different sources (different sampling locations) are not exempted;
  2. All chemical parameters have been previously analyzed, identified, and confirmed by a second column or GC/MS.

3. The resulting gas chromatograms are relatively simple and do not contain complex or overlapping peaks; and

4. Chromatograms are largely unchanged from those for which confirmation was performed.

SECTION 10: DATA REDUCTION, VALIDATION, REPORTING AND CONFIDENTIALITY

Data Reduction and Validation

All analytical data generated within Calscience is thoroughly checked for accuracy and completeness. The data validation process consists of data generation, reduction, and four levels of review as described below.

The analyst generating the analytical data has the primary responsibility for its correctness and completeness. All data is generated and reduced following protocols specified in the appropriate SOPs. Each analyst reviews the quality of his or her work based upon an established set of guidelines specified in the SOPs or as specified by project requirements. The analyst reviews the data package to ensure that:

- ⇨ Holding times have not been exceeded;
- ⇨ Sample preparation information is correct and complete;
- ⇨ Analysis information is correct and complete;
- ⇨ The appropriate procedures were employed;
- ⇨ Analytical results are correct and complete;
- ⇨ All associated QC is within established control limits and, if not, out-of-control forms are completed thoroughly explaining the cause and corrective action taken;
- ⇨ Any special sample preparation and analytical requirements have been met; and
- ⇨ Documentation is complete, i.e., all anomalies in the preparation and analysis have been documented; out-of-control forms, if required, are complete, etc.

The data reduction and validation steps are documented, signed and dated by the analyst on the QC Review coversheet accompanying each data package. This initial review step, performed by the analyst, is designated as primary review. The analyst then forwards the data package to his or her Group Leader, or designated data reviewer, who performs a secondary review. Secondary reviews consist of an independent check equivalent to that of the primary review and is designed to ensure that:

- ⇨ Calibration data is scientifically sound, appropriate to the method, and completely documented;
- ⇨ QC data is within established guidelines or reported with appropriate clarification/qualification;
- ⇨ Qualitative identification of sample components is correct;
- ⇨ Quantitative results are correct;
- ⇨ Documentation is complete and any anomalies properly addressed and documented;
- ⇨ The data is ready for incorporation into the final report package; and
- ⇨ The data package is complete and ready for archiving.

A significant component of the secondary review is the documentation of any errors which have been identified and corrected during the review process. Calscience believes that the data package which is submitted for a secondary review should be free from errors. Errors that are discovered are documented and formally transmitted to the appropriate Group Leader. The cause of the errors are then addressed by additional training or clarification of procedures (SOP revisions) to ensure that similar errors do not recur and high quality data will be generated.

The completion of secondary reviews is documented on the QC Review coversheet by signature of Data Reviewer and the date

of review which constitutes approval for data release and generation of analytical report.

During both of the QC review processes, 100% of the raw data associated with the entire project is available to the reviewer. Data packages are checked back to the raw data as deemed necessary by the reviewer.

Following draft report generation, the report is reviewed by the Project Manager to ensure that the data set and quality control data is complete and meets the specific requirements of the project. When available, the data is also evaluated against historical site information. Once all requested analytical work has been verified as complete, a final report is generated and signed by the Project Manager.

Following approval for release by the Project Manager, a final review is performed by the Quality Assurance Manager or Designee to ensure that the analytical and quality control data is correct. The Quality Assurance Manager reviews 10% of the project files back to the raw data.

Data Reporting

A variety of reporting formats, from normal typed reports to computerized data tables to complex reports discussing regulatory issues are available. In general, Calscience reports contain the following information.

Analytical Data

Analytical data is reported by sample and test. Pertinent information including date(s) sampled, received, prepared, and analyzed are included on each results page. The reporting limit for each method analyte is also listed.

QC Data

A QC Summary is provided with each final report. Unless otherwise specified in a QAPP or requested by the client, QC Summaries include results for method blanks, matrix spikes, matrix spike duplicates, and surrogate spikes. Laboratory control sample and method blank surrogates are routinely included if matrix interference results in a QC outlier. The effective control limits for the reported QC values are also provided on the QC Summary as well as explanations for any QC outliers.

As required for the project, data reports from "results only" through "full CLP" will be generated and provided. Included in this range are reports for the major DoD programs including NFESC, AFCEE, and USACE.

Methodology

References for the analytical methodology employed are included on all final analytical reports.

Signatory

Final reports are ready for release to the client following review and approval by the Project Manager and QA Manager, as evidenced by their signature on the final report cover page.

Preliminary Data

Upon client request, preliminary data shall be released prior to completion of a full QC review. Preliminary data is subject to change pending QC review and, therefore, shall be clearly marked as "Preliminary, QC Pending" and not include a signature of approval. This qualification is provided as

notification to the client that the data review process has not been completed yet and that the data is subject to possible modification resulting therefrom.

Report Correction

Should an error be detected in a report which has been released to a client, the client will be immediately notified by verbal communication and issued a revised report which states "REVISED ANALYTICAL REPORT".

Client Confidentiality

Calscience is sensitive to the fact that much of the analytical work performed for clientele may be subject to litigatory processes.

Calscience, therefore, holds all information in strict confidence with laboratory release only to the client. Information released to entities other than the client is performed only upon written request from the client.

Due to the investigative nature of most site assessments, analytical information may become available to regulatory agencies or other evaluating entities during site assessment of the laboratory for the specific purpose of attaining laboratory certifications, accreditations, or evaluation of laboratory qualification for future work. During these occurrences, the laboratory will make its best effort to maintain the confidence of client specific information.

SECTION 11: INTERNAL QUALITY CONTROL CHECKS

The quality of Calscience's analytical data is monitored using internal QC checks. Internal quality control checks are used to determine the following:

- ⇨ Calscience's analytic processing is "in-control", that is to say, operating within acceptable QC guidelines during data collection; and
- ⇨ Sample matrices effect on the analytical data being produced.

Unless specified otherwise by project requirements, the following QC checks are performed:

Event-Based Internal QC Checks

Event-based internal QC consists of method blanks (MBs) and laboratory control samples (LCSs) prepared and processed with each preparatory event. For methods that do not employ a sample preparation step (e.g., most volatiles analysis), the QC samples are prepared and processed with each analytical event.

Method Blanks

The MB is used to document contamination resulting from the analytical procedure. One (1) MB, at a minimum, shall be processed and analyzed for every twenty (20) samples or each preparation batch of similar matrix, whichever is more frequent. For methods that do not employ a sample preparation step (e.g., most volatiles analyses), one (1) MB, at a minimum, shall be processed and analyzed for every twenty (20) samples or portion thereof, loaded concurrently.

MBs are analyzed to assess the level of contamination that exists in the analytical system or are introduced by the reagents or sample preparation activities which could lead to the reporting of elevated concentration levels or falsely positive data.

A MB is a blank sample (reagent water or clean sea sand) to which all reagents are added in the same volumes or proportions as used in sample processing and which is carried through every aspect of the procedure. Ideally, the concentration of an analyte in the MB is below the reporting limit for that analyte. However, some common laboratory solvents and metals are difficult to eliminate to the low levels commonly reported in environmental analyses. Calscience does not correct analytical data for MB contamination and reports MB data associated with each sample result reported. Calscience does, however, adhere to the guidance as set forth in Federal Register / Vol. 53, No. 232 / Friday, December 2, 1988 / Notices where, for common laboratory contaminants, the reportable concentrations may increased when they are found in MBs above the reportable limits. A summary follows:

For Volatile and Semi-Volatile Compounds

No positive sample results are reported unless the concentration of the compound in the sample exceeds ten (10) times the amount in the associated MB for the following common laboratory contaminants: methylene chloride, acetone, methyl ethyl ketone, and common phthalate esters.

For Pesticides/PCBs

No positive sample results are reported unless the concentration of the compound in the sample exceeds five (5) times the amount in the associated MB.

For Inorganic Compounds

No positive sample results are reported if the sample results are greater than the

instrument detection limit (IDL) and less than ten (10) times the amount found in the associated MB. Any MB with a negative result whose absolute value is greater than the IDL is carefully evaluated to determine the effect on the sample data.

For Drinking Water (500 Series) Methods

Drinking water samples (or samples analyzed by drinking water methodologies) will not be analyzed if the MB contains regulated analytes above the reportable limits (DLRs). In this case, the analytical system is considered out-of-control and, as such, must be subjected to corrective measures prior to proceeding with MB re-analysis and sample analysis. Final results for each compound consist of the concentration of the sample and MB, the MDL, and the dilution factor.

Laboratory Control Samples

A LCS is a blank sample (reagent water or clean sea sand) to which known concentrations of target analytes have been added. The spiked sample is then taken through the entire analytical procedure and the recovery of the analytes calculated. Measurement of process accuracy is expressed as percent recovery (%REC).

A LCS duplicate (LCSD) is a second aliquot of blank sample that is also spiked with known concentrations of target analytes and processed. Results are also expressed as %REC.

The measurement of process precision is determined through comparison of the LCS and LCSD recoveries. The result is expressed as relative percent difference (RPD).

The QC data derived from the analyses of LCSs are used to evaluate the effectiveness of the analytical process employed. Acceptable LCS results demonstrate that the entire analytical process is in control.

As process control can also be demonstrated by acceptable matrix spike (MS) results, LCSs may not be routinely reported unless the MS data is unacceptable. When analyzed to support process control in lieu of acceptable MS data, one (1) LCS pair is required for each twenty (20) samples of similar matrix. The LCS is processed along with other samples in the batch.

Matrix-Based Internal QC Checks

Matrix-Based, or matrix-specific, internal QC relies upon the use of actual samples to assess the effects of the sample matrix on a specific analytical process.

The main elements of matrix-based QC are:

- ⇨ The analysis of matrix spikes (MSs), matrix spike duplicates (MSDs), or unspiked sample duplicates (as required);
- ⇨ Monitoring the recovery of surrogate compounds;
- ⇨ Monitoring the recovery of internal standards; and
- ⇨ Monitoring the analytical data resulting from the use of standard additions.

Matrix Spiked Samples

A matrix spike (MS) is an environmental sample to which known concentrations of target analytes have been added. The spiked sample is then taken through the entire analytical procedure and the recovery of the analytes calculated. The MS is used to evaluate the effect of the sample matrix on the accuracy of the analytical process. Results are expressed as %REC.

A matrix spike duplicate (MSD) is a second aliquot of an environmental sample which is also spiked with known concentrations of

target analytes and processed. Results are also expressed as %REC.

The effect of the matrix on precision of the process is determined by comparing the MS and MSD recoveries. The result is expressed as RPD.

Unspiked Sample Duplicate

An unspiked sample duplicate is an environmental sample which is divided into two separate aliquots. The aliquots are processed separately and the results compared to determine the effects of the matrix on the precision of the analysis. Results are expressed as RPD.

Spiking Compounds

For Non-Drinking Water (Hazardous Waste) Samples

Spiked samples shall contain a minimum of six (6) representative or ten percent (10%) of the target analytes, whichever is greater. If there are less than six analytes in the method, all target analytes must be used. The spike compounds selected should span the range and categories of method analytes. The analytes chosen for spiking should range from early to late eluters and should, if possible, cover the general types of method analytes, i.e., for EPA Method 8260B, chlorinated, aromatic, and ketone solvents.

For analytical data to be judged "in-control," all spiked compound recoveries should fall within established control limits. However, due to the variances in sample matrices, it is not mandatory that all spiked compounds be "in-control". None-the-less, all data which has been produced since the last acceptable matrix specific QC analyses should be considered suspect. If a spike recovery is not "in control", the cause of the low or high recovery is investigated to determine if it results from matrix interference or laboratory error. If matrix interference is suspected, the sample(s) should be re-extracted and/or re-analyzed as confirmation and, if matrix interference is confirmed, all associated data shall be reported with qualifiers. If due to laboratory error, all associated data will be invalidated and re-analyzed or appropriately qualified depending upon the effect on the resultant data.

For Drinking Water Samples

Samples must be spiked with a minimum of all regulated analytes in the applicable method.

For analytical data to be judged "in-control" all spiked regulated compound recoveries must fall within established control limits. All analytical data associated with matrix specific QC outliers must be invalidated and the samples re-analyzed.

For Single Analyte Samples

For analytical data to be judged "in-control," the spiked compound recovery should fall within established control limits. However, due to the variances in sample matrices, it is not mandatory that the spiked compound be "in-control". None-the-less, all data which has been produced since the last acceptable matrix specific QC analyses should be considered suspect. If a spike recovery is not "in control", the cause of the low or high recovery is investigated to determine if it results from matrix interference or laboratory error. If matrix interference is suspected, the sample(s) should be re-extracted and/or re-analyzed as confirmation and, if matrix interference is confirmed, all associated data shall be reported with qualifiers. If due to laboratory error, all associated data will be invalidated and re-analyzed or appropriately qualified depending upon the effect on the resultant data.

SECTION 16: AIR TOXIC SPECIFIC QUALITY CONTROL

Analysis of air samples requires quality assurance/quality control procedures which, in some respects, are more difficult to achieve than those for traditional soil and water analyses. Therefore, the specific quality assurance and control procedures for air analyses are described in this section.

Calscience receives two basic types of air samples: Those collected on solid or liquid media and whole air samples collected in containers. The QC procedures associated with each are a function of the collection method and may further vary according to the analytical methodology.

Irrespective of the collection media, the following routine QC procedures are accomplished: A multipoint calibration curve is generated initially and, when warranted, thereafter. Daily laboratory performance QC is based upon the use of a midpoint calibration verification (CV) and the comparison of the data resulting from its analysis against the current multipoint calibration curve. Method blanks are analyzed with a minimum frequency of five percent (5%) of the samples per matrix per batch of samples. If there are less than 20 samples in a batch, at least one per matrix per batch is analyzed. Data resulting from method blanks and daily CVs are used to assess daily laboratory performance.

Solid and Liquid Media

Air samples are typically obtained by drawing air through a media which has an affinity for the contaminants of concern. Examples include XAD-2 resin for polynuclear aromatic hydrocarbons, activated carbon for chlorinated solvents, and filters for particulates and metals. Unless otherwise specified by the particular method, Calscience will assess accuracy and precision using the QC procedures discussed previously in this document, that is, using matrix spiked pairs and/or duplicate samples, and surrogate spikes (as applicable). Matrix spiked pair and/or duplicate samples are analyzed with a minimum frequency of five percent (5%) of the samples per matrix per batch of samples. If there are less than 20 samples in a batch, at least one per matrix per batch must be analyzed.

Whole Air

Numerous methodologies call for the collection of whole air samples in containers such as Summa® Polished Canisters or Tedlar® Bags for analysis of volatile organic compounds, petroleum hydrocarbons, fixed gases, etc. QC procedures previously described in this manual can not be applied to whole air samples resulting from the fact that such samples cannot be accurately spiked with the analytes of interest. Resulting from this inability to accurately spike whole air samples, matrix spikes and matrix spike duplicates cannot be accomplished and, therefore, LCS and LCSD analyses are used to assess accuracy and precision, respectively, on 5% batch basis.

Accuracy

For solid and liquid media air samples, the accuracy of analytical measurements is determined by spiking of the original matrix with known concentrations of target analytes (MS/MSD) and determination of their %RECs. For whole air matrices, spiking is not possible, therefore, the determination of the %RECs of the target analytes from the LCS and LCSD are used as a measure of accuracy.

In both cases, accuracy is assessed every 20 samples (5%) or portion thereof.

Precision

For solid and liquid media air samples, the precision of analytical measurements is determined by the spiking of the original matrix with known concentrations of target analytes (MS/MSD) and determination of the RPD between the two measurements. For whole air matrices, spiking is not possible, therefore, the determination of the RPDs of the target analytes from the LCS and LCSD are used as a measure of precision.

Precision is assessed every 20 samples (5%) or portion thereof.

Pre-Sampling Quality Control

Calscience frequently prepares air sampling media for its clientele. Routine QC of sampling media is required to ensure that the media has been prepared properly and is free of contamination. This QC consists of analyzing the prepared media for the target constituents. Depending on the clients desire and the media involved, QC shall be conducted at either the batch or individual unit basis. Sampling media is not released if the target analytes are detected above the reporting limits.

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Frequency of Matrix-Based QC

When not restricted by the analyte(s) or method, Calscience performs MS/MSD and unspiked sample duplicate analyses as specified below:

- ⇨ Matrix spiked samples are analyzed with a minimum frequency of five percent (5%) of the samples per matrix per batch of samples;
- ⇨ Matrix spiked duplicate samples are analyzed with a minimum frequency of five percent (5%) of the samples per matrix per batch of samples; and
- ⇨ When unspiked sample duplicates are specified in the regulatory method, they are analyzed at a minimum frequency of five percent (5%) of the samples per matrix per batch of samples.

Matrix-specific QC samples are performed using the "Closed Batch" concept which requires that all samples in the batch be prepared concurrently or, in the case of volatiles, loaded onto the P/T autosampler concurrently.

Surrogate and Internal Standards and Standard Additions

Surrogates standards are organic compounds which are similar to the analytes of interest in chemical behavior, but which are not normally found in environmental samples such as brominated, fluorinated, or isotopically labeled compounds. Surrogates are added to method blanks, samples, matrix spikes, matrix spike duplicates, unspiked sample duplicates (if analyzed), and standards to evaluate analytical efficiency by measuring recovery. Results are reported in terms of percent recovery (%REC). Calscience relies on data from both matrix specific QC and surrogate recoveries from environmental samples to judge data acceptability. Surrogate standards are selected from those recommended by the EPA, unless otherwise warranted.

Internal standards are organic compounds which have similar retention times to method analytes. They provide required quantitation corrections resulting from minor variations in instrument performance and injection quantities. Additionally, internal standards are used to establish relative RFs for each method analyte and for the establishment of initial and on-going calibration curves. Calscience adds internal standards to all samples requiring GC/MS and ICP/MS analyses. Internal standards are selected from those recommended by the EPA.

Method of standard additions (MSA) is the practice of adding a series of known amounts of an analyte to an environmental sample. The fortified samples are then analyzed and the recovery of the analytes calculated. This technique is used to compensate for sample constituents that enhance or depress the analyte signal, thus producing a different slope from that of the calibration standards. MSA is generally used with trace metal and conventional analyses.

Client/project specific requirements or QAPPs may require other quality assurance procedures "in addition to" or "in lieu of" the above protocols. Those methods not amenable to standard quality control practices will be examined and alternate procedures developed.

Control Limits

The %REC and RPD data from spiked and unspiked sample analyses are compared to their respective control limits to identify out-of-control and potential out-of-control situations.

When control limits are not specified in the regulatory method, the laboratory may

choose to generate its own limits or adopt limits from similar methods. In no case are control limits allowed to exceed maximums which may be set by the various methods.

In addition to environmental sample data, Calscience's Laboratory Information Management System (LIMS) collects and stores, pertinent QC data. Statistical analysis of this data from the actual instrumentation, processes, and analysts performing the method generate the most representative limits for statistical control of that particular operation. Use of the laboratory's historic QC data is the preferred method of establishing control limits when they are not designated in the regulatory method.

Laboratory-generated (in-house) control limits for acceptance and warning levels are established by statistical analysis of a pool of historic QC data generated at Calscience.

The acceptance limits represent the range in which the analytical system is deemed to be in statistical control. Under a normal distribution curve, the probability of a single measurement lying in the range is 99.74%. Acceptance limits for accuracy (%REC) are based upon three standard deviation (±3S) units about the mean. Acceptance limits for precision (RPD) are based upon zero (no difference) and three standard deviation (3S) units above zero.

The warning limits represent the range in which the probability of a single measurement lying in the range is 95.44%. Measurements outside this range indicate a increased potential for the analytical system to go out of control and should prompt the analyst to more closely monitor the process. Procedures for the determination of warning limits are identical to those for acceptance limits, except 2S is used instead of 3S.

Control limits require periodic updates to accurately redefine statistically acceptable operation of an analytical system over a given period. The frequency of updates is dependent upon the stability of the analytical system, which varies with instrumentation and technique employed.

Generation of in-house control limits shall be coordinated by the QA Department.

SECTION 12: SYSTEM / PERFORMANCE AUDITS AND QUARTERLY QA REPORTS

Calscience participates in a wide variety of system and performance audits conducted by numerous federal and state agencies, as well as through its major clientele. These audits are conducted to verify that analytical data produced conforms to industry standards on a routine basis.

A System Audit is a qualitative evaluation of the measurement systems utilized at Calscience, specifically, that Calscience has, in place, the necessary facilities, staff, procedures, equipment, and instrumentation to generate acceptable data. This type of audit typically involves an on-site inspection of the laboratory facility, operations, and interview of personnel by the auditing agency.

A Performance Audit verifies the ability of Calscience to correctly identify and quantitate compounds in blind check samples. This type of audit normally is conducted by the auditing agency through laboratory participation in round robin Performance Evaluation (PE) programs. Examples of current PE program involvement include those conducted by the USEPA (WS/WP and DMR-QA), CADHS/ELAP (solids and bioassay), and ERA InterLaB Soil Studies, as well as programs administered by major industry.

In addition to performance and system audits conducted by auditing agencies or clients, Calscience's QA Manager in association with the Laboratory Director regularly generates quarterly QA Reports.

A reporting system is a valuable tool for measuring the overall effectiveness of Calscience's QA program. It serves as an instrument for evaluating the program's design, identification of problems and trends, and planning for future needs.

The Quarterly QA Reports normally addresses the following information:

- ⇨ Laboratory certifications and approvals;
- ⇨ System and performance audits;
- ⇨ Performance evaluation studies;
- ⇨ LIMS
- ⇨ Performance on major contracts; and
- ⇨ Miscellaneous issues.

The QA goals for the following year will be included in the last Quarterly QA Report of every year.

Should the result of any audit detect a significant error which has been identified to adversely affect released data, the situation shall be thoroughly investigated. Corrective measures shall be enacted to include system re-evaluation, the determined affect on released data and client notification, as necessary.

SECTION 13: PREVENTIVE MAINTENANCE

To minimize downtime and interruption of analytical work, routine preventive maintenance is performed on each analytical instrument. Designated laboratory personnel are trained in preventive maintenance procedures for all major instrumentation. When repairs are necessary, they are performed by either trained Calscience employees or service engineers employed by the instrument manufacturer working, under contract, for Calscience.

Calscience has dedicated SOPs describing preventive maintenance procedures and also maintains records of all maintenance, preventive or corrective, events for each analytical instrument.

SECTION 14: ASSESSMENT OF ACCURACY AND PRECISION

The effectiveness of a QA program is measured by the quality of the data generated in the laboratory. Data quality is judged in terms of its accuracy, precision, representativeness, and comparability. These terms are defined as follows:

Accuracy

Accuracy is a determination of how close the measurement is to the true value. Accuracy can be assessed using reference standards, laboratory control samples, or spiked environmental samples. Unless specified otherwise, Calscience monitors accuracy by spiking environmental samples and comparing laboratory control sample results with the control limits established at plus or minus three standard deviation units from the mean of historical control sample results.

The determination of the accuracy of a measurement requires a knowledge of the true or accepted value of the signal being measured. Calscience monitors accuracy by calculating the recoveries (%RECs) of the matrix spike and matrix spike duplicate analyses. %REC is calculated as follows:

$$\%REC = \frac{(SSR - SR)}{SA} \times 100$$

where: SSR = Matrix spike (or matrix spike duplicate) sample result
SR = Sample result
SA = Spike added

Precision

Precision is the degree to which the measurement is reproducible. Precision is assessed by replicate measurements of reference standards, actual samples, or spiked samples. Calscience routinely monitors precision by comparing the RPD to control limits established at zero plus three standard deviations from the mean RPD of historical control data.

Precision is frequently determined by the comparison of replicates. Standard deviation of a sample of size N of measurements of X_i is commonly used in estimating precision.

Sample standard deviation (S) is calculated as follows:

$$S = \sqrt{\frac{\sum_{i=1}^{N} X_i^2 - \left(\sum_{i=1}^{N} X_i\right)^2 / N}{N-1}}$$

Where a concentration X_i is measured N times.

The relative standard deviation (RSD), which expresses standard deviation as a percentage of the mean, is generally useful in the comparison of three or more replicates, although it may be applied in the case of N = 2.

$$RSD = \frac{S}{\overline{X}}$$

where: RSD = Relative Standard Deviation
S = Standard Deviation
$\overline{X}$ = Mean

In the case of duplicate control measurements, a matrix spike/matrix spike duplicate or laboratory control sample pair, the RPD between the pair shall be used to estimate precision.

$$RPD = \frac{|C_1 - C_2|}{\left(\frac{C_1 + C_2}{2}\right)} \times 100$$

where: C_1 = Concentration of analyte in measurement #1.
C_2 = Concentration of analyte in measurement #2.

Representativeness

Representativeness is the degree to which data accurately and precisely represents a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition. Analytical data should represent the sample analyzed regardless of the heterogeneity of the original sample matrix. Calscience strives to accommodate all sample matrices. Some samples may require analysis of multiple phases to obtain representative results.

Comparability

Comparability expresses the confidence with which one data set can be compared to another data set measuring the same property. Comparability is assured through the use of established and approved analytical methods, consistency in the basis of analysis (dry weight, volume, etc.), and consistency in reporting units (ppm, ppb, etc.).

Completeness

Completeness is a measure of the amount of data obtained from a measurement process compared to the amount that was expected to be obtained under the conditions of measurement.

Detection Limits

The sensitivity of an analytical method is related to the detection limit, i.e., the lowest concentration of an analyte that can be detected. The following are common expressions of limits of detection in use in the laboratory.

Instrument Detection Limit (IDL)

Definition:
The smallest signal above background noise that an instrument can detect reliably.

Measurement:
Analysis of a minimum of seven (7) replicate standard solutions at 3-5 times the expected IDL on three nonconsecutive days.

Calculation:
Three (3) times the standard deviation of the replicate measurements.

Frequency:
Re-evaluated at frequency specified in the applicable regulatory method and following process modifications.

Reference:
Contract Laboratory Program (CLP), SOW ILM04.0.

Method Detection Limit (MDL)

Definition:
The minimum concentration of a substance that can be identified, measured and reported with 99% confidence that the analyte concentration is greater than zero.

Measurement:
Analyzing a minimum of seven (7) replicates spiked at one to five times the expected MDL.

Calculation:
The standard deviation of the replicate measurements times the Student t-value at the 99% confidence level. For seven (7) replicates, $t = 3.143$.

Frequency:
Re-evaluated annually and following process modifications.

Reference:
40 CFR Part 136, Appendix B., 7-1-88 edition.

Estimated Quantitation Limit (EQL)

Definition:
EQL is defined as the lowest concentration that can be reliably determined under routine laboratory operating conditions within specified limits of precision and accuracy.

Measurement:
Determination of the MDL.

Calculation:
The EQL is established following consideration of various information from both, internal and external sources. These sources include 1) laboratory MDL or IDL data; 2) EQL data in SW-846 and Federal Register; 3) the Contract Required Detection Limits (CRDL); and 4) other industry standards. Using this procedure, the EQLs established are generally within 2 to 10 times the laboratory MDL or IDL.

Frequency:
Re-evaluated following MDL/IDL determinations and process modifications.

Reference:
USEPA SW-846, Third Edition.

As a matter of routine procedure, detection limits are reported for every analysis conducted by Calscience, irrespective of the results. The reported detection limits are commonly referred to as the "Reporting Limit" (RL). RLs are usually greater than or equal to the EQL.

SECTION 15: CORRECTIVE ACTION

When errors, deficiencies, or out-of-control situations exist, the QA program provides systematic procedures, called "corrective actions", to resolve problems and restore the proper functioning of the particular analytical system.

Laboratory personnel understand that corrective actions are necessary when any of the following conditions exist:

- ⇨ QC data is outside the acceptance limits for precision and accuracy;
- ⇨ Method blanks contain contaminants above acceptable levels;
- ⇨ Undesirable trends are detected in %RECs or the RPDs between duplicate spiked or unspiked analyses;
- ⇨ There are unusual changes in updated method detection limits;
- ⇨ Deficiencies are noted by the QA Manager or Laboratory Director during internal or external audits or from the results of performance evaluation samples; and
- ⇨ Inquiries concerning data quality are received from clients.

The essential steps associated with corrective actions are:

- ⇨ Identification and definition of the problem;
- ⇨ Assignment of responsibility for investigating the problem;
- ⇨ Investigation and determination of the cause of the problem;
- ⇨ Determination of a corrective action to eliminate the problem;
- ⇨ Assigning and accepting responsibility for implementing the corrective action; and
- ⇨ Verification that the corrective action has eliminated the problem.

The QA Manager will ensure that the above listed steps are taken in each case where corrective action becomes necessary.

Corrective action procedures are often handled at the analyst level by the analyst and group leader, who review the preparation or extraction procedure for possible errors, checks the instrument calibration, spike and calibration mixtures, instrument sensitivity, etc. If the problem persists or cannot be identified, the matter is referred to the QA Manager for further investigation and resolution. Once resolved, full documentation of the corrective action procedure is maintained within the QA Department.

As noted previously in this document, Calscience actively participates in numerous performance evaluation programs. Of special concern are "unacceptable" (results $\geq \pm 3S$) or "check for error" ($\pm 3S \geq$ results $\geq \pm 2S$) results. For "other than acceptable" results, the cause will be thoroughly investigated and corrective actions effected. The cause and corrective action will be documented in a PE Sample Deficiency Corrective Action Report forwarded to the generator with a copy maintained by the QA Department.

APPENDIX C

HEALTH AND SAFETY PLAN

HEALTH AND SAFETY PLAN

CENCO OIL REFINERY
SANTA FE SPRINGS, CALIFORNIA

Prepared for:

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Prepared by:

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January 28, 1999

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FIGURE

Figure 1 Emergency Medical Facility Location

TABLES

Table 1 Health Hazard Information for Constituents
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ATTACHMENTS

Attachment 1 Accident Report

1.0 INTRODUCTION

1.1 General

This Health and Safety Plan (HASP) was developed to provide information on the potential hazards associated with activitites of the Revised Master Work Plan at the CENCO Refining Company facility, at 12345 Lakeland Road in Santa Fe Springs, California ("CENCO" or "Site"), and to provide general health and safety guidance for personnel conducting Revised Master Work Plan field activities in the immediate vicinity of the Site.

The following regulatory, guidance, and background documents were used in developing this HASP:

- *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities* (National Institute for Occupational Safety and Health [NIOSH], Occupational Safety and Health Administration [OSHA], United States Coast Guard [USCG], U.S. Environmental Protection Agency [USEPA], 1985)
- *Standard Operating Safety Guides* (USEPA, 1988)
- 29 Code of Federal Regulations (CFR) Part 1910 and 1926
- Title 8, California Code of Regulations (CCR)
- *Site Safety Plan Guidance Document for Site Assessment and Site Mitigation Projects* (California Department of Health Services [DHS], 1988)
- *Documentation of Threshold Limit Values and Biological Exposure Indices* (American Conference of Governmental Industrial Hygienists [ACGIH], 1989)
- *NIOSH Pocket Guide to Chemical Hazards* (U.S. Department of Health and Human Services, Center for Disease Control, National Institute for Occupational Safety and Health, 1996)

This HASP is part of the *Revised Master Work Plan* for the CENCO facility. The site characterization data presented in previous investigation reports and the results of interviews with individuals familiar with the Site were used to complete the chemical hazard assessment described in this HASP.

1.2 Site Background

The Powerine Site had been used as a refinery since the 1930s. Prior to the construction of the refinery, the Powerine Site was an oil field consisting of crude oil production wells and unlined sumps. In 1936, Rothschild Oil Company purchased the refinery from Bell View Oil Syndicate.

The Rothschild family owned and operated Powerine Oil Company from 1936 to 1984, when Powerine went into bankruptcy and ceased operations at the refinery. In 1986, the refinery emerged from bankruptcy with a new owner, Mr. Oscar Schmidt. The refinery was restarted and operated until 1992, when it ran into financial problems and shut down. In 1993, Castle Energy Corporation bought Powerine and operated the facility until 1995, at which time operations were temporarily suspended. In 1996, Energy Merchant Corporation (EMC) purchased Powerine. In August 1998, CENCO Refining Company acquired the assets and liabilities of Powerine.

The facility processed crude oil to produce petroleum products. The main products produced by the refinery were transportation fuels, including gasoline, Jet A fuel, high and low sulfur diesel, and petroleum coke. The refinery also produced refinery gas and hydrogen, which were consumed internally. In addition, the refinery also produced revenue generating non-fuel by-products such as sulfur and carbon dioxide. Gasoline, jet fuel, diesel and fuel oils were transported via common carrier pipelines to Southland terminals for distribution. The remaining products were shipped off-site by trucks.

The following constituents of concern have either been detected in soil or ground water samples collected at the Site, or are suspected based on reports of chemicals historically used at the Site:

- Total Petroleum Hydrocarbons (TPH) as Gasoline (TPH-g), Diesel Fuel (TPH-d), Jet fuel (TPH-j)
- Halogenated volatile organic compounds (HVOCs)
- Benzene, Toluene, Ethylbenzene, and Xylene isomers (BTEX)
- Methyl Tertiary Butyl Ether (MTBE)
- Lead

1.3 Scope of Hasp

The purpose of the Revised Master Work Plan is to outline a detailed plan for remedial activities of soil and groundwater at the Powerine Site, which include: 1) updating the "Refinery Source Identification and Reduction Plan" and characterizing the extent of TPH and benzene impacted subsurface soils; 2) further characterizing the extent of TPH and benzene impacted groundwater; 3) evaluating the hydrogeological characteristics of the underlaying aquifers; 4) providing a cleanup strategy for both subsurface soil and groundwater; and 5) implementing a schedule for the proposed remedial activities.

This HASP provides standard operating safety procedures for personnel conducting the following Revised Master Work Plan field activities:

- Soil and groundwater sampling
- Aquifer testing
- Monitoring well installation
- Monitoring well destruction
- Wellhead maintenance and repair

Supplements to this HASP will be prepared, as necessary, to address special hazards associated with any other Revised Master Work Plan activities. Soil sampling, aquifer testing, monitoring well installation and maintenance, and surface water sediment and groundwater sampling will be performed by Versar personnel. Well installation, decommissioning, and well repair will be performed by Versar subcontractors. Drilling subcontractors may also be used to facilitate soil and groundwater sample collection. Versar and subcontracted personnel are required to adhere to all provisions of this HASP. Subcontractors can choose to prepare their own plan using these provisions as minimum requirements. The subcontractors are also responsible for following all federal, state, and local requirements applicable to their operations that are not specifically addressed in this HASP. Upon request, the subcontractors shall provide Versar documentation of safety training and medical surveillance program participation, and the applicable respirator fit-test records for all personnel conducting field activities.

1.4 Human Exposure Pathways

Impacted soil and water at the Site are the primary potential exposure media for personnel implementing Revised Master Work Plan field activities. The potential exposure pathways for constituents in Site soil and water include dermal contact, incidental ingestion, and inhalation of windblown dust or vapors during the field activities. The overall potential for inhalation of dust or vapors is expected to be relatively low because the entire Site is either paved or covered by structures.

Dermal contact and incidental ingestion pathways will be minimized through a vigilant personal hygiene program and the use of personal protective equipment. Inhalation of volatile organic compounds (chlorinated solvents) is considered to pose the greatest potential threat for chemical exposure. See Section 3.0 for *Hazard Assessments and Control Measures*. See Section 4.0 for *Air Monitoring* criteria which includes rationale for selection of, and thresholds for, respiratory protective equipment including air monitoring response factors and risk from exposure to (volatile organic compounds (VOCs) based on Permissible Exposure Limits (PELs). Air monitoring in the breathing zone will be performed to confirm that ambient volatile organic compound concentrations are below prescribed action levels (see Section 4.0).

2.0 PROJECT SAFETY AUTHORITY

The following Versar personnel are responsible for project health and safety during implementation of the Revised Master Work Plan:

Project Engineer or Geologist - Sudhakar Talanki
Project Safety Coordinator - Senior on-site field representative
Site Safety Coordinator - Kurt Martin

In addition, each individual working at the site will be responsible for compliance with the safety procedures established herein as well as general safe work practice.

2.1 Project Engineer/Geologist

The *Project Engineer or Geologist* is responsible for disseminating the information contained in this HASP to all Versar personnel assigned to the project, and to the responsible representative of each subcontractor firm working under Versar on the project. The Project Engineer or Geologist will provide subcontractors with copies of the HASP prior to start of work.

2.2 Project Safety Coordinator

The *Project Safety Coordinator* is also responsible for disseminating the information contained in this HASP to all Versar personnel assigned to the project, and to the responsible representative of each subcontractor firm working under Versar on the project. The *Project Safety Coordinator* is responsible for on-site safety and loss-prevention functions.

2.3 Site Safety Coordinator

Enforcement of all policies and practices of the HASP will be the responsibility of the *Site Safety Coordinator* when the *Project Safety Coordinator* is not present. The Site Safety Coordinator has the authority to suspend work any time that it is determined the provisions of this HASP are not being met. The *Site Safety Coordinator* shall also inform the *Site Technical Coordinator* about individuals whose conduct is not consistent with the requirements of this HASP.

The *Site Safety Coordinator* is directly responsible for the following items during implementation of the project:

- Conducting inventory of safety supplies and equipment
- Conducting safety briefings
- Reporting accidents and incidents
- Enforcing safe work practices
- Coordinating waste containment or storage

The *Site Safety Coordinator* shall review the requirements of this HASP during a meeting with all project personnel (Versar and subcontractor personnel) before each phase of the field activities begin. Safe work practices, control of potentially impacted materials, and protection of personnel and property as described in this HASP shall be emphasized during the safety meeting. Field personnel will be required to sign a certification indicating that they will comply with the plan provisions (see Section 14).

Subcontractors shall identify their responsible representatives for project safety by name before the field activities begin. Telephone numbers of these individuals for emergency contact shall also be provided.

3.0 HAZARD ASSESSMENT AND CONTROL MEASURES

The constituents of potential occupational exposure concern at the site are petroleum hydrocarbons, HVOCs, BTEX, MTBE, and lead. A brief description of these constituents, relevant toxicological data, and an exposure hazard assessment are presented below.

Field personnel are required to control exposure primarily through the use of safe work practices and personal protective equipment (PPE). The working conditions will be assessed using air monitoring instruments and visual observations. Air monitoring will be conducted during Revised Master Work Plan field activities to assess airborne levels of potential contaminants. The action levels specified in Section 4 will be used to control activities in areas where hazardous levels of vapors may be present.

3.1 Chemical Hazards

Chemicals detected in soil and groundwater samples from the CENCO facility are presented in Table 1. Also included in the table are (1) permissible exposure limits (PELs), (2) concentrations in air that would be immediately dangerous to life or health (IDLHs), (3) potential exposure pathways, and (4) acute exposure symptoms. The PELs listed in Table1 are defined as the time-weighted average concentrations for a nominal 8-hour work day and a 40-hour work week, to which nearly all workers may be repeatedly exposed without adverse effect (Title 8, CCR, Section 5155). The IDLH values listed in Table1 represents a maximum level from which a person could escape within 30 minutes without escape-impairing symptoms or irreversible health effects (*NIOSH Pocket Guide to Chemical Hazards,* U.S. Department of Health and Human Services, 1996). However, the concentrations of constituents reported in the soil and groundwater samples (which are reported on a weight-to-weight or weight-to-volume in water ratio) are not directly comparable to the airborne exposure criteria (PELs and IDLHs, which are reported on a weight-to-volume ratio in air or volume-to-volume ratio).

3.1.1 Petroleum Hydrocarbons

Occupational exposure criteria for petroleum-hydrocarbon products identified at the Site, diesel and waste oil, have generally not been developed. The PEL for oil mist as a nonvapor particulate is 5 milligrams per cubic meter (mg/m^3). However, the toxicity of a petroleum compound is generally proportional to its viscosity. Highly viscous compounds such as heavy greases and oils, are considered to have only limited toxicity. Diesel fuel is considered by NIOSH to present no significant acute oral hazard; it has a toxicity rating of 0. Prolonged skin contact with diesel and waste oil may result in dermatitis, due to defatting of the skin. Given the expected low levels of diesel and waste oil at the Site, exposure of field personnel to hazards associated with petroleum hydrocarbons are not anticipated.

3.1.2 Halogenated Volatile Organic Compounds (HVOCs)

Previous investigations have identified the following HVOCs in the soil and groundwater at the Site: trichloroethene (TCE), tetrachloroethene (PCE), 1,1,1-trichloroethane (TCA), and 1,1-dichloroethane (1,1-DCA). Other HVOCs have been reported at low concentrations. The compounds reported at highest concentrations and frequencies are TCE, PCE, and TCA.

In addition, TCE, TCA, and PCE are considered potentially carcinogenic. HVOCs are generally moderately toxic through inhalation and ingestion exposure pathways. Several are strong irritants to the eyes and skin. Inhalation of high concentrations causes narcosis and anesthesia. Chronic exposure can lead to liver damage.

The primary potential exposure pathways during the RI/FS field activities are expected to be through inhalation and dermal contact. Occupationally significant airborne concentrations of HVOCs (above the PELs) are not anticipated during the field activities because of the relatively low concentrations detected in the soil and groundwater. Dermal contact will be minimized by practicing contamination avoidance and using the assigned level of PPE. Air monitoring in the breathing zone will be performed to confirm that ambient HVOC concentrations are below prescribed action levels (see Section 4). Respiratory protection will be available for use as necessary.

3.1.3 Benzene

Benzene can enter the body through inhalation, ingestion, or skin contact. Studies have noted that chronic exposure to benzene vapor can produce neurotoxic and hemopoietic (blood system) effects. Other effects can include headache, dizziness, nausea, convulsions, coma, and possible death if exposure is not reversed. The most significant chronic effect of benzene is bone marrow toxicity. Although the cause-effect relationship is not fully understood, it is believed that there might be a strong association between chronic exposures to benzene and the development of leukemia. Exposure routes include contact, inhalation and ingestion. Benzene has a PEL of 1.0 ppm and a short-term exposure limit (STEL) of 5 ppm. It should be noted that NIOSH recommends that exposure to carcinogens be limited to the lowest feasible concentration.

3.1.4 Toluene

Inhalation exposure to toluene vapor can produce effects such as central nervous system depression. Depending on exposure factors, signs and symptoms can include headache, dizziness, fatigue, muscular weakness, lack of coordination, drowsiness, collapse, and possible coma. Studies have noted anemia could be a possible effect of chronic exposure to toluene. Toluene can be a skin and mucous membrane irritant and has been shown to cause liver and kidney damage when overexposure is significant. Exposure routes include contact, inhalation and ingestion. Toluene has a PEL of 100 ppm and a threshold limit value (TLV) of 50 ppm

3.1.5 Xylenes

Depending on exposure factors, inhalation of xylenes vapor may produce central nervous system excitation followed by depression. Exposure to xylene vapor can produce dizziness, staggering, drowsiness, and unconsciousness. At very high concentrations, xylenes vapor may produce lung irritation, nausea, vomiting, and abdominal pain. Liver enlargement and nerve cell damage have been noted from chronic overexposure. Ingestion exposures to xylenes can produce temporary liver damage and should be avoided. Exposure routes include inhalation, ingestion and contact. Xylenes have a PEL of 100 ppm.

3.1.6 Ethyl benzene

Ethyl benzene is an irritant to eyes, mucous membranes, the respiratory tract, and skin. High levels in the air can cause central nervous system depression, a sense of chest constriction, headache and dizziness. Skin contact may cause irritation, inflammation, and first- or second-degree burns. Exposure routes include contact, inhalation, and ingestion. Ethyl benzene has a PEL of 100.

3.1.7 Methyl tert-Butyl Ether

Part of a family of ethers that are a dangerous fire and explosion hazard when exposed to heat, flame or sparks. They can react violently with strong oxidizers; MBTE is a suspected carcinogen. Exposure routes include contact, inhalation, and ingestion. MBTE has a TLV of 40 ppm.

3.2 Physical and Biological Hazards

The physical hazards associated with the field activities may present a greater risk of injury than the chemical constituents in soil and groundwater at the CENCO facility. Activities within the scope of this project shall comply with California and federal OSHA construction safety standards.

3.2.1 Head Trauma

To minimize the potential for head injuries field personnel will be required to wear NIOSH approved hard hats while drilling and sampling activities are being performed. Hats must be worn properly and not altered in any way that would decrease the degree of protection provided.

3.2.2 Foot Trauma

To avoid foot injuries, field personnel will be required to wear steel-toed safety shoes while drilling and sampling activities are being performed. To afford maximum protection, all safety shoes must meet American National Standards Institute (ANSI) standards. Drums or other heavy containers used at the site should be moved only with a drum dolly or by an appropriate lifting mechanism. When drums are moved, all personnel should stand clear of the drum or container to avoid foot injury.

3.2.3 Eye Trauma

Field personnel will be required to wear eye protection (safety glasses with side shields) while field activities are being performed to prevent eye injuries caused by contact with chemical or physical agents. Care should be taken to prevent splashing when working with containers with hazardous materials. Any movement of containers with liquids will be done only with the appropriate lid secured.

3.2.4 Noise Exposure

Field personnel will be required to wear hearing protection (ear plugs or muffs) in high noise areas (e.g., around heavy equipment) while field activities are being performed. Local noise ordinances will be observed during execution of the Revised Master Work Plan activities. The threshold for wearing noise protection shall be to don protection if a conversation cannot be conducted at normal voice levels between two individuals standing approximately three feet apart.

3.2.5 Heavy Equipment Limitations

Vehicles and heavy equipment shall not exceed a speed limit of 10 miles per hour in the project area. Drivers and equipment operators will wear seat belts at all times. No riders will be allowed on heavy equipment or in vehicles unless seats and seat belts are available for their use.

Severe Site accidents are often related to the use of heavy equipment. During activities, trucks, excavation, and steam cleaning equipment will be used. All heavy equipment used on this project will be in good working order and operated in accordance with recognized industry standard and Cal-OSHA Title 8, Subchapter 4, Construction Safety Orders. Safety maintenance checks of all equipment shall be conducted just prior to the start of each work day. Employers and workers at the site shall comply with all Cal OSHA requirements including personal

protection, safety, training, and safety planning rules. Removal activities that pose imminent hazard to site personnel will not be permitted. All cables, slings, and locks will be inspected daily by the contractor to insure that they are in safe working order.

3.2.6 Buried Utilities and Overhead Power Lines

Excavation and well installation or destruction locations will be examined by Site personnel or an underground utility locator service. Utilities will be protected during excavation activities. Underground Services Alert will be provided notice at least two days before beginning excavation or well installation activities. Protection from overhead power lines will be accomplished by maintaining safe equipment and personnel distances of at least 15 feet from the power lines at all times.

3.2.7 Excavations

Field personnel are prohibited from entering into excavations deeper than 5 feet below ground surface unless a Cal-OSHA excavation permit is obtained and Cal-OSHA excavation regulations are observed. The subcontractor shall obtain a Cal-OSHA excavation permit if entry is required. Excavations will be protected from inadvertent or unauthorized entry through the use of temporary fencing when the excavation is unattended. Warning lights will be operated around the excavation from dusk to dawn each day, and as otherwise required.

Underground Service Alert (USA) is required to be utilized prior to drilling, excavation or trenching. CENCO personnel and private utility locators will also be used to determine the presence of subsurface utility lines, tanks and/or drums (if suspected) at the Site.

During the excavation operations, two persons (one designated as "operator" and the other as the "helper") must be present at all times. Every attempt must be made to keep unauthorized personnel from entering the work area. If this is not possible, the operation should be shut down until the area is cleared. The *Site Safety Officer* or the *Field Team Leader* has the authority and responsibility to shut down the excavating operations whenever a hazardous situation is deemed present.

3.2.8 Thermal Stress

Adverse climate conditions are an important consideration in planing and conducting Site operations. The effects of ambient temperature can cause physical discomfort, personal injury, and increase the probability of accidents. In addition, heat stress due to lack of body ventilation caused by protective clothing is an important consideration. Heat-related illnesses commonly consist of heat exhaustion and heat stroke.

The symptoms of heat exhaustion include:

- Weak pulse
- General weakness and fatigue
- Rapid shallow breathing
- Cold, pale, clammy skin
- Nausea or headache
- Profuse perspiration
- Unconsciousness
- Appearance of having fainted

The symptoms of heat stroke include:

- Sudden onset
- Change in behavior
- Confusion
- Dry, hot and flushed skin
- Dilated pupils
- Fast pulse rate
- Body temperature reaching 105° or more
- Deep breathing later followed by shallow breathing

One or more of the following precautions will reduce the risk of heat stress on the Site:

- Provide plenty of liquids to replace lost body fluids. Water, electrolytic drinks, or both will be made available to minimize the risk of dehydration and heat stress.

- Establish a work schedule that will provide appropriate rest periods, and accommodate Site temperature conditions.

- Establish work regimens consistent with the American Conference of Governmental Industrial Hygienists (ACGIH) guidelines.

- Provide adequate employee training on the causes of heat stress and preventive measures.

In the event of temperatures below 55 degrees Fahrenheit, reasonable precautions will be made to avoid risks associated with low temperature exposure (hypothermia). Risks associated with mild hypothermia include loss of fine motor control, reasoning, and distraction caused by discomfort. Reasonable precautions may include use of appropriate clothing as insulation and protection from moisture, and provision of warming fluids and shelter.

3.2.9 Traffic

Some of the Revised Master Work Plan field activities may occur on city streets and in parking and access driveways of the Site and adjacent properties. Vehicular traffic will be a potential hazard during these activities. Control of these areas will be established using barricades or traffic cones. Personnel will be required to wear high-visibility traffic vests while working in streets and near the highway. Local requirements for lane closure will be observed as necessary. If work occurs in a high traffic area, use of subcontracted traffic control specialists will be considered.

3.2.10 Electric Shock

All electrical equipment and power cables used in and around wells or structures containing chemical contamination must be explosion-proof and/or intrinsically safe and equipped with a three-wire ground lead that has been rated as explosion-proof for hazardous atmospheres (Class 1 Div 1&2). In accordance with OSHA 29 CFR 1926.404, approved ground fault circuit interrupters (GFCI) must be utilized for all 120 vault, single-phase, 15-and 20-amp receptacle outlets on the Site that are in use by employees and that are not part of the permanent wiring as defined by the NEC 1987. Receptacles on the ends of the extension cords are not part of the permanent wiring and therefore, must be protected by GFCI's whether or not the extension cord is plugged into permanent wiring. Use of more than one GFCI on a line is not permitted, as they will cancel each other.

3.2.11 Confined Space

A confined space has limited or restricted means of entry or exit, is large enough for an employee to enter and perform assigned work, and is not designed for continuous occupancy by the employee. These spaces may include, but are not limited to, underground vaults, tanks, storage bins, pits and diked areas, vessels, trenches, and silos.

A permit-required confined space is one that meets the definition of a confined space and has one or more of these characteristics: (1) contains or has the potential to contain a hazardous atmosphere, (2) contains a material that has the potential for engulfing an entrant, (3) has an internal configuration that might cause an entrant to be trapped or asphyxiated by inwardly converging walls or by a floor that slopes downward and tapers to a smaller cross section, and/or (4) contains any other recognized serious safety or health hazards.

It is not anticipated that field activities involving confined space entry or permit-required confined space entry will be encountered during the RI/FS. However, should field activities involving confined space entry be encountered, supplements to this HASP will be prepared, as necessary, to address special hazards associated with confined space entry or permit-required confined space entry.

3.2.12 Slip, Trip and Fall

The CENCO facility is complex and comprises an unfamiliar landscape to non-refinery workers. Obstructions and structures may occur in all directions, and workers must take extra care to accommodate unfamiliar conditions. Some activities may occur at night or in areas that are poorly lit or lighting is obstructed or obscured. Additional portable lighting will be provided at the discretion of the *Site Safety Coordinator* if necessary. Workers shall not pass through or work in areas of inadequate lighting in order to prevent physical injury.

3.2.13 Biological Hazards

Drugs and alcohol are prohibited from the Site. Any worker or oversight personnel suspected of being in an impaired condition due to drugs or alcohol will be immediately expelled from the Site.
Any worker or oversight personnel with a relevant medical condition which may require attention should inform the Site Safety Coordinator of such condition, and describe appropriate measures to be taken if the individual should become symptomatic.

All Site personnel should be aware that poisonous snakes, spiders, and insects may possibly be encountered inside our outside of the CENCO facility, and should be avoided. Care should be taken in lifting objects and otherwise investigating locations in which a poisonous insect or reptile may be residing.

4.0 AIR MONITORING

Volatile organic compound (VOC) concentrations in the work area will be measured using a portable photo-ionization detector (PID), or by using colorimetric detector tubes. The PID lamp used for chlorinated solvent monitoring will be a minimum10.6 eV. The PID response factor will be adjusted to reflect the predominant hazardous VOC in the work area. The PID will be calibrated using standard 100 parts per million isobutylene calibration gas. The minimum frequency for VOC monitoring in each work area will be once every 30 minutes during well installation or decommissioning and soil or groundwater sampling. Results will be used to assess the level of respiratory protection required. If VOC concentrations measured by the PID meet the PEL associated with the indicator constituent of concern for a period of 15 minutes in worker breathing zones, half or full face respirators will be employed until the hazard is mitigated for subsides. These action levels and appropriate protection measures such as air-purifying respirators will be used within the exclusion zone and contaminant reduction area (see Section 8).

If the PID or detector tube readings meet the short term exposure limit (STEL) for the indicator constituent of concern for in any work area, the field personnel will temporarily suspend operations, cover the vapor emitting sources, move to an upwind location away from the vapor source, and contact the Site Technical Coordinator or Project Safety Coordinator for implementation of corrective measures.

All monitoring instruments will be calibrated daily before use, consistent with the manufacturers' recommendations. All calibration data and monitoring results shall be recorded in a field logbook.

5.0 PERSONAL PROTECTIVE EQUIPMENT (PPE)

The potential hazards from exposure to petroleum hydrocarbons, HVOCs, BTEX, MTBE, and lead will be minimized by using the appropriate PPE. The minimum level of protection selected for the project is Level D, as defined by OSHA regulation 1910.132 (July 1988). Level D protective equipment is used on sites that have been investigated and characterized as posing occupationally insignificant skin or respiratory hazards and at which all criteria for the use of air-purifying respirators have been met. Dermal protection will be required when direct contact with potentially impacted materials is possible to prevent unnecessary exposure. The protection level at the project area may be upgraded to Level C as specified by the Site Safety or Project Safety Coordinator, based on air monitoring results as outlined in Section 4.0.

The following PPE must be worn during all field activities associated with this project:

Level D

- Safety glasses or goggles
- Hardhat
- Steel-toed boots

In addition, chemical resistant (Nitrile) gloves are recommended when handling soil or water samples.

The following PPE will be readily available, for use as necessary, based on monitoring results outlined in Section 4.0:

Level C

- Half- or full-facepiece respirators with organic vapor cartridges and high efficiency particulate filters (see Section 4.0 for use requirements)
- Chemical-resistant (Nitrile) gloves
- Chemical-resistant boots
- Tyvek® or Saranex® outer garment

All field personnel assigned to work in the project area where respiratory protection may be necessary will be required to have been fit-tested for, and trained in the use, limitations, care, and maintenance of air-purifying respirators, in accordance with OSHA, California Title 8, and IIPP regulations.

6.0 EXPOSURE MONITORING

The selective monitoring of high-risk workers (i.e., those who are closest to the source of contaminant generation), may be conducted. This approach is based on the rationale that the probability of significant exposure varies directly with the distance from the source. If workers closest to the source are not significantly exposed, then all other workers are, presumably, also not significantly exposed, and probably do not need to be monitored. Personal monitoring samples may be collected at the discretion of the Site Safety Coordinator in the breathing zone and, if workers are wearing respiratory protective equipment, outside the face-piece. These samples would represent the actual inhalation exposure of workers who are not wearing respiratory protection and the potential exposure of workers who are wearing respirators. Personnel monitoring will be initiated in the event that respiratory protective equipment is required for any Site worker for the duration of more than four hours in any one instance during field activities, and conditions requiring respiratory protection persist for a minimum of four hours subsequent to initiation of personnel monitoring. Personnel monitoring may be executed via a passive 3M™ 3500 Organic Vapor Monitor (OVM), which contains a single sorbent wafer for collection and analysis of organic vapors by gas chromatography.

7.0 SITE ACCESS

Access to the CENCO facility is controlled through a locked or monitored Site gate. Unauthorized personnel and visitors are not allowed access to the facility. Only personnel with specific operational duties are present on the Site when field operations are being conducted. Site control at work locations shall be established using barricades, cones, and flagging tape as necessary to prevent unauthorized access by CENCO operations personnel during work. The site gate is locked during off-hours for security.

8.0 WORK AREAS

This section provides a brief description of the work areas that will be established for the activities described in this HASP. In addition to the areas described below, an evacuation meeting place will be designated before operation begins, based on the field activity planned. Work-zone boundaries will be delineated in the field, as necessary, using safety cones, barricades, and flagging tape.

8.1 Exclusion Area

An exclusion area will be established to control access to the work areas. The exclusion area will extend from a distance of at least 10 feet from the area where potentially-impacted media is being sampled or tested when sampling monitoring wells or creek sediments, and to at least 25 feet in areas where drill rigs or heavy equipment is in use. Level D protection will be required at a minimum for all personnel within the exclusion area.

8.2 Contaminant Reduction Area

A contaminant reduction area will be placed in an area adjacent to and upwind from the exclusion area, if practical. In this area, personnel and equipment will be decontaminated, as appropriate, after work has been completed.

8.3 Support Area

The support area covers all areas outside the exclusion and contamination reduction areas. This support area provides for all administrative and support functions (command post, first-aid station, rest area, etc.) necessary to keep the field activities running smoothly. Potable water and wash facilities for the field personnel shall be provided at this location. Emergency eye wash and shower facilities occur at locations within the CENCO facility, their locations will be made known to workers. The entire project area will be considered the support area when no field activities are being conducted. Restrooms are available at the facility, and the location will be made known to all individuals working at the Site.

9.0 DECONTAMINATION PROCEDURES

Decontamination procedures will be performed before leaving the work areas as part of the system for preventing or reducing the physical transfer of impacted materials from the project area. Wash tubs with soap and water and rinse tubs will be provided for cleaning of personnel and reusable equipment. A portable hand washing facility will be provided in the support area. All personnel will be required to wash their hands before eating and after work. Solid waste (disposable sampling equipment and used PPE) and liquid waste (decontamination and purged groundwater) will be placed in labeled containers as these wastes are generated.

The wastes will be managed following the procedures described in the Investigation Derived Wastes (IDW) Plan and in accord with applicable law.

Specific procedures for decontamination of reusable equipment will be provided in the *Field Sampling and Analysis Plan.* Personnel decontamination procedures should be performed in the following sequence:

- If gross contamination is obvious, remove contamination with water prior to leaving the exclusion zone. Contain water in a bucket or tub;
- Remove equipment used in the exclusion zone to the contamination reduction zone for subsequent decontamination or disposal;
- Scrub chemical-resistant boot and gloves (if worn) with detergent and water followed by water rinse. Contain water in bucket or tub;
- Remove outer garment (if worn) and discard into appropriate container;

- Remove respirator (if worn); avoid touching face with fingers;

- Thoroughly wash hands and face.

10.0 GENERAL SAFE WORK PRACTICES

The field activities will be conducted following the minimum safety practices described below.

10.1 Safe Work Practices

- Eating, drinking, chewing gum or tobacco, smoking, or any practice that increases the probability of hand-to-mouth transfer and ingestion of materials is prohibited in any area where the potential of contamination exists.

- Hands must be thoroughly washed when leaving a contaminated, or suspected contaminated area, before eating, drinking, or any other activities.
- Impacted PPE will not be removed from the contaminant reduction zone until it has been properly containerized.

- Removal of materials from PPE by blowing, shaking, or any means that may disperse materials into the air is prohibited.

- Personnel on site must use the "buddy" system when wearing respiratory protective devices. Emergency communications will be prearranged in case unexpected situations arise. Visual contact must be maintained between "pairs" on site, and each individual should remain close enough to assist the other in an emergency.

- Personnel will be cautioned to inform each other of subjective symptoms of chemical exposure, such as headache, dizziness, nausea, and irritation of the respiratory tract.

- No excessive facial hair that interferes with a satisfactory fit of the facepiece-to-face seal will be allowed on personnel required to wear respiratory protective equipment.

- On-site personnel will be thoroughly briefed about the anticipated hazards, equipment requirements, safety practices, personal hygiene, emergency procedures, and communications methods, initially and in briefings.

- All field personnel will, whenever possible, locate themselves so that they work upwind from any excavation area.

- Field personnel are prohibited from entering confined spaces, trenches, or excavations deeper than four feet unless the entry provisions of Title 8 CCR are addressed. Open trenches or excavations that are unattended will be guarded covered, or marked by the subcontractor as described in Section 7 to restrict entry.

10.2 Safe Workplace Conditions

- A multipurpose (A, B, C) portable fire extinguisher and other emergency response equipment shall be located in the immediate vicinity of the work area. The *Site Safety Coordinator* will be responsible for maintaining fire extinguishers.

- Field equipment shall be kept in good condition.

- First-aid supplies shall be available in the project area.

- Appropriate work areas designated for support, contamination reduction, and exclusion will be maintained.

11.0 EMERGENCY RESPONSE PLAN

Illnesses, injuries, or accidents occurring during the field activities shall be reported to the Project Safety Coordinator, and attended to immediately.

The following emergency equipment shall be kept in each work area:

- A copy of this Health and Safety Plan
- First aid kit
- 20-pound ABC dry chemical extinguisher
- Portable eyewash unit
- Supply of clean water
- Hand-held horn

A first-aid kit will be available in the vehicle of the Site Safety Coordinator for treatment of minor injuries such as cuts or bruises that may result from an accident. The first-aid kit will contain but not be limited to clean gauze, bandages, tape, and disinfectant. The use of the first-aid kit will be limited to treatment of only minor injuries such as shallow cuts and scratches. Tweezers will be available for removal of splinters and shards.

In an emergency or hazardous situation involving explosions, fires, or major physical injuries, the individual who observes this condition will immediately give a verbal alarm or sound a hand held horn. Upon hearing the alarm, field personnel will safely de-energize nonessential equipment and evacuate to a safe location identified for each work area. The injured personnel must be attended to immediately and medical attention must be obtained. If required, the injured personnel will be transported to the hospital by ambulance. The field activities will be suspended until the cause of the injury has been investigated and the work procedures modified accordingly. An accident/loss report will be completed for any illness, injury, or accident that occurs during the field activities. A copy of the report is presented in Attachment 1. The Site Safety Coordinator shall report to the Project Safety Coordinator or Project Geologist for instructions.

Prior to beginning the field work, the Los Angeles Community Hospital Emergency Department will be notified of the work taking place at the CENCO facility. The Site conditions and scope of work will be described, so as to allow emergency staff to be prepared for any potential chemical or physical injury or contamination which may be encountered and require a hospital emergency room visit.

The telephone numbers of local emergency services are given in Table 2. A map with directions to the Los Angeles Community Hospital is shown for reference in Figure1.

The only hazardous materials which are to be handled are investigation-derived soil, groundwater or excavation spoils. In the event that hazardous materials are spilled at the Site, the *Site Project Manager* or the *Site Technical Coordinator*, and the *Site Safety Coordinator* should be immediately informed. Measures to contain and clean up any hazardous material spills should be taken immediately. Any contaminated surfaces from a hazardous material spill should be appropriately decontaminated.

A portable eye-wash will be available in the work area, and an eye wash and shower are located at locations throughout the CENCO facility.

12.0 TRAINING

All personnel performing the field activities described in this HASP will have received the initial safety training required by OSHA in 29 CFR Part 1910.120 and Title 8, CCR Section 5192. Current refresher training status will also be required for all personnel engaged in the field activities. Documentation that this training has been completed will be provided to Versar upon request. During the field activities, daily safety meetings will be held by the Site Safety Coordinator to review specific health and safety aspects of the scheduled work.

Versar field personnel responsible for air monitoring will be adequately trained in the use, calibration, and limitations of the field monitoring equipment.

13.0 MEDICAL MONITORING

All personnel scheduled for field activities will have completed medical examinations meeting the minimum medical surveillance requirements described in 29 CFR, Part1910.120, and Title 8, CCR, Section5192.

14.0 SITE HEALTH AND SAFETY PLAN SIGNATURES

I have reviewed Versar's HASP for implementation of the Revised Master Work Plan at the Site and immediate vicinity. I understand its purpose and consent to adhere to its policies, procedures, and guidelines for this project while an employee of Versar or Versar contractor (subcontractor).

Name (please print)	Date	Signature

FIGURE

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Yahoo! Yellow Pages

New Search

Starting From:	Arriving At:	Distance:	Approximate Travel Time:
12345 Lakeland Road Santa Fe Springs, CA 90670	Los Angeles Community Hospital 13222 Bloomfield Ave Norwalk, CA 90650 (562) 863-4763	1.7 miles	4 mins

Directions	miles
1. Start out going East on LAKELAND RD towards FOREST PL by turning left.	0.3
2. Turn RIGHT onto BLOOMFIELD AVE.	1.4

Full Route

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Destination

TABLES

Table 1
Health Hazard Information for Constituents

Contaminant	Permissible Exposure Limits (PELs)*	Immediately Dangerous to Life or Health (IDLH)*	Potential Exposure Pathways	Acute Exposure Symptoms
Benzene	1.0 ppm	--	Inhalation, dermal contact	Drowsiness, dizziness, rapid heart rate, headache, tremors, confusion.
1,1-Dichloroethane	100 ppm	4000 ppm	Inhalation, dermal contact	Headache, loss of appetite, nausea, vomit, intense jaw pain, cranial nerve palsy
Ethylbenzene	100 ppm	--	Inhalation, dermal contact	Eye and skin irritant, dizziness, irritates nose and throat
Methyl tert Butyl Ether	40 ppm†	--	Inhalation, dermal contact	nose and throat irritation, headache, nausea, dizziness, confusion
Toluene	100 ppm	--	Inhalation, dermal contact	Light-headedness, confusion, tiredness, weakness.
Trichloroethene	25 ppm	1000 ppm	Inhalation, dermal contact	Irritant to eyes, skin, headache; vertigo, vision disturbance, fatigue, giddiness; cardiac arrhythmias, liver damage.
Tetrachloroethene	25 ppm	150 ppm	Inhalation, dermal contact	Irritant to eyes, nose, throat; nausea, flush face, neck, sleepiness, skin redness, liver damage.
Xylene	100 ppm	900 ppm	Inhalation, dermal contact	headache, loss of coordination, dizziness, confusion

mg/m^3 milligrams per cubic meter
ppm parts per million
* National Institute for Occupational Safety and Health (NIOSH) Pocket guide to Chemical Hazards, 1994, 1996
** Occupational Safety & Health Administration (OSHA) Permissible Exposure Limit (PEL) for chromic acid and chromates
*** NIOSH 10 hr time weighted average for Cr(VI)
Ψ OSHA PEL for polychlorinated biphenyls
† American Conference of Governmental Industrial Hygienists (ACGIH) recommended exposure limit for 8-hour work day, 40 hours per week.

Table 2
Emergency Assistance Information

CENCO Facility
Santa Fe Springs, California

Party	Number
Local Fire/Police Department/Ambulance	**911**
Los Angeles Community Hospital	**(562) 863-4763**
Hazmat: National Control Center **Poison Control Center**	**(800) 424-8802** **(800) 962-1253**
Versar, Inc. Project Manager: Sudhakar Talanki Site Safety Coordinator: Project specific	 **(916) 863-9360** **(916) xxx-xxxx**
Project Safety Coordinator: Kurt Martin	**(916) 863-9336**
CENCO Point of Contact: Neil Norcross	**562/906-0753**

ATTACHMENT 1

ATTACHMENT 1

Name of injured person: _____

Company Name and Address: _____

Age: _____ Sex: _____ SSN: _____

Summary of incident: (provide detail and parts of body affected.)

_____

_____

_____

_____

Type of incident: Possible chemical exposure _____ Physical incident _____ Other_____

Chemical name and form (liquid, solid, gas, fume, mist) _____

Date of Incident: _____ Time of incident: _____

Weather conditions at time of incident: (temperature, precipitation, wind speed, and direction)

_____

_____

Was medical care provided on-site? Yes _____ No _____

If yes, when and where was care provided _____

_____

By whom: _____

If "off-site" care was provided, provided name and location of health-care facility:

_____

_____

Nature of care at the health-care facility: _____

Was the Site Health and Safety Coordinator contacted? Yes_____ No _____

If no, who was contacted? _____

Has the employee returned to work? Yes _____ No _____

If yes, on what date? _____

Provide names of persons who witnessed the exposure/injury incident.

_____

Was the activity being performed under a Health and Safety Plan?

Yes ____ No ____ If yes, attach a copy of the plan.

Provide a list of any personal protective clothing and equipment used by the employee at the time of the exposure/injury incident.

_____

Did any aspect of personal protective clothing and equipment contribute to the exposure/injury incident? Yes _____ No _____ If yes, please explain. _____

_____

Are measures available that may help prevent a repeat of a similar exposure/injury incident? Yes _☐____ No _☐_____ If yes, please explain. _

_____

Describe property damage, if applicable. _____

_____

Name, job position, office location of individual(s) completing this exposure/injury incident

report. _____

Project Manager Signature

_____ Date: _____

Employee Signature

_____ Date: _____

Site Safety Coordinator Signature

_____ Date: _____

Site Technical Coordinator Signature

_____ Date: _____

APPENDIX D

HUMAN HEALTH RISK ASSESSMENT WORK PLAN

HUMAN HEALTH RISK ASSESSMENT
WORK PLAN

CENCO REFINING COMPANY
SANTA FE SPRINGS, CALIFORNIA 90670

Prepared For:

CENCO REFINING COMPANY
12354 Lakeland Road
Santa Fe Springs, California 90670

Prepared By:

Versar INC
7844 Madison Avenue, Suite 167
Sacramento, CA 95628

January 28, 2000

2026-00/3917-014/JAN28'00

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1.0 INTRODUCTION

The primary objective of a human health risk assessment (HHRA) is to evaluate the level of cancer and noncancer risks associated with Site-related constituents of potential concern (COPCs). The results of this assessment are used to develop risk-based cleanup criteria that aid in evaluating whether remedial action is required to protect human health. The HHRA Work Plan describes the proposed approach to developing Site-specific risk-based cleanup criteria for soil for the CENCO Site.

2.0 SITE DESCRIPTION AND HISTORY

A physical description of the CENCO Facility and surrounding areas, and the history of the Site and environmental investigations are presented, respectively, in Section 2.0 and Sections 4.0 and 5.0 of the Revised Master Work Plan.

3.0 THE HHRA APPROACH

3.1 Regulatory Authority and Guidance

The U.S. Environmental Protection Agency (EPA) provides guidance and specific procedures for conducting baseline risk assessments (BRAs). This guidance is found in EPA's *Risk Assessment Guidance for Superfund: Volume I, Human Health Evaluation Manual* (RAGS) (EPA, 1989). Part B of the RAGS describes procedures used for the development of PRGs (i.e., cleanup objectives). Supplemental guidance for performing risk assessments is also periodically issued by EPA Headquarters (e.g., EPA, 1991).

In California, the California Environmental Protection Agency (Cal-EPA) has centralized its risk assessments in three departments, the Office of Environmental Health Hazard Assessment (OEHHA), Department of Pesticide Regulation (DPR), and the Department of Toxic Substances Control (DTSC). It is our understanding that the California Regional Water Quality Control Board will utilize the staff and expertise of the OEHHA to provide technical review of the HHRA prepared by CENCO.

As described in Section 6.3.3 of the Revised Master Work Plan, a Risk-Based Corrective Action (RBCA) assessment will be performed to develop soil cleanup criteria for petroleum hydrocarbon and lead-impacted soil. The RBCA process utilizes risk and exposure assessment practices developed by the EPA in RAGS. The RBCA process was developed by the American Society for Testing and Materials (ASTM), and promulgated as ASTM Method PS-104. The HHRA Work Plan will utilize the RBCA decision-making process that takes into account general, then specific, physical and chemical Site characteristics in a tiered approach to tailor assessment and remediation activities to Site-specific conditions. The RBCA assessment method has been recognized by the RWQCB

as a viable decision-making approach to assess risks from impacted sites to human health and environmental resources. Soil cleanup criteria will be developed that are protective of refinery workers (industrial scenario) and consider dermal, incidental ingestion and inhalation exposure pathways.

3.2 The HHRA Process

The risk assessment process is iterative. It begins with a preliminary assessment to identify critical factors to focus available resources efficiently. The preliminary assessment is usually conservative (i.e., erring on the side of health protection). If risks are perceived to be acceptable the assessment process will stop at that point. The functional elements of risk assessment are well-defined and widely accepted by the federal and state regulatory agencies. These are exposure assessment, toxicity assessment and risk characterization.

There are four major steps involved in conducting a human health risk assessment: data collection and evaluation, exposure assessment, toxicity assessment, and risk characterization. Each step is briefly described below.

3.2.1 Data Collection and COPC Screening

Data collection and evaluation involve gathering and evaluating site data relevant to human health, and identifying both the media of concern (e.g., soil, sediment, groundwater), and the substances present at the site that should be the focus of the risk assessment process (i.e., COPCs). These COPCs are selected based on a combination of their intrinsic toxicities and levels of occurrence at the site. The anticipated COPCs at CENCO include total petroleum hydrocarbons (TPH) in the gasoline (TPH-g) and diesel (TPH-d) ranges; benzene, toluene, ethyl benzene and total xylenes (BTEX); methyl tertiary butyl ether (MTBE); polycyclic aromatic hydrocarbons (PAHs); and lead.

EPA Region 9 Preliminary Remedial Goals will be used to conduct initial screening of COPCs selected for the consideration in the HHRA. Industrial PRG concentrations will be considered for the Site, since Site use will be an active refinery. Soil screening levels (SSLs) for the protection of groundwater will be included in reviewing PRGs for identifying COPC concentrations in soil requiring further evaluation. The SESOIL chemical leaching program will be used to determine the final COPC concentrations protective of groundwater, as PRGs can be overly conservative. Cal-EPA PRGs will be incorporated in the COPC screening review where "CAL-Modified PRGs" for specific chemicals may be "significantly" more restrictive than the federal values.

3.2.1.1 HHRA Conceptual Site Model: Prior to screening of COPCs for further risk evaluation using EPA PRGs, an initial conceptual site model (CSM) will be developed. The Site-specific HHRA CSM will be used to evaluate whether exposure pathways of concern and conditions at the site match those taken into account by the PRG framework.

For those pathways not covered by PRGs, risk assessment specific to these additional pathways will be addressed in the HHRA. Nonetheless, the PRG lookup values will still be useful in such situations for focusing further investigative efforts on the exposure pathways not addressed.

Preparation of the HHRA CSM will include a records search and compilation of existing data (e.g. available site sampling data, historical records, aerial photographs, and hydrogeologic information). Once this information is obtained, CSM worksheets such as those provided in ASTM's *Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites* (1996) can be used to tailor the generic worksheet model to a Site-specific CSM. The final CSM diagram represents linkages among contaminant sources, release mechanisms, exposure pathways and routes and receptors.

3.2.1.2 Background Levels Evaluation: A necessary step in determining Site COPCs is the consideration of background COPC concentrations. There are two types of "background" at sites: naturally occurring and anthropogenic. Natural background is usually limited to metals whereas anthropogenic (i.e. human-made) "background" includes both organic and inorganic contaminants. Existing data on the subject collected by CENCO and published by others will be used to evaluate local background concentrations in the area. On-Site COPCs that have concentrations similar to or less than background concentrations will be eliminated as COPCs.

3.2.2 Assessment of Exposure

The exposure assessment estimates the magnitude of actual and/or potential human exposures, frequencies and duration of these exposures, and pathways by which humans may be exposed. In the exposure assessment, reasonable maximum exposure (RME) estimates are developed for both current and, where applicable, future land use assumptions. Current exposure estimates are used to evaluate potential doses based on existing exposure conditions at the site. Future exposure estimates are used to provide an understanding of potential future exposures and quantitative estimates of the likelihood of such exposures occurring. Conducting the exposure assessment involves analyzing chemical releases; identifying exposed populations; estimating exposure point concentrations (EPCs) for specific pathways based on both environmental monitoring data and predictive chemical modeling results; and estimating chemical intakes for specific pathways. The results of the exposure assessment are pathway-specific intakes for current and future exposures to individual substances.

CENCO's exposure assessment will include use of EPA Region 9 revised exposure factors for dermal contact with (EPA, 1999). The recommended RME (reasonable maximum exposure) defaults for adult workers' skin surface areas and soil adherence factors are 3,300 square centimeters per day (cm^2/day) and 0.2 milligrams per square centimenter (mg/cm^2), respectively. Soil cleanup criteria will also be developed in this assessment. Standard exposure parameters will be used with appropriate, chemical-

specific toxicological data, as described below, to establish the chemical-specific concentrations to which receptor populations could be exposed without appreciable harm to human health.

3.2.3 Assessment of Toxicity

The toxicity assessment considers: (1) the types of adverse health effects associated with chemical exposures; (2) the relationships between magnitudes of exposures and potential adverse effects; and (3) related uncertainties such as the weight of evidence of a particular chemical's carcinogenicity in humans. Toxicity assessments are generally accomplished in two steps. The first step, hazard identification, is the process of evaluating whether exposure to an agent can cause an increase in the incidence of an adverse health effect (e.g., cancer or birth defects). Hazard identification also involves characterizing the nature and strength of the evidence of causation. The second step, dose-response evaluation, is the process of quantitatively evaluating the toxicity information and characterizing the relationships between doses of chemicals administered or received and the incidence of adverse health effects in the exposed population. From those quantitative dose-response relationships, toxicity values have been derived that use the estimated incidence of adverse effects occurring in humans at different exposure levels. Typically, risk assessments rely heavily on existing toxicity values (e.g., reference doses [RfDs] for chronic and subchronic exposure and cancer slope factors [SFs]) developed for specific chemicals by EPA. These toxicity are published in EPA's Integrated Risk Information System (IRIS) data base and in its Health Effects Summary Tables (HEAST). The EPA's values may be augmented by consideration of the potency factors proffered by the OEHHA's Reproductive and Cancer Hazard Assessment Section (RCHAS), the Air Toxicology and Epidemiology Section (ATES), and the Pesticide and Environmental Toxicology Section (PETS) and DPR's Medical Toxicology Branch (MTB). RCHAS generates the cancer potency factors for OEHHA's implementation of the Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65).

The Act also requires that the OEHHA adopt public health goals (PHGs) based on health risk assessments using the most current scientific methods. As defined in statute, PHGs for noncarcinogenic chemicals in drinking water are set at a concentration "at which no known or anticipated adverse health effects will occur, with an adequate margin of safety."

3.2.4 Characterization of Risk

Risk characterization summarizes and combines outputs of the exposure and toxicity assessments to characterize baseline risks, both in quantitative expressions and qualitative statements. During risk characterization, exposure estimates are combined with chemical-specific toxicity information to evaluate whether current or future levels at or near the site may be of potential concern. Human health risks or hazards are generally classified into: (1) incremental risk of cancer and (2) noncancer effects as determined by

the hazard index. Cancer risks are expressed as incremental lifetime risk, such as $1x10^{-6}$ or one in one million chance of developing cancer from exposure to the substance over a lifetime. Cancer risks are the product of the exposure value and the SF. According to the National Oil and Hazardous Substances Contingency Plan (NCP) (EPA, 1988), which provides the framework for the implementation of the Superfund program, the lifetime incremental cancer risk should not exceed the $1x10^{-6}$ to $1x10^{-4}$ range. Noncancer risk is expressed in terms of Hazard Quotient (HQ) for a single substance or Hazard Index (HI) for multiple substances and/or exposure pathways. These are ratios of particular chemical exposures to RfDs. If a HQ is less than one unit, the hazards are not considered to pose a threat to public health, including sensitive subgroups. Generally speaking, cancer risks higher than $1x10^{-6}$ to $1x10^{-4}$ and hazard indices higher than one are considered to raise a regulatory public health concern. Since CENCO will be evaluating risk to worker health at an operating refinery, a cancer risk of $1x10^{-5}$ will be used as the target risk level in assessing the level of concern and in calculating cleanup criteria. In calculating cleanup criteria for chemicals with risks greater than $1x10^{-5}$ or a hazard index greater than one (i.e., COPCs), the risk assessment process will be reversed using standard exposure factors, chemical-specific toxicity factors, and a target risk of $1x10^{-5}$ or a hazard index greater than one, to establish the soil concentration below which "unacceptable" risks to human health would not be likely to occur for this industrial setting.

3.3 Performing the HHRA Using ASTM Guidelines

The ASTM has developed guidelines for environmental assessment of hazardous substances and oil spill responses, waste management, and for environmental risk management. CENCO proposes the use of ASTM's *PS 104: Guide for Risk-Based Corrective Action (provisional standard 1998)* in performing the HHRA for the CENCO refinery. The decision process in this guide integrates risk and exposure assessment practices, as suggested by the EPA with site assessment activities and remedial measure selection to ensure that the chose action is protective of human health and environmental resources.

The HHRA analysis for the CENCO Site will utilize the RBCA Tool Kit for Chemical Releases, Version 1.2, by Groundwater Services, Inc. (RBCA Tool Kit). The RBCA Tool Kit is designed to complete all calculations required for Tiers 1 and 2 of the RBCA planning process. Based upon Site-specific data supplied by the user, the RBCA Tool Kit combines fate and transport modeling and risk characterization functions to compute: exposure concentrations, average daily intake, baseline risk levels, and risk-based media cleanup standards. The RBCA Tool Kit consists of a series of linked workbooks programmed in Microsoft Excel, Version 7.0 or 97, which calculate baseline risk levels and/or cleanup standards for soil and groundwater remediation, based upon information provided by the user. Risk assessment procedures employed in the RBCA Tool Kit are consistent with current EPA guidelines (EPA, 1989a; 1996). The parameters utilized in the RBCA Tool Kit can be customized to incorporate guidances and requirements of local practices and regulatory authorities.

The RBCA process employs a tiered approach to derivation of risk-based soil and groundwater cleanup goals, with each tier serving to refine the risk analysis based upon additional site data and more sophisticated fate and transport modeling methods. For example, Tiers 1 and 2 of the site evaluation process are amenable to use of simple analytical models to estimate risk-based concentration limits. In each case, risk-based concentration limits are derived for relevant exposure pathways, receptors, and COPCs and compared to measured source media concentrations. Source media exceeding these target levels will require either further investigation or remedial action in the time frame necessary to control exposure. Summary information regarding principal calculation steps is provided below.

The RBCA Tool Kit uses a system of ten analytical models linked to internal libraries of standard exposure factors and chemical/toxicological data for over 90 compounds. Based upon site-specific data supplied by the user, the RBCA Tool Kit combines fate-and-transport modeling and risk characterization functions to compute: exposure concentrations, average daily intake, baseline risk levels, and risk-based media cleanup standards. In all cases, model predictions must be shown to be consistent with the actual constituent distributions observed at the site. Proper scientific and/or engineering expertise is required both for characterization of input parameters and assessment of model results.

The RBCA Tool Kit includes the following HHRA evaluation steps:

Exposure Concentrations: Based on representative concentrations of COPCs present in the affected source media, maximum steady-state concentrations likely to occur at the point of exposure (POE) are calculated using the steady-state analytical fate-and-transport models identified in Appendix X3 of ASTM PS 104. To perform these calculations, the system evaluates cross-media partitioning (e.g., volatilization from soil to air) and lateral transport from the source to the POE (e.g., constituent transport via air or groundwater flow).

Average Daily Intake: Based upon the exposure factors selected by the user, the average daily chemical intake for each receptor along each selected pathway is calculated in accordance with EPA guidelines. These values are used in baseline risk calculations for each complete pathway.

Baseline Risk Characterization: Human health risks associated with exposure to COPCs are calculated by the software on the basis of average daily intake rates and the corresponding toxicological parameters for carcinogenic and non-carcinogenic effects. For each complete pathway, the system output provides both individual and additive constituent results for carcinogens and noncarcinogens.

Media-Specific Cleanup Standards: For a given exposure pathway and COPC, the risk-based standard represents a concentration in the affected source medium (soil) that is

protective of a human or ecological receptor located at a relevant POE. For example, for the human health soil-to-air exposure pathway, the cleanup standard is the mean concentration in the affected surface soil zone that will prevent unsafe human exposures via soil vapor or particulate release to air. The ASTM RBCA Standard and other regulatory programs distinguish between two types of risk-based cleanup standards: i) the Risk-Based Screening Level (RBSL), a *generic* target level utilized under Tier 1, and ii) a Site-Specific Target Level (SSTL), a *Site-specific* target level utilized under Tier 2 or Tier 3. Under the RBCA process, Tier 1 RBSLs are based on an assumed exposure in immediate proximity to the source. If source media COPC concentrations exceed Tier 1 RBSLS, the relevant exposure pathways and COPCs may be further evaluated under Tier 2 or Tier 3 to calculate SSTLS which would address actual Site-specific conditions.

Applicable target risk limits (TR, THQ) for health protection can be matched to levels specified by the environmental regulatory authority. Toxicological parameters for each COPC can be determined from published references, such as the EPA IRIS. Exposure rates correspond to the chronic rate of contact or intake of the affected exposure medium (air, water, soil) by the receptor under anticipated land use conditions. As a conservative measure, these rates can be estimated based on standard exposure factors published by the regulatory authority or other source (e.g., American Industrial Health Council) for the anticipated land use at the site (e.g., industrial).

3.3.1 Assessment of Cumulative Risk

The RBCA Tool Kit is able to compute SSTLs based on cumulative risk effects. The Cumulative Risk Worksheet applies if the affected soil must be remediated to meet a cumulative risk limit, i.e., an upperbound carcinogenic risk or hazard index for the combined effects of multiple constituents. The worksheet lists all COPCs and displays individual and cumulative risk values for each applicable exposure medium and receptor.

If an individual or cumulative risk exceeds the applicable limit, the individual constituent concentration limits may be adjusted downward and the risks recalculated until all risk goals are achieved for all exposure media. Once all individual and cumulative risk totals are in compliance with the applicable limits, the target concentrations displayed on the worksheet will represent the applicable media cleanup standards.

The cumulative risk assessment function of the RBCA Tool Kit includes a worksheet to calculate an SSTL for TPH based on a methodology developed by the TPH Criteria Working Group. This approach, designed to incorporate TPH into the RBCA framework, involves dividing TPH into representative fractions with similar physical, chemical, and toxicological characteristics. Thirteen TPH fractions have been incorporated in the RBCA Tool Kit with representative toxicological values and transport parameters for each fraction included the chemical/toxicological database. For calculation of risk levels and cleanup standards, each TPH fraction is treated as a single COPC.

Two options are provided for deriving a cumulative SSTL for TPH based on the SSTLs calculated for the individual TPH fractions. The SSTL for total TPH may be calculated as either i) the inverse weighted average of the individual fraction-specific SSTLs, or ii) the minimum value of all fraction-specific SSTLs divided by their respective mass fractions. CENCO will use the inverse weighted average method, as is expected to be recommended by the TPH Criteria Working Group.

4.0 REFERENCES

American Society for Testing and Materials (ASTM), 1996. *Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites*, Designation: E 1739-95.

U.S. Environmental Protection Agency (EPA), 1988. *Proposed Revisions to the National Oil and Hazardous Substance Contingency Plan.* 53 Federal Register 51394 (December 21, 1988).

EPA, 1989. *Risk Assessment Guidance for Superfund - Volume I. Human Health Evaluation Manual (Part A). Interim Final.* Office of Solid Waste and Emergency Response. EPA/540/1-89/002.

EPA, 1991. Supplemental Guidance for Human Health Exposure Manual: *Standard Default Exposure Factors. Office of Solid Waste and Emergency Response.* Memorandum dated March 25, 1991.

EPA, 1999. *Preliminary Remediation Goals (PRGs).* October 1, 1999.

Groundwater Services, Inc. (GSI). *RBCA Tool Kit for Chemical Releases, Version 1.0a.* 1998.