INTEGRATED
Environmental Services, Inc.

Offsite Groundwater Characterization Workplan

Lockheed Martin Corporation
Former International Light Metals Facility
Los Angeles, California

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Prepared by
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For
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INTEGRATED
ENVIRONMENTAL SERVICES, INC.

SIGNATURES

OFFSITE GROUNDWATER CHARACTERIZATION WORKPLAN

FORMER INTERNATIONAL LIGHT METALS FACILITY

LOS ANGELES, CALIFORNIA

MARCH 1998

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CONTENTS

1. INTRODUCTION 1-1
1.1 BRC C-6 Facility History 1-2
1.2 BRC C-6 Groundwater Conditions 1-2
1.3 International Light Metals Facility History 1-3
1.4 LMC Groundwater Conditions 1-5
1.5 Regional Geology and Hydrogeology 1-6

2. DATA QUALITY OBJECTIVES 2-1

3. SAMPLING RATIONALE 3-1
3.1 Groundwater Contamination Source 3-2
3.1.1 Total Petroleum Hydrocarbons 3-2
3.1.2 Volatile Organic Compounds 3-2
3.1.3 Total and Hexavalent Chromium 3-3
3.2 DAC-P1 Monitoring Results Summary 3-3
3.3 Proposed Monitoring Well Locations 3-4
3.4 Well Design and Installation 3-5
3.4.1 Monitoring Well Drilling and Installation 3-5
3.4.2 Monitoring Well Development 3-8
3.4.3 Survey 3-9

4. SAMPLING AND ANALYSIS PLAN 4-1
4.1 Field Analysis and Measurements 4-1
4.1.1 Water-Level Measurements 4-1
4.1.2 Conductivity, Temperature, pH, and Turbidity Measurements 4-2
4.1.3 Photoionization Detector 4-2
4.2 Groundwater Sampling 4-3
4.3 Quality Assurance 4-6
4.3.1 Trip Blanks 4-6
4.3.2 Field Blanks 4-6
4.3.3 Rinsate Blanks 4-7
4.4 Sample Handling and Custody 4-7
4.4.1 Field Custody Procedures 4-8
4.4.2 Transfer of Custody and Shipment 4-9
4.4.3 Laboratory Custody Procedures 4-9
4.5 Documentation and Photography 4-10

BOE-C6-0093789

Contents (continued)

4.5.1 Field Report 4-10
4.5.2 Daily Field Measurement Record 4-11
4.5.3 Daily Analytical Sample Record 4-11
4.5.4 Daily Summary of Field Activities 4-12
4.5.5 Corrections to Documentation 4-12
4.5.6 Disposition of Documentation 4-12
4.5.7 Laboratory Files 4-13

5. REPORTING AND SCHEDULE 5-1

6. REFERENCES 6-1

EXHIBITS

1. BRC C-6 Facility and LMC Former ILM Facility Site Location
2. BRC C-6 Facility Parcel Delineation
3. BRC C-6 Facility Building 36 Groundwater Plume
4. 1945 Plancor Properties Map
5. LMC Groundwater Sampling and Monitoring Wells Locations
6. LMC TPH-Diesel Distribution in Shallow Groundwater for September 1996
7. LMC TCE Distribution in Shallow Groundwater for September 1996
8. LMC Dissolved Hexavalent Chromium Distribution in Shallow Groundwater for September 1996
9. Proposed Offsite Groundwater Monitoring Well Locations

BOE-C6-0093790

1. INTRODUCTION

The Boeing Realty Corporation (BRC), an indirect subsidiary of The Boeing Company, is currently redeveloping Parcel A of its C-6 facility in Los Angeles, California. McDonnell Douglas Realty Company (MDRC) began the redevelopment in 1996. MDRC became an indirect subsidiary of The Boeing Company on August 1, 1997, and is now known as Boeing Realty Corporation. As part of the redevelopment effort, a review of historic and recent site environmental data was conducted. The results of that review indicate that constituents of concern (COCs) in groundwater originating upgradient of the BRC facility have migrated off-site and are now impacting groundwater beneath the BRC property. The BRC property shares a common boundary with the Lockheed Martin Corporation (LMC), International Light Metals (ILM) property and is hydraulically down gradient.

An investigation of groundwater beneath the western portion of the C-6 facility has been proposed jointly by BRC and LMC. This effort will be funded by LMC to characterize and delineate the groundwater plume containing COCs migrating from the LMC property.

The investigation will:

1. Provide information for use by LMC in fulfilling the Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) for groundwater conducted at the former ILM facility under the jurisdiction of the Department of Toxic Substances Control (DTSC), a matter with which BRC is not concerned.

2. Provide BRC, LMC and regulatory agencies with information on the concentrations and the lateral and vertical extent of LMC-derived COCs in the groundwater beneath the BRC facility.

This workplan has been developed to provide procedures for installing new temporary and permanent monitoring wells and for collecting and analyzing the first round of groundwater samples collected from the wells during the investigation. Subsequent sampling and investigative tasks will be covered, as required, by workplans developed specifically for those tasks.

BOE-C6-0093791

1.1 BRC C-6 FACILITY HISTORY

The BRC C-6 property is located at 19503 South Normandie Avenue in Los Angeles, California, just south of the San Diego Freeway (I-405) and approximately one mile west of the Harbor (I-110) - San Diego Freeway interchange (Exhibit 1).

Aerial photographs indicate that the area was farmland prior to the 1940s. Industrial use of the property began in 1941 when the Defense Plant Corporation (Plancor) developed the site as part of an aluminum reduction plant. The Aluminum Company of America (ALCOA) operated the plant for the government to produce aluminum during World War II. ALCOA operated the plant until it closed in September 1944. The War Assets Administration used the site for temporary storage during the following two years. In 1948, Columbia Steel Company purchased the property. No significant changes were made to the plant under Columbia Steel Company ownership (CDM 1991).

In March 1952, the US Navy purchased the property and established the Douglas Aircraft Company (DAC) as the contractor and operator of the facility for the manufacture of aircraft parts. DAC purchased the property from the Navy in 1970 and used the facility to manufacture components for various commercial and military aircraft until approximately 1992. DAC has used the C-6 facility for the storage and distribution of aircraft parts since cessation of manufacturing activities (K/J 1996a, b, c).

BRC began a phased redevelopment of the 170-acre property in 1996 (phased both in terms of actual environmental activities and demolition). As shown in Exhibit 2, the property has been divided into three parcels (A, B, and C). Each parcel will undergo, as required, environmental investigation, assessment, and remediation prior to construction. Redevelopment of Parcel A began in 1996 and is ongoing. Redevelopment of Parcel B has just begun. Historically, the majority of Parcel B has always been an employee parking lot – no manufacturing or machining operations have occurred in the area of Parcel B bordering the LMC property.

1.2 BRC C-6 GROUNDWATER CONDITIONS

Environmental investigations of the BRC property have identified a plume of dissolved-phase chlorinated solvents in groundwater beneath the C-6 facility (Exhibit 3). The plume, known as

the Building 36 Plume, is believed to have resulted from leaks in tanks or piping associated with a cluster of four underground solvent tanks formerly located near Building 36. The tanks were removed in October 1991 (JMM 1992).

The northern, eastern, and western extent of the plume has been defined; however, the southern extent beneath Buildings 1 and 2 has not been determined. Ongoing operations and space restrictions within these buildings have prevented the collection of samples. Newer, more compact drilling rigs requiring less vertical clearance are now available, however, and wells have been proposed for Buildings 1 and 2 to help define the plume's southern boundary.

Monitoring wells to investigate the Building 36 Plume and to delineate the northern, eastern, and western extent were installed between 1987 and 1992. Data collected from the wells indicate that trichloroethene (TCE), 1,1,1-trichloroethane (TCA), 1,1-dichloroethene (DCE), 1,1-dichloroethane (DCA), cis-1,2-dichloroethene (cis-1,2-DCE), trans-1,2-dichloroethene (trans-1,2-DCE), and toluene have impacted the shallow groundwater beneath the site. A review of historical sampling data shows that concentrations within the plume are decreasing, and that the highest concentrations have typically been found in well WCC-3S, located nearest the former tank cluster. Currently, toluene, DCE, TCE, and cis-1,2-DCE are present within the plume at concentrations of 9,100 ppb, 7,000 ppb, 2,700 ppb, and 2,000 ppb, respectively (K/J 1997).

1.3 INTERNATIONAL LIGHT METALS FACILITY HISTORY

The LMC property, located at 19200 South Western Avenue, is adjacent to and west of the BRC property (Exhibit 1). Industrial development of the LMC property began in 1942 when Plancor constructed an aluminum extrusion facility on the property. The plant, known as Plancor 326, was operated by Bohn Aluminum & Brass Corporation on behalf of the United States government. Extrusion operations at the site began in late 1943 or early 1944 (HMC 1993).

The facility was shut down on August 15, 1945, following the end of World War II, and the property was transferred to the Reconstruction Finance Corporation and the War Assets

Administration for disposition. A Reconstruction Finance Corporation drawing from 1945 (Exhibit 4) shows the Defense Plant Corporation properties in Los Angeles, including the Bohn (LMC) and ALCOA properties (BRC). The western portion of what is now Parcel B of the BRC C-6 facility is labeled "Office Parking" on the drawing (HMC 1993).

The Reconstruction Finance Corporation leased the Bohn property to the Harvey Company in October 1946. The Harvey Company moved munitions equipment from its Long Beach facility to the site in order to expand the extrusion capabilities of the plant to include brass and copper. The Harvey Company purchased the property in December 1948, and between 1950 and 1953 began to rapidly expand and improve operations at the newly created Harvey Aluminum facility. In 1956, Harvey Aluminum began a second major expansion of the facility and continued to increase production capabilities until the mid-1960s when expansion of the facility ceased. The later expansions gave Harvey Aluminum the ability to extrude brass, steel, titanium, and zirconium; ultimately, the company emerged as the leading producer of titanium and related products in the United States (HMC 1993).

Martin Marietta Corporation began acquiring interest in the Harvey Company, and in April 1972 changed the name of the facility to Martin Marietta Aluminum, Inc. Between 1972 and 1975, Martin Marietta Aluminum began to curtail some operations at the plant and focused on the core aluminum and titanium output (HMC 1993). The facility produced titanium and aluminum extrusions and forgings for the aerospace and automotive industries. Operations at the facility were divided into two divisions: Aluminum and Titanium. Operations occurring at the Aluminum Division included:

- Casthouse Operations, where pure and pedigree scrap aluminum were alloyed and prepared for the division's forge and extrusion operations. Wastes generated during casthouse operations included spent lubricating oil, clay used in absorbing oil spills, rags and filters from the maintenance of hydraulic equipment, and oil-contaminated wastewater (K/J 1994)

- Forge Operations, where aluminum billets from the casthouse were placed into a furnace and forged by a hydraulic press. The forged metal was then etched and rinsed. Hexavalent chromium was occasionally used as an etchant. Wastes generated in forging operations included spent acidic and caustic solutions, tank bottom sludges containing metals, waste hydraulic oil, and steam-cleaning water contaminated with hydraulic fluid (K/J 1994).

- Extrusion Operations, where aluminum billets were heated almost to the melting point of aluminum and then sent through the extrusion press. The types of wastes generated in extrusion operations were not provided in the referenced report (K/J 1994).

The Titanium Division melted pure and scrap titanium into ingots. The ingots were then dry forged, extruded, or rolled into their final shapes. Processes that generated waste include grinding, metal cleaning, parts rinsing, hydraulic systems draining, and general plant maintenance. The types of wastes produced included spent sulfuric, nitric, and hydrofluoric acids, spent sodium hydroxide, waste TCA and petroleum solvents, waste oils, acid/caustic sludges, aluminum dross, and polychlorinated biphenyls (PCBs) (K/J 1994).

In 1984, Martin Marietta Corporation set up a joint venture with Nippon Ko Kan (NKK), a Japanese steel and shipbuilding corporation with interests in aluminum, and the facility was renamed International Light Metals Corporation. NKK withdrew from the joint venture in 1991. Martin Marietta tried unsuccessfully to find a buyer for the property, and decided to close the facility in 1992. Aluminum extrusion production ended in April 1992, followed by the cessation of titanium production in June 1992, and aluminum forging in August 1992 (HMC 1993). Structures at the site have been razed, and BRC has been informed that soils beneath the facility have been remediated to levels protective of human health and which should cause no additional impacts to groundwater at the site .

1.4 LMC GROUNDWATER CONDITIONS

An investigation of groundwater at the LMC site conducted as part of the RFI determined that volatile organic compounds (VOCs), total petroleum hydrocarbons (TPH), and metals have impacted the shallow groundwater beneath the LMC property near the border with BRC. TCE is the most frequently detected VOC at the LMC site, followed by DCE, tetrachloroethene (PCE), benzene, and vinyl chloride (G&M 1996b). The highest concentrations of TCE have been found in well P-1 at the eastern border of the LMC property. TCE levels ranged between 22,000 ppb and 24,000 ppb in groundwater samples collected from well P-1 during quarterly sampling conducted between January 1995 and September 1996 (G&M 1996b). Additional information concerning VOC impacts at LMC is provided in Section 3.1.2.

Two TPH compounds, TPH as crude or waste oil (TPH-C) and TPH as diesel (TPH-D), have been detected in groundwater samples collected at LMC. TPH-C was detected at LMC's eastern border in well P-15, and TPH-D was detected in well P-5 at the northeastern border. TPH-D was detected at 5,200 ppb in a groundwater sample collected from P-5 in September 1996 (G&M 1996b). Additional information concerning VOC impacts at LMC is provided in Section 3.2.1.

Metals, including aluminum, arsenic, barium, cadmium, chromium, hexavalent chromium and nickel, have been detected in groundwater samples collected from the shallow groundwater beneath LMC. Hexavalent chromium was detected in the eastern perimeter wells P-1, P-8, and P-20. The highest levels of hexavalent chromium obtained during quarterly groundwater sampling have been detected in P-1. Elevated levels of chromium have been found in soil near wells P-1 and P-14 (G&M 1996b). Additional information concerning hexavalent chromium is provided in Section 3.2.3.

Data gathered during the groundwater RFI indicates that off-site migration of LMC-derived COCs has occurred. Monitoring well DAC-P1, installed by BRC at the LMC/BRC boundary directly across from P-1, has been used to evaluate the quality of shallow groundwater entering BRC from upgradient sources. Groundwater samples collected from DAC-P1 have consistently contained high levels of TCE. The latest sampling data from May 1997 show that TCE at 15,000 ppb is present in groundwater at the border between LMC and BRC (K/J 1997). A review of sample data collected from DAC-P1 shows that concentrations of TCE in groundwater at the location remain high but are decreasing (K/J 1997). Groundwater samples collected from DAC-P1 are analyzed only for VOCs.

1.5 Regional Geology and Hydrogeology

The BRC and LMC properties lie within the West Coast Basin, a major groundwater basin which underlies approximately 160 square miles of the coastal plain in southwestern Los Angeles County. The facilities are located in an area where surface geology is characterized by Holocene

Age sediments within the Torrance plain. The Torrance plain is defined as the area between Palos Verdes Hills to the south and the distinct belt of hills caused by folding and flexures along the Newport-Inglewood Uplift to the north. The Pacific Ocean forms the western boundary of the basin, while the San Pedro Bay and Dominguez Gap form the eastern boundary. The properties are underlain by Holocene and Pleistocene alluvium deposits that comprise the local hydrogeologic system described below (MW 1994).

Two geologic formations exist beneath the properties: the Lakewood and the San Pedro. The Lakewood formation extends to a depth of approximately 180 feet bgs and contains two major hydrogeologic and stratigraphic units known as the Bellflower aquiclude and the Gage aquifer (MW 1994).

In the vicinity of the properties, the Bellflower aquiclude is composed of low-permeability, late Pleistocene Age sediments which lie above the Gage aquifer. Composed predominantly of silty clays with thin, discontinuous sand lenses or gravelly clays, the Bellflower locally extends from ground surface to 80 to 150 feet bgs (MW 1994, K/J 1996d).

The Gage aquifer underlies the Bellflower aquiclude and extends over the entire West Coast basin. In the vicinity of the properties, the Gage is composed of water-bearing, fine-medium to coarse sand with variable amounts of coarse gravels and thin beds of silt and clay. The Gage aquifer is typically encountered at approximately 80 to 150 feet bgs (MW 1994).

The San Pedro formation, which underlies the Lakewood, consists of lower Pleistocene deposits of marine origin and contains the Lynwood and Silverado aquifers. The San Pedro formation extends to a depth of approximately 1,000 feet bgs (K/J 1996d). The Lynwood aquifer has an approximate thickness of 90 feet and is encountered at about 310 feet beneath the properties. The Silverado aquifer is encountered approximately 520 feet bgs. The Silverado is considered a source of drinking water (K/J 1996d) and is the primary water source for the basin due to its high specific yield through the coarser sediments and its good water quality. The Silverado is continuous and merges with the Lynwood aquifer at the base of the El Segundo Sand Hills to the west (MW 1994).

Data collected from monitoring wells installed on the BRC and LMC properties indicate that groundwater flow in the region is generally to the southeast. The LMC data indicate that

groundwater beneath the site is unconfined with a local hydraulic gradient of 0.0055 feet/foot. Groundwater beneath the LMC property generally ranges from 65 to 70 feet bgs and generally flows to the east and southeast (G&M 1996a). Groundwater beneath the BRC property also occurs at approximately 65 feet bgs at the western property boundary, with flow generally to the southeast, bending to the south. Groundwater flow on the BRC property appears to be influenced or controlled by a persistent trough or depression along the eastern BRC property boundary (K/J 1996a, b, c).

2. DATA QUALITY OBJECTIVES

The objective of this groundwater investigation is to develop sufficient information to make informed decisions regarding the nature and extent of groundwater impacts associated with LMC-derived COCs migrating onto the BRC property. In addition to BRC and LMC, users of the data generated as a result of this program include the Regional Water Quality Control Board (RWQCB) and Department of Toxic Substance Control (DTSC) of the California Environmental Protection Agency (Cal/EPA). To accomplish the objective of this program, BRC and LMC have developed three data quality objectives (DQOs):

1. Evaluate the lateral and vertical extent of groundwater contamination in the Bellflower aquiclude that has migrated from the LMC property to BRC.
2. Characterize LMC-derived COCs.
3. Develop sufficient data resources to develop and evaluate remedial alternatives in accordance with regulatory agency requirements.

To a certain extent, several of these DQOs are interrelated, and data collection efforts can serve to meet more than one objective. Specific tasks have been developed to enable this study to meet each specific objective.

Groundwater impacts at the ILM site are believed to be well documented. BRC has been informed that the source of these impacts has been established and addressed during a RCRA Corrective Action Program conducted under the direction of DTSC. However, little groundwater data has been collected on the lateral and vertical extent of LMC-derived groundwater impacts on the BRC property. Previous site investigation activities were performed by LMC and were limited to the ILM property. For this investigation, groundwater samples will be collected from existing wells in the study area, and additional monitoring wells that will be installed on BRC property. With the exception of one monitoring well to be installed in the deeper groundwater zone, new monitoring wells will be installed in the shallow groundwater of the Bellflower aquiclude. The additional wells will be used to investigate the horizontal and vertical extent of groundwater impacts and assist with the screening of remedial alternatives. Samples collected

during the investigation will be analyzed for VOCs, TPH, and metals including aluminum and total and hexavalent chromium.

3. SAMPLING RATIONALE

In the preparation of the LMC RFI, investigative tasks were divided between soils and groundwater. The soil RFI, completed in 1995, provided detailed information on the vertical and lateral extent of constituents in soil. A preliminary assessment of groundwater was also conducted as part of the soil RFI to determine if a detailed investigation of groundwater beneath the LMC property was needed. The groundwater RFI for the LMC property began in late 1995 and was designed to acquire, analyze, and interpret data to accomplish the following (G&M 1996b):

- Determine whether releases to soils have created a release to groundwater
- Collect groundwater data necessary to identify the type and concentration of hazardous waste and constituents released
- Evaluate the on-site extent of groundwater impacted by contaminant releases
- Evaluate the potential for downward migration of impacted groundwater from the first encountered groundwater to the underlying aquifers

The groundwater RFI is currently ongoing. The first three objectives have been accomplished, and it is anticipated that the fourth objective will be initiated in 1998.

Exhibit 5 presents the well and HydroPunch™ locations sampled in the soil and groundwater RFIs for the assessment of groundwater contamination. As part of the groundwater RFI, quarterly monitoring has been conducted since the initial sampling in late 1995.

Groundwater sampling results indicate that the quality of the Bellflower aquiclude beneath the LMC property is relatively poor. The water is slightly saline and very hard. Groundwater samples collected from the aquifer indicate that it has been impacted by TPH, VOCs, and metals. TCE is the most frequently detected VOC in groundwater at the site and is detected at the highest concentrations along the southern half of the eastern property boundary. Other VOCs detected in the shallow groundwater include DCE, cis-1,2-DCE, TCA, PCE, chloroform, benzene, and toluene. Metals have also been detected in groundwater samples collected at the LMC property.

BOE-C6-0093801

Metals detected at concentrations exceeding primary MCLs include aluminum, arsenic, barium, chromium, cadmium, and nickel (G&M 1996a).

3.1 GROUNDWATER CONTAMINATION SOURCE

The migration of COCs to the BRC property from the adjacent LMC property is well documented. These COCs were identified in the RFI Report completed for the LMC property by Geraghty & Miller in 1996 (G&M 1996a). A discussion of the most abundant LMC-derived COCs present in groundwater at the border with BRC is presented in the following subsections. Analytical groundwater results obtained during the RFI for TPH, VOCs, and total and hexavalent chromium are presented. These findings have been supplemented with the most recent quarterly groundwater monitoring results when available. Additional information concerning LMC-derived COCs is provided in section 1.4.

3.1.1 Total Petroleum Hydrocarbons

During the RFI, 30 groundwater samples were analyzed for TPH content. Of the 30 groundwater samples, TPH-D was the most frequently detected petroleum hydrocarbon (13 of 30). The highest TPH concentrations (Exhibit 6) were located along the northern half of the eastern property boundary (G&M 1996a, 1996b).

Quarterly groundwater monitoring conducted by LMC in July 1997 identified a sheen of petroleum product in the northeast corner of the LMC property.

Based on these findings, and the close proximity of the groundwater impact to the BRC property boundaries, TPH is believed to have migrated onto the northwest corner of the BRC property.

3.1.2 Volatile Organic Compounds

Sixteen different VOCs were detected in 29 groundwater samples collected and submitted for VOC analysis. TCE, present in 27 of the 29 samples, was the most frequently detected VOC in the shallow groundwater beneath LMC (Exhibit 7). TCE was found at a maximum concentration of 24,000 ppb in well P-1, adjacent to the LMC/BRC property boundary (G&M 1996a). A review of BRC quarterly groundwater monitoring results shows a TCE concentration of 15,000

BOE-C6-0093802

ppb in DAC-P1 directly down gradient of the LMC well P-1 (K/J 1997). Additional VOCs were identified in the RFI, however not of this magnitude.

Based on these findings and the close proximity of the groundwater impact to the BRC property boundary, VOCs are believed to have migrated onto the western portion of the BRC property.

3.1.3 Total and Hexavalent Chromium

Total and hexavalent chromium have been detected in groundwater beneath the LMC property (Exhibit 8). A potential source of chromium contamination exists on the LMC property near wells P-1 and P-14. Well P-1 is directly across the property boundary from the BRC well DAC P-1. Well P-14 is north of P-1, approximately 180 feet from the LMC/BRC property boundary. Concentrations of hexavalent chromium measured in P-1 and P-14 in September 1996 were 1,100 ppb and 1,590 ppb, respectively. An extensive hexavalent chromium plume covers the eastern portion of the LMC property and is shown clearly to extend beyond the LMC property boundary. Plume concentrations at the eastern LMC boundary exceed 1,000 ppb. Total chromium exceeded MCLs in 10 of 19 sample locations and was present above MCLs in border wells P-1 and P-5. (G&M 1996b).

Based on these findings, and the close proximity of the impact to the BRC property boundary, total and hexavalent chromium are believed to have migrated onto the western portion of the BRC property.

3.2 DAC-P1 Monitoring Results Summary

BRC installed monitoring well DAC-P1 on its property to confirm potential off-site migration from the LMC property. The well is located on the eastern boundary of the BRC property, an area historically used by BRC for an employee parking lot, and downgradient of LMC well P-1. Throughout the monitoring history of DAC-P1, contaminant concentrations have been closely correlated with constituents found in LMC well P-1. This includes type and concentration of groundwater contaminants.

3.3 PROPOSED MONITORING WELL LOCATIONS

The locations and depths of BRC wells adjacent to the LMC property have been reviewed in conjunction with the available data on localized hydrogeology, the potential source areas of groundwater contamination, and the estimated nature and extent of contamination. A determination was made that additional wells are needed to supplement the existing wells. Prior to the installation of permanent monitoring wells, temporary wells will used to determine the presence or absence of VOCs, TPH, and metals, and to delineate the horizontal extent of the plume(s).

Two phases of temporary well installation may be required to characterize and evaluate the extent of LMC-derived COCs beneath BRC property. Eight temporary wells, BL-1 through BL-8, are being proposed for the first phase of the investigation (Exhibit 9). Seven of the wells will be installed in the shallow groundwater zone and one well, BL-3, will be installed in the deeper zone of the Bellflower aquiclude. Locations for these wells are based on known or suspected sources of contamination on the LMC property and the regional southeasterly flow of groundwater.

With the exception of BL-3, boundary wells BL-1 through BL-4 will be installed on BRC property near the western BRC fenceline. BL-3 will be installed near DAC-P1 in the aquifer underlying the shallow groundwater to evaluate the quality of water in the deeper zone and to evaluate whether vertical migration of COCs has occurred. Well BL-1 will be installed at the northwestern corner of BRC near an area of TPH contamination detected on the LMC property. BL-2 will be installed southeast of LMC well P-5, approximately 50 feet east of the fenceline and 500 feet south of BL-1. Well BL-4 will be installed approximately 50 feet east of the fenceline and directly across the property line from LMC well P-7 to characterize the quality of groundwater entering the western portion of BRC from upgradient sources.

Wells BL-5 and through BL-8 will be installed to evaluate the lateral and downgradient extent of LMC-derived COCs. Wells BL-5 and BL-6 will be installed approximately 100 and 150 feet east of the BRC fenceline, respectively. Well BL-5 will be located approximately 850 feet south of BL-1 and will be used to evaluate the lateral and downgradient extent of VOC, TPH, and metal impacts to the shallow groundwater. Well BL-6 will be installed approximately midway

between BL-4 and BL-5 and will be used to evaluate the lateral and downgradient extent of VOC and metal impacts to the shallow groundwater.

Two additional wells, BL-7 and BL-8 will be installed farther downgradient, approximately 400 and 350 feet, respectively, east of the LMC/BRC property line. BL-7 will be installed approximately 650 feet southeast of BL-5, and BL-8 will be installed approximately 550 feet southeast of DAC-P1.

If the data collected during the first phase of well installation and sampling indicate the extent of LMC-derived COCs beneath the BRC property has not been characterized, additional wells may be installed to further delineate the impacts. The locations of these wells will be determined after an analysis of samples collected from BL-1 through BL-8 has been completed. In addition, if data collected from BL-3 indicate that the deeper aquifer has been impacted, additional wells may be installed in a cluster-type arrangement to further delineate impacts in the deeper zone.

Temporary wells providing useful data on the nature and extent of LMC-derived COCs beneath BRC property will be converted to permanent wells. Permanent wells will be developed to provide groundwater monitoring data necessary to meet all data quality objectives specified in Section 2. Temporary wells will be abandoned by over-drilling to a depth of 12 feet and pressure grouting the remaining well casing.

3.4 WELL DESIGN AND INSTALLATION

During the investigation, temporary wells will be installed to measure water levels, evaluate the presence or absence of chemical compounds, and/or the nature and concentration of contamination, if detected. Key temporary wells will be converted to permanent wells to obtain regular water-level measurements and groundwater quality data. The following sections describe the procedures to be used during the drilling, installation, and surveying of both temporary and permanent monitoring wells.

3.4.1 Monitoring Well Drilling and Installation

Drilling will proceed from ground surface to the first water-bearing zone. Prior to drilling, the contractor will notify the Underground Service Alert (USA) and appropriate BRC personnel to

confirm the presence or absence of underground utilities near the boring locations. In addition, each borehole will be hand-augered to a minimum of 5 feet to clear the location for unmarked lines or utilities.

Drilling will be accomplished using 8-inch, outside diameter, hollow-stem augers. All soil collected will be described in the field by the contractor's geologist, acting under the supervision of a California registered geologist. All field inspections and soil descriptions will be completed on a BRC soil boring log. The boring log will include lithologic descriptions in accordance with the Unified Soil Classification System (USCS), color according to the Munsell color chart, identification number, sample interval, blow counts, and other pertinent data for each borehole drilled.

Soil samples will not be collected for analysis during the installation of boreholes unless staining or odors are present. An investigation of soil in the Parcel B area of the BRC C-6 facility was completed in January 1998 (K/J 1998) under the oversight of the RWQCB, the lead agency for the BRC C-6 facility, with input from DTSC. As part of that investigation, 229 soil samples were collected from 52 soil borings drilled to 50 feet bgs. All soil samples obtained during the investigation were analyzed for VOCs and total recoverable petroleum hydrocarbons (TRPH). Selected additional analyses were performed on an area-by-area basis for TPH, SVOCs, Title 22 metals (including hexavalent chromium), PCBs and pesticides. Results obtained from the investigation indicate that no COCs are present in soil within Parcel B of the BRC facility at levels of concern (K/J 1998).

Temporary monitoring wells will be installed in each boring. All wells will be constructed using threaded, 2-inch-diameter, Schedule 40, flush-jointed, polyvinyl chloride (PVC) casing. Each monitoring well installed in the shallow groundwater zone will be constructed with one slotted interval extending from 10 feet above the saturated zone to 10 feet into the saturated zone. The screened interval above the water table is necessary since groundwater in the shallow zone is rising at a rate of approximately 1 foot per year (K/J 1997). In the case of cluster wells, the well installed in the deeper aquifer will be constructed with one slotted interval extending 5 to 10 feet into the deeper water-bearing zone. The deep well will not be screened above the aquifer. The blank and slotted well casing will be assembled above ground and lowered into the borings

through the center of the hollow-stem augers to the proper depth. Grease, oil, and glue will not be used when joining the sections together.

A sand filter pack will be installed around entire vertical distance of the slotted interval and will extend a minimum of 2 feet above the slotted interval. Slot size and sand filter packing needs will be based on a location-specific grain size analysis. Clean silica sand (compatible with the slot size) will be added as the augers are retracted from the borings. Depth soundings will be taken regularly to ensure that heaving conditions or sand bridging are not occurring and that the level of the introduced sand pack remains just above the lower extent of the augers being removed from the borehole. This process will continue until the sand pack extends a minimum of 2 feet above the top of the slotted casing.

Following initial placement of the sand filter pack, the well will be surged using the appropriate diameter surge block to facilitate additional settling of the sand filter pack. Surging will consist of lowering the surge block to the bottom of the well and then raising and lowering the surge block along the entire length of the saturated screened interval. During surging operations, depth soundings will be taken regularly to determine whether additional sand will be necessary.

Temporary wells will be sealed by installing a 2-foot-thick bentonite casing seal above the slotted interval to prevent the infiltration of surface water or foreign material. Potable water will be used to hydrate the bentonite. The amount of water added will be noted on the boring log. The remaining annular space extending from the bentonite seal to approximately 1 foot bgs will be grouted. The PVC casing in each well will be capped with a PVC slip cap.

Temporary wells in which COCs are detected above MCLs may be converted to permanent wells. All other temporary wells will be abandoned. Temporary wells will be converted to permanent wells by installing a traffic-rated, watertight box with a locking cap to protect the well from accidental damage and vandalism. In addition, a concrete pad, sloped to encourage surface-water runoff away from the monitoring well will be constructed around the well box, and a permanent identification marker will be affixed to each well.

3.4.2 Monitoring Well Development

Monitoring wells will be developed no sooner than 48 hours after well installation has been completed. Well development will begin by bailing accumulated sediments from the well. The well screen will then be mechanically surged by swabbing the slotted interval slowly with a surge block to break down any fines smeared on the borehole wall during well drilling. This procedure will create a better pathway for groundwater flowing into the well.

After the initial surging, the well will be bailed again to remove sediments from the bottom of the well. After most of the accumulated sediment has been removed, the well will be pumped to remove additional sediments and fine-grained materials or clogs in the formation surrounding the well screen.

Groundwater levels and the total depth of the wells will be measured prior to and after completion of development. In addition, water quality parameters such as pH, temperature, specific conductance and turbidity will be measured at regular intervals during well development (at a minimum, after purging each well volume) and the results recorded on the Daily Field Measurement Record.

Monitoring wells will not be considered "developed" until a minimum of 5 well volumes of water have been removed, extracted groundwater has become devoid of sediment, and water quality parameters have stabilized. Water quality parameters are considered to have stabilized when three successive measurements of pH are within 0.1 units, temperature is within 0.5 degree Celsius (C), specific conductance is $\pm$ 10 μmhos/cm for the 0-800 range (+ 50 at 800-1000), and turbidity is $\leq$ 5 nepthelometric turbidity units (NTUs). The pH, temperature-specific conductance, and turbidity meters will be calibrated and operated in accordance with their respective instrument manuals, and calibration data will be recorded on the Daily Field Measurement Record. Development of wells not meeting these criteria after 10 well volumes have been removed will be discontinued.

Development water from each monitoring well installed during this study will be stored and sealed in Department of Transportation (DOT) approved 55-gallon drums. All drums will be labeled appropriately and retained on site, pending analysis and subsequent treatment and/or disposal by the contractor.

3.4.3 Survey

Newly installed temporary and permanent wells will be surveyed for location and elevation. A permanent mark on the north side of the PVC casing will be used as the reference point for water-level measurements. Surveyor reference marks will be located on both the well casing and outer protective casing. The northing/easting coordinates of the sample location will be surveyed by Tait & Associates to within ± 1.0 foot. Elevations will be surveyed to an accuracy of ± 0.01 foot. The elevation of each well will be surveyed relative to mean sea level. The reference points will be measured by a California-licensed surveyor. Survey information will be documented on survey forms, the master surveyed site plan, and in a computer database format.

4. SAMPLING AND ANALYSIS PLAN

This section describes the types of field measurements that will be made and presents the procedures to be followed by personnel performing the measurements and collecting groundwater samples. Quality assurance/quality control (QA/QC) procedures, sample handling and custody requirements, laboratory custody procedures, and documentation requirements are also presented.

4.1 FIELD ANALYSIS AND MEASUREMENTS

Field data will be collected during well installation and sampling activities. The types of field data to be collected include:

- Water-level measurements
- Conductivity, temperature, pH, and turbidity measurements
- Photoionization detection

The methods presented below are intended to ensure that field measurements are consistent and reproducible when performed by various individuals. Field personnel will record field measurements on the standardized Daily Field Measurement Record as described in Section 4.5.2. In addition to properly recording data on the standardized forms, personnel will maintain field notebooks in which all data will be recorded.

4.1.1 Water-Level Measurements

Water levels will be measured using either an electric probe or pressure transducer. If a pump or other equipment is in the well, measurement devices will be lowered slowly to avoid entanglements. Water-level measurements in completed wells will be made from the permanently marked reference point on the well casing. The elevation of this point will be established by survey in relation to a National Geodetic Vertical Datum (NGVD). Water levels measured in boreholes or wells during construction will be made relative to ground surface.

Measurements will be made and recorded in the Daily Field Measurement Record to the nearest hundredth of a foot.

4.1.2 Conductivity, Temperature, pH, and Turbidity Measurements

Specific conductance, water temperature, pH, and turbidity measurements will be made in the field during well purging. The water sample will be placed in a sample container solely for field testing. A field pH meter with a combination electrode or equivalent will be used for pH measurements. Temperature measurements will be performed using standard thermometers or equivalent temperature meters. Combination instruments capable of measuring two or all three parameters may also be used.

All instruments will be calibrated as described in their respective instrument manuals. All instrument calibration data will be recorded in the Daily Field Measurement Record. All probes will be thoroughly cleaned and rinsed with distilled water prior to conducting any measurements.

4.1.3 Photoionization Detector

The photoionization detector (PID) will be used for measuring gaseous levels of a variety of organic and inorganic compounds. The PID is a portable, nonspecific, vapor/gas detector which will be calibrated using isobutylene. Isobutylene provides a mid-range response for most contaminants of interest, is relatively safe to use, and is readily available. The PID contains an ultraviolet light source within a sensor chamber. Ambient air is drawn into the chamber, and if the ionization potential of any molecule present in the ambient air is equal to or lower than the energy of the ultraviolet light source, ionization will take place, causing a deflection in the meter.

A PID will be used to monitor soil cuttings during drilling operations if soil staining or odors are present. A glass jar will be partially filled with soil obtained from the cuttings and covered with a Teflon sheet. After waiting approximately 30 seconds, the PID reading will be obtained by inserting the tip of the probe through the Teflon sheet and holding it approximately ½-inch above the soil surface for 5 seconds. Response time is approximately 90 percent at 3 seconds. The measurements are reported in parts per million. The PID will also be used to measure organic

vapors in the headspace of monitoring wells immediately after the cap has been removed prior to each sampling event. All readings will be recorded in the Daily Field Measurement Record.

4.2 GROUNDWATER SAMPLING

Groundwater samples will be collected from each well installed as part of the groundwater investigation and submitted to a state-certified laboratory for analysis. The initial round of groundwater samples will be analyzed for COCs known to be present at both the LMC and BRC sites. This data set will establish a broad information baseline that can be used to assess groundwater quality and, if needed, to assist in development a groundwater remediation program. Initial groundwater samples collected from wells BL-3 through BL-8 will be analyzed for:

- VOCs using EPA Method 8260
- Filtered and non-filtered Title 22 metals, including aluminum and total chromium, using EPA Method 6010
- Filtered and non-filtered hexavalent chromium using EPA Method 7196

Initial groundwater samples collected from wells BL-1 and BL-2 will be analyzed for:

- TPH-fuel fingerprint (TPH-ff) using modified EPA Method 8015
- VOCs using EPA Method 8260
- Filtered and non-filtered Title 22 metals, including aluminum and total chromium, using EPA Method 6010
- Filtered and non-filtered hexavalent chromium using EPA Method 7196

All monitoring wells will be purged prior to sample collection. The procedures to be used for purging and sampling monitoring wells installed during the investigation are as follows:

1. Remove the well cap and check for VOCs in the headspace using a PID. Record the reading in the Daily Field Measurement Record.
2. Measure the static water level and total depth of all wells as described in Section 4.1.1 prior to collecting groundwater samples. If more than 24 hours have elapsed since water

levels were collected, recheck the static water level prior to purging for documentation purposes. Record the data and calculate the purge volume using the following equation

$$V = C_f \pi r^2 h$$

where

V = well volume (gallons)

r = well radius (ft)

h = column of water in the well (total depth - depth to water) (ft)

C_f = 7.48 gallons/ft^3

3. Purge water from the well until conditions described in item 4 below have been met. Water may be removed from the well using either a bailer or submersible pump The use of a pump is the preferred evacuation method; bailers will only be used if it is not possible to use a pump. Criteria for selecting the proper device for purging the well are presented below.

   a. Bailers are most applicable for sampling after purging and for purging small-diameter, low-yield wells. If a bailer is used, it should be dedicated to the well, i.e., used only for that well. Field decontamination of bailers is not permissible.

   b. Submersible pumps are most effective for wells that recharge quickly and where water levels are below 20 feet bgs. When a submersible pump is used, the pump will be slowly lowered into the well on a polypropylene safety line. Once the pump has been lowered to the desired level, the safety line will be secured. The submersible pump must be decontaminated between wells by washing the outside surfaces with tap water and a non-phosphate detergent, rinsing it with tap water, placing the pump in a container and pumping 20 gallons of potable water through it, and then rinsing again with distilled/deionized water. New drinking-water-grade polyethylene tubing will be used at each well where the submersible pump is employed for purging.

4. Measure the pH, conductivity, temperature, and turbidity after each well volume has been purged to determine stabilization. Purging will be completed when 5 well volumes have been removed or when 3 successive measurements of specific conductance, pH, and temperature have stabilized at values within the following ranges:

   a. Specific Conductance: $\pm$ 10 μmhos/cm for the 0-800 range (+ 50 at 800-1000)

   b. pH: $\pm$ 0.1 pH units

BOE-C6-0093813

c. Temperature: $\pm$ 0.5°C

d. Turbidity: $\leq$ 5 NTUs

5. Record the stabilization results on the Daily Field Measurement Record. Wells that recover very slowly should be purged at a rate of less than 1 gallon per minute. If the well is purged to near dryness using this slow rate, allow it to recover before collecting a sample.

6. Collect a groundwater sample from the well within 1 hour of purging or when water level recovers to within 90% of the original level. Slowly recharging wells are permitted to sit for no more than 3 hours prior to sampling.

   a. Samples will be collected using decontaminated, disposable, bottom-loading Teflon or polyethylene bailers. Clean polypropylene rope will be used to lower the bailer into the well. The field team will wear disposable gloves when handling the sampling equipment. New rope and disposable gloves will be used at each well. Care will be taken to ensure that bailers and rope do not come into contact with any contaminated surface.

      Filtered samples submitted for dissolved metals analysis will be obtained by first collecting a sufficient quantity of groundwater in a decontaminated bucket or other suitable container from which the water may be pumped through a filter into the sample container. A peristaltic pump with disposable tubing shall be used to extract water from the container to obtain the filtered sample. Filtering will be accomplished by using an in-line disposable filter cartridge having a 0.45-micron pore-diameter. Approximately 200 mL of discharge water shall be flushed through the filter prior to collecting the sample. The filter shall be replaced when water flow through the filter is impaired.

   b. Samples will be carefully transferred into containers, avoiding agitation or turbulence, which can result in the loss of VOCs and/or excessive oxygenation of the samples. Care will be exercised to avoid breakage and prevent contact between any foreign substance and the interior surface of the containers or caps. Caps will not be removed from the container until sampling actually occurs.

   c. A sample label will be affixed to each sample container indicating the well number, and sample collection time and date. This information will be entered into the Daily Analytical Sample Record as described in Section 4.5.3. Containers will be sealed with signed chain-of-custody seals for shipment to the laboratory.

d. Samples will be packed on blue ice in a cooler and the Analytical Sample Record and chain-of-custody form will be completely filled out. Samples will be shipped to the laboratory at the end of each day's sampling.

7. All nondisposable sampling equipment will be decontaminated to prevent or minimize cross-contamination or the transfer of contamination from the equipment to the sample. This is important for preventing the introduction of error into sampling results and for protecting the health and safety of site personnel. Equipment will be cleaned before and after each use with Alconox in water followed by a double rinse in distilled water. Decontamination fluids collected during equipment cleaning will be stored in properly labeled 55-gallon drums and disposed of in accordance with applicable regulatory requirements

4.3 QUALITY ASSURANCE

The Quality Assurance Project Plan prepared by Geraghty & Miller in January 1996 and approved by DTSC in January 1996, for the groundwater RFI will be followed where appropriate. In summary, standard laboratory QA/QC procedures developed by DTSC and RWQCB will be followed to ensure the quality of the analytical results obtained from all samples. In addition, three types of quality control samples—trip blanks, equipment blanks, and rinsate blanks—will be collected.

4.3.1 Trip Blanks

At least one trip blank will be prepared for each cooler used for storage and transport of samples. Trip blanks will be submitted to the laboratory for VOC analysis by EPA Method 8260 and will consist of a vial of laboratory-supplied distilled, deionized water. The trip blank will accompany the empty sample containers to the field and will be placed in the cooler to be returned to the laboratory with the samples collected on that sampling day. A trip blank will not be opened until it is analyzed in the laboratory with the actual site samples.

4.3.2 Field Blanks

Field blank samples are obtained by replicating the sample collection process in the field using laboratory-supplied distilled, deionized water. This process will be used to identify potential

BOE-C6-0093815

contamination of samples from surrounding contamination sources. Each sampling crew will collect 1 field blank for every 20 groundwater samples or a minimum of 1 field blank per day during each sampling event. Field blanks will accompany the samples collected on that day to the laboratory for analysis. Field blanks will be analyzed for:

- TPH-ff by modified EPA Method 8015
- VOCs by EPA Method 8260
- Title 22 metals, including aluminum and total chromium, using EPA Method 6010
- Hexavalent chromium using EPA Method 7196

4.3.3 Rinsate Blanks

Rinsate blanks are obtained by collecting laboratory-supplied distilled, deionized water as it is poured through or over decontaminated sampling equipment. Each sampling crew will collect 1 rinsate blank for every 20 groundwater samples or a minimum of 1 rinsate blank per day during each sampling event. Rinsate blanks will accompany the samples collected on that day to the laboratory for analysis. Rinsate blanks will be analyzed for:

- TPH-ff using modified EPA Method 8015
- VOCs using EPA Method 8260
- Title 22 metals, including aluminum and total chromium, using EPA Method 6010
- Hexavalent chromium using EPA Method 7196

4.4 SAMPLE HANDLING AND CUSTODY

To establish the documentation required to trace sample possession from the time of collection to the time of sample analysis and reporting, a chain-of-custody form will be used. The completed form will accompany every sample to the designated state-certified laboratory and then through the laboratory during sample analysis. The following information shall be completed on the chain-of-custody form:

- Project number
- Total samples shipped
- Date samples are relinquished
- Signature of sample collector
- Sample identification
- Date/time samples collected
- Sample type
- Container type
- Analyses requested
- Signature of person or persons involved in the chain of possession

4.4.1 Field Custody Procedures

The following chain-of-custody procedures will be implemented to maintain and document sample possession:

1. Samples will be collected as described in this workplan.
2. The Task Leader is personally responsible for the care and custody of the samples until they are properly transferred or dispatched to the analytical laboratory.
3. Labels will be completed for each sample and then affixed to the sample container as described in Section 4.2, item 6c.
4. If a sample label should become lost during shipment, a written statement shall be prepared detailing how the sample was collected and transferred to the laboratory. The statement should include all pertinent information, such as entries in field log books regarding the sample, whether the sample was in the sample collector's physical possession or in a locked compartment until hand-transported to the laboratory, etc.

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4.4.2 Transfer of Custody and Shipment

The following procedures will be implemented when transferring custody of samples:

1. Samples will be accompanied by a chain-of-custody form. When transferring possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the form. The chain-of-custody form documents sample custody and the transfer of the sample from the environmental crew, often through another person, to the analyst in the laboratory.

2. Samples will be packaged properly for shipment and dispatched to the laboratory for analysis, with a separate custody form accompanying each shipment (i.e, one for samples shipped to the laboratory). Containers will be sealed with signed chain-of-custody seals for shipment to the laboratory.

3. Each shipment will be accompanied by the chain-of-custody form that identifies the contents of that shipment. The courier transporting the shipment will sign the chain-of-custody form. The original form will accompany the shipment and a copy will be retained by the Field Operations Leader for inclusion in project reports.

4. If sent by common courier or air freight, proper documentation will be maintained (such as a FedEx airbill).

4.4.3 Laboratory Custody Procedures

The following procedures will be implemented when the samples arrive at the laboratory:

1. A designated custodian will take possession of all samples upon their arrival at the laboratory. When samples are delivered to the laboratory after hours or when the sample custodian is not present to accept the samples, the samples will be placed in a designated sample area in accordance with the procedures established by the laboratory.

2. The custodian will be responsible for inspecting all sample labels and chain-of-custody forms to ensure that the information on each matches and that all are completed properly. The custodian will then assign a unique laboratory number to each sample and transfer the samples to secured storage areas. The custodian will enter the label data into the sample tracking system of the laboratory. This system will use the sample label and will ensure that all samples are transferred to the proper analyst or stored in the appropriate secure area.

4.5 DOCUMENTATION AND PHOTOGRAPHY

Each environmental crew leader is required to maintain a Daily Activity Log on-site during field activities to provide a daily record of significant events, observations, and field operations. The crew leader will submit the log to management for review by 8:00 a.m. the following day. All entries in the log and field data sheets will be made legibly in indelible ink, signed, and dated. The field entries will be factual, detailed, and objective. The Daily Activity Log will consist of:

1. A Field Report
2. A Daily Field Measurement Record
3. A Daily Analytical Sample Record
4. A Daily Summary of Field Activities

A description of each component of the Daily Activity Log is presented below.

4.5.1 Field Report

The Field Report is used to document activities occurring at the site and to update management and other team members who may not be on the site every day. The information contained in the Field Report will include, but is not limited to, the following:

- Date
- Project name and number
- Location
- Weather conditions at the site
- Names of environmental crew members present onsite and names of other organizations present onsite (such as drilling or construction crews)
- Detailed chronological record of activities at the site
- Name and signature of the individual completing the field report

In the detailed chronological record of activities, activities at the site will be recorded on an hourly basis, at a minimum. It is also important to record equipment calibration data and information about any activities, extraneous to sampling activities, that may affect the integrity of the samples collected on that day (e.g., emissions from nearby operations).

4.5.2 Daily Field Measurement Record

The Daily Field Measurement Record will be used to record field measurements collected during sampling. The information contained in the record will consist of, but is not limited to, the following:

- Project name and number
- Date
- Instrument calibration data
- Well for which data is being measured
- Time sample was collected
- Water level, conductivity, temperature, pH, and sample headspace reading

4.5.3 Daily Analytical Sample Record

The Daily Analytical Sample Record is intended to log groundwater samples collected at the site on a daily basis. The information included on the Daily Analytical Sample Record will include, but is not limited to, the following:

- Project name and number
- Date
- Well being sampled
- Time sample was collected
- Sample number assigned to the sample

- Comments about the sample

4.5.4 Daily Summary of Field Activities

The Daily Summary of Field Activities is intended to present concise information on the installation and sampling activities that occurred at the site on that day. In addition, the Daily Summary of Field Activities will include:

- Date
- Project name and number
- Location
- Names of contracting and environmental companies present onsite that day
- Listing of any site visitors on that day
- Name and signature of the individual completing the field report

In addition to the written documentation described above, representative photographs will also be taken of the well installation and sampling procedures. Photographs will logged by location.

4.5.5 Corrections to Documentation

If an error is made on any of the Daily Activity Log entries, the individual who signed the document will make corrections by crossing out the error with a single line and then entering the correct information. The erroneous information should not be obliterated. All corrections will be initialed and dated.

4.5.6 Disposition of Documentation

Upon completion of the field effort at the facility, field documentation will be clearly labeled and placed in the project files of both BRC and LMC.

4.5.7 Laboratory Files

Laboratory files will be maintained for the groundwater monitoring. The file will contain all data and reports including raw data calculation sheets, chromatograms, and mass spectrums in both electronic and hard copy formats. All written and electronic records of laboratory handling and analysis will also be maintained as part of the permanent file.

5. REPORTING AND SCHEDULE

The anticipated task/reporting schedule for well installation and the initial sampling is presented in Table 5-1 below.

TABLE 5-1.
TASK AND REPORTING SCHEDULE

DATE (1998)	TASKS/REPORTS
March 16	Workplan submitted to agency for review and approval.
April 10	Temporary monitoring well installation begins.
April 20	Groundwater sampling of temporary wells.
May 20*	Groundwater monitoring report submitted to agency for review.
June 20	Install permanent wells (if needed).
July 1	Collect first round of permanent well samples.
August 1	Permanent well sampling report submitted to agency for review.

*If analytical results indicates that additional well installation is required, the schedule from this point forward will be altered.

All permanent groundwater wells will be sampled at a frequency to be determined. All groundwater monitoring reports will include isoconcentration maps for each COC and a discussion of the analytical data, noting any observed data trends. The first permanent well sampling report, scheduled for August 1, 1998, will provide recommendations for a more

focused quarterly groundwater sampling program. This workplan does not cover sampling conducted after the initial round of sampling from the permanent groundwater wells.

6. REFERENCES

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Kennedy/Jenks Consultants (K/J) 1996a. Phase 1 Environmental Assessment Parcel A. Prepared for McDonnell Douglas Realty Company.

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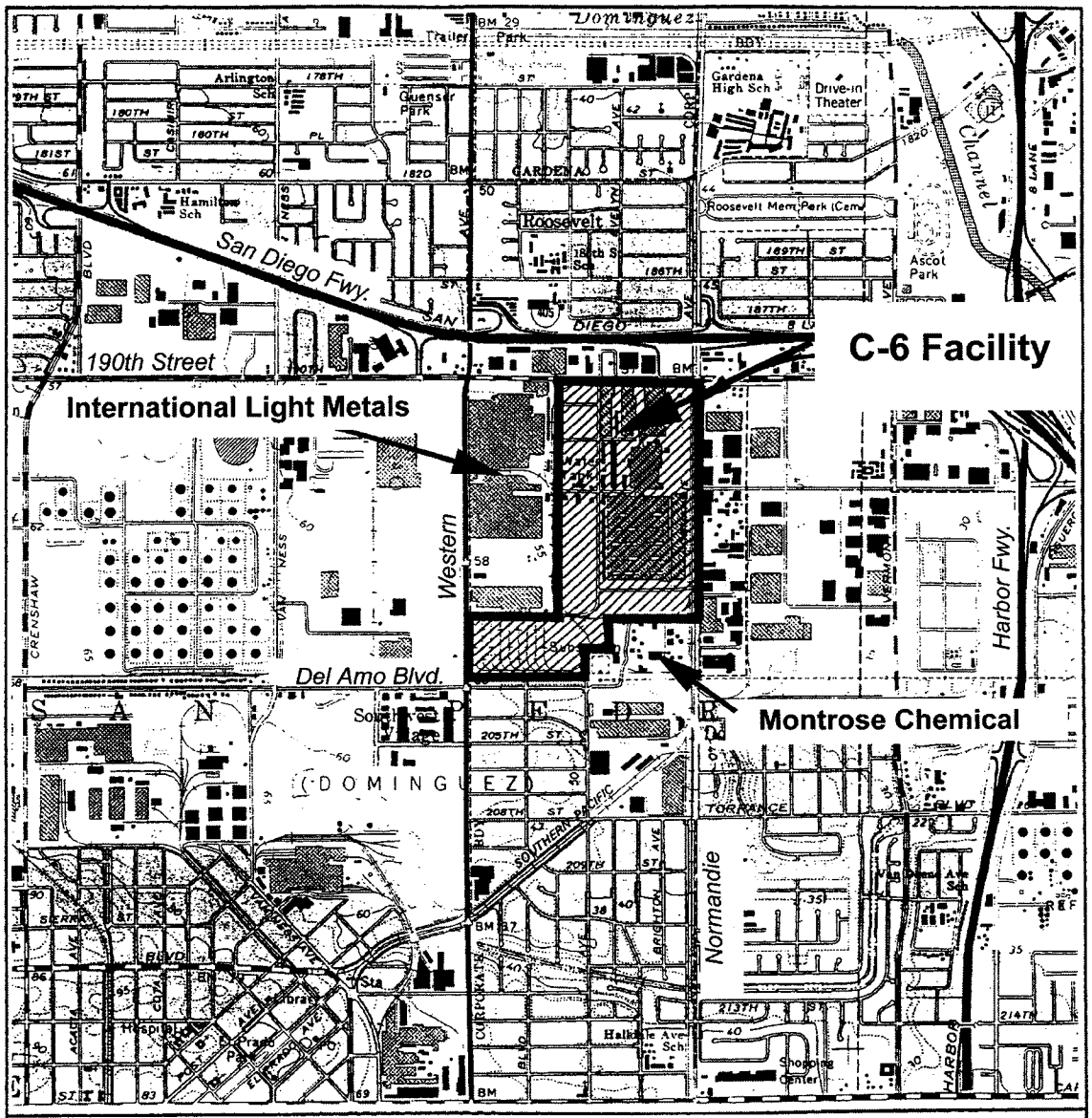
Kennedy/Jenks Consultants (K/J) 1998. Parcel B - Phase II Soil Characterization Boeing Realty Company C-6 Facility Los Angeles, California. Prepared for Boeing Realty Company.

Montgomery Watson (MW) March 1994. Conceptual Design of Final Soil and Groundwater Remediation System at the Douglas Aircraft Company, C6 Facility. Prepared for McDonnell Douglas Corporation.

Exhibit 1
BRC C-6 Facility and LMC Former ILM Facility
Site Location



Base Map: U.S.G.S. 7.5 Minute Topographic Map, Torrance, California Quadrangle, 1981.

0 2000 4000

Approximate Scale in Feet

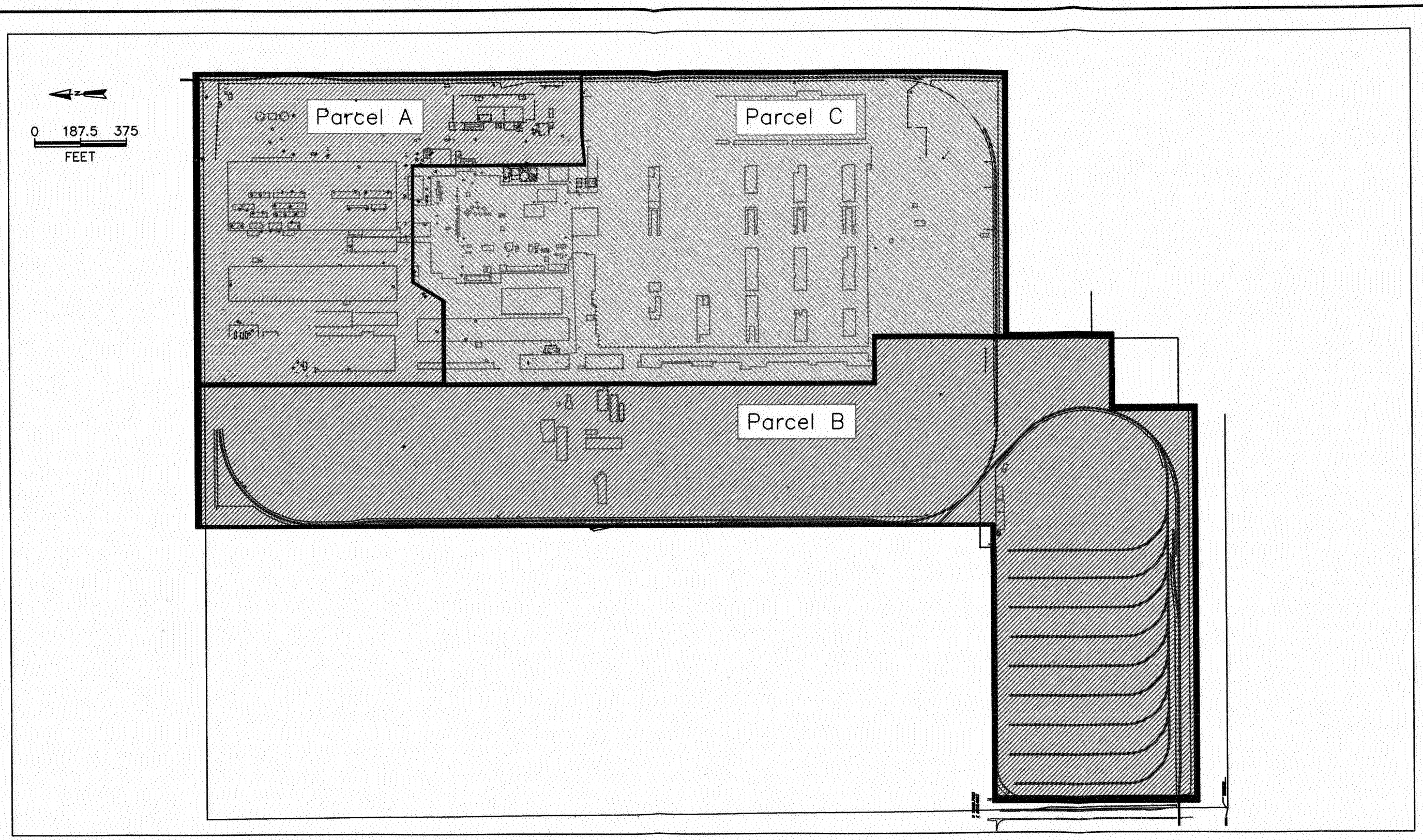
N

INTEGRATED Environmental Services, Inc.

LMC ILM & BRC C-6 Properties and Vicinity

INTEGRATED
ENVIRONMENTAL SERVICES, INC.

Exhibit 2
BRC C-6 Facility Parcel Delineation



F:\PROJECTS\BOEING-C6\PARCEL-A_RA\FIGURES\PARCELS.DWG

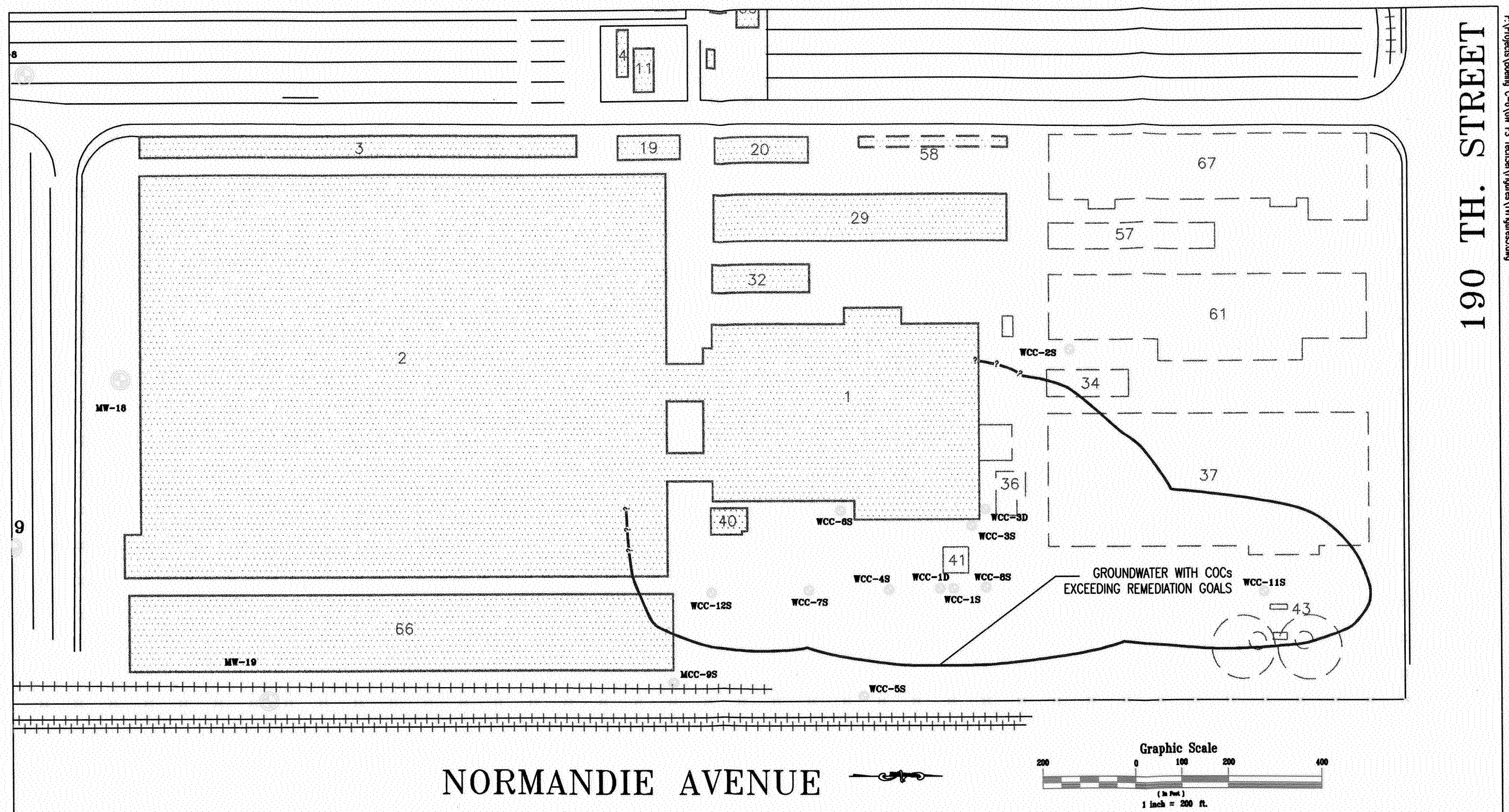
INTEGRATED
Environmental Services, Inc.
3380 Westerly Place, Suite 210
Newport Beach, CA 92660 (714) 852-9050

TITLE:
Boeing C-6 Facility
Parcels A, B, and C

DWN: JL	DES.: JL	PROJECT NO.: Boeing C-6
CHKD: JH	APPR: MY	FIGURE NO.: Exhibit 2
DATE: 3-12-98	REV.: 1	

INTEGRATED
ENVIRONMENTAL SERVICES, INC.

Exhibit 3
BRC C-6 Facility Building 36 Groundwater Plume



REV	DATE	BY	CHECK	APP	DESCRIPTION
1	3-5-98	JL	JH	MY	TV Bldg 36 Soil Contamination Rmvd.
2	3-12-98	JL	JH	MY	TV Bldg 36 Soil Contamination Rmvd. Exhibit 3

LEGEND

- FORMER BUILDING
- BUILDING
- CHAIN LINK FENCE
- RAIL ROAD
- MONITORING WELL

TERRA VAC
17821 MITCHELL AVENUE
IRVINE, CA 92614-6003

Boeing Company C-6 Facility

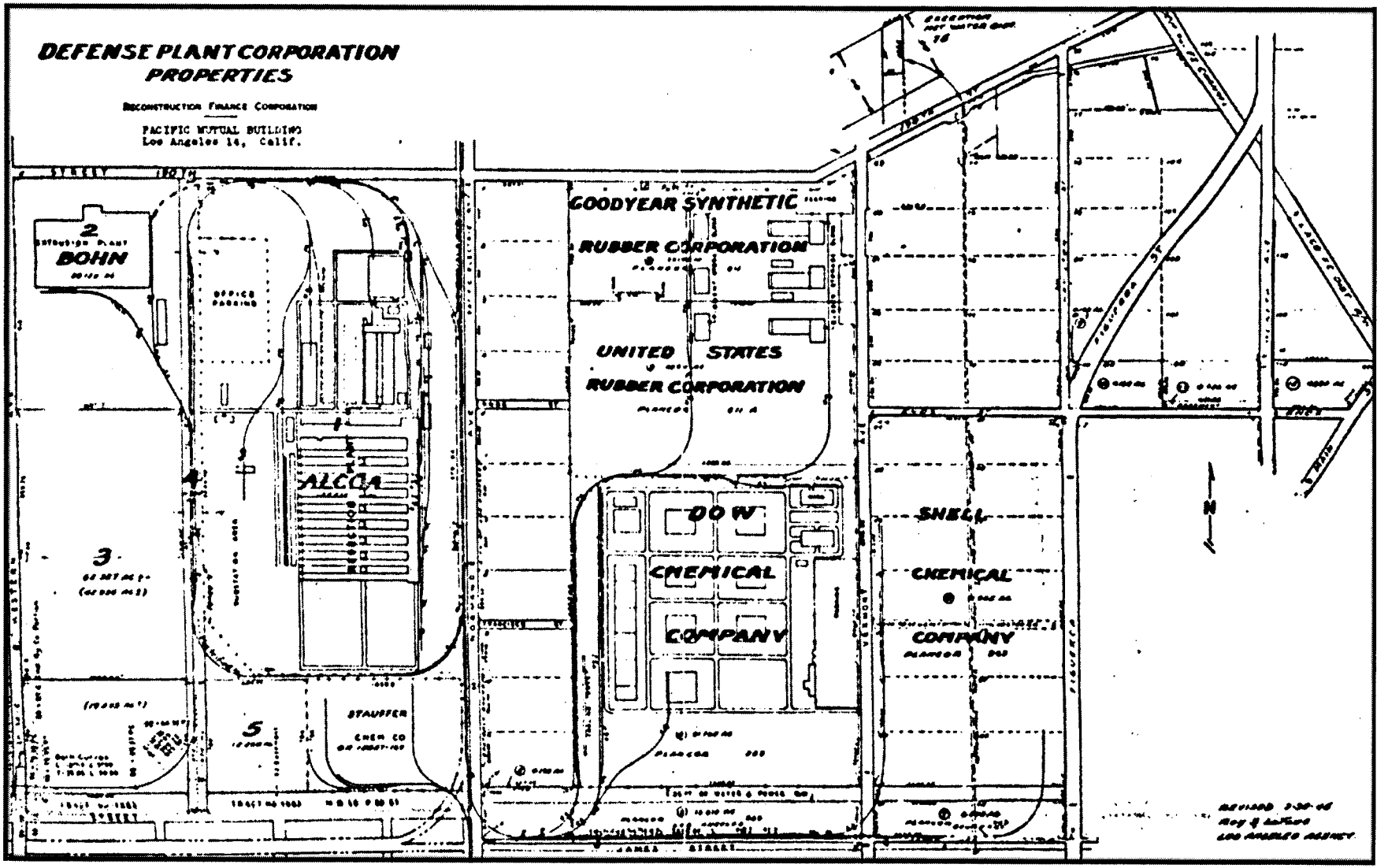
Building 36 Groundwater Plume

DRAWN BY: C.CARLOS	CHECKED BY:	PROJECT NO: GW Chor WP	Exhibit 3
APPROVED BY:	DATE: 3/5/98	SCALE: AS SHOWN	

BOE-C6-0093832

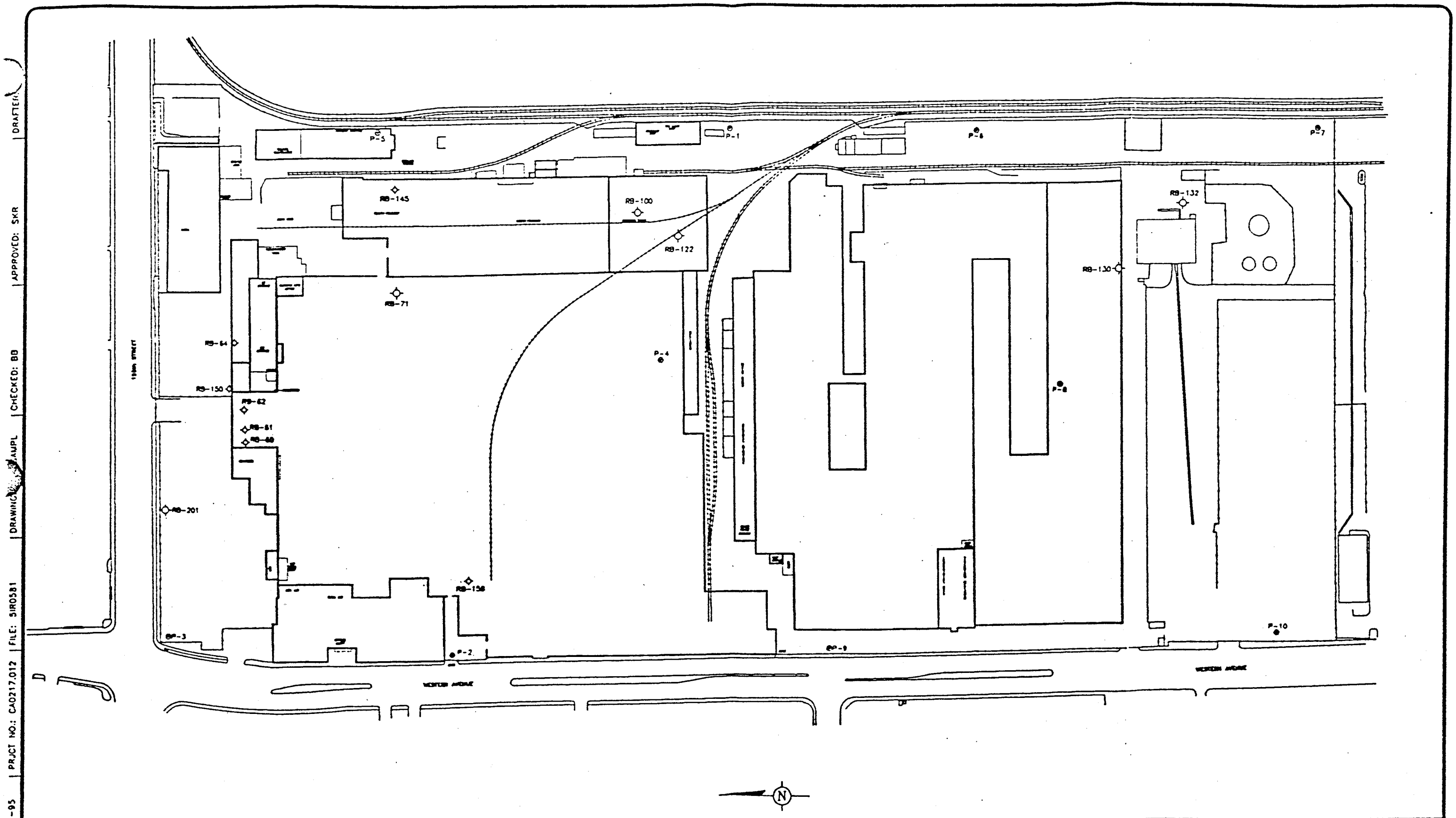
INTEGRATED
ENVIRONMENTAL SERVICES, INC.

Exhibit 4
1945 Plancor Properties Map
(HMC 1993)



1945 Plancor Properties Map

Exhibit 5
LMC Groundwater Sampling and Monitoring Well Locations
(G&M 1996a,b)



LEGEND

P-1 ⊙ PIEZOMETER LOCATION AND DESIGNATION

RB-71 ⊕ HYDROPUNCH LOCATION AND DESIGNATION

GERAGHTY & MILLER, INC.
Environmental Services

0 200 FT

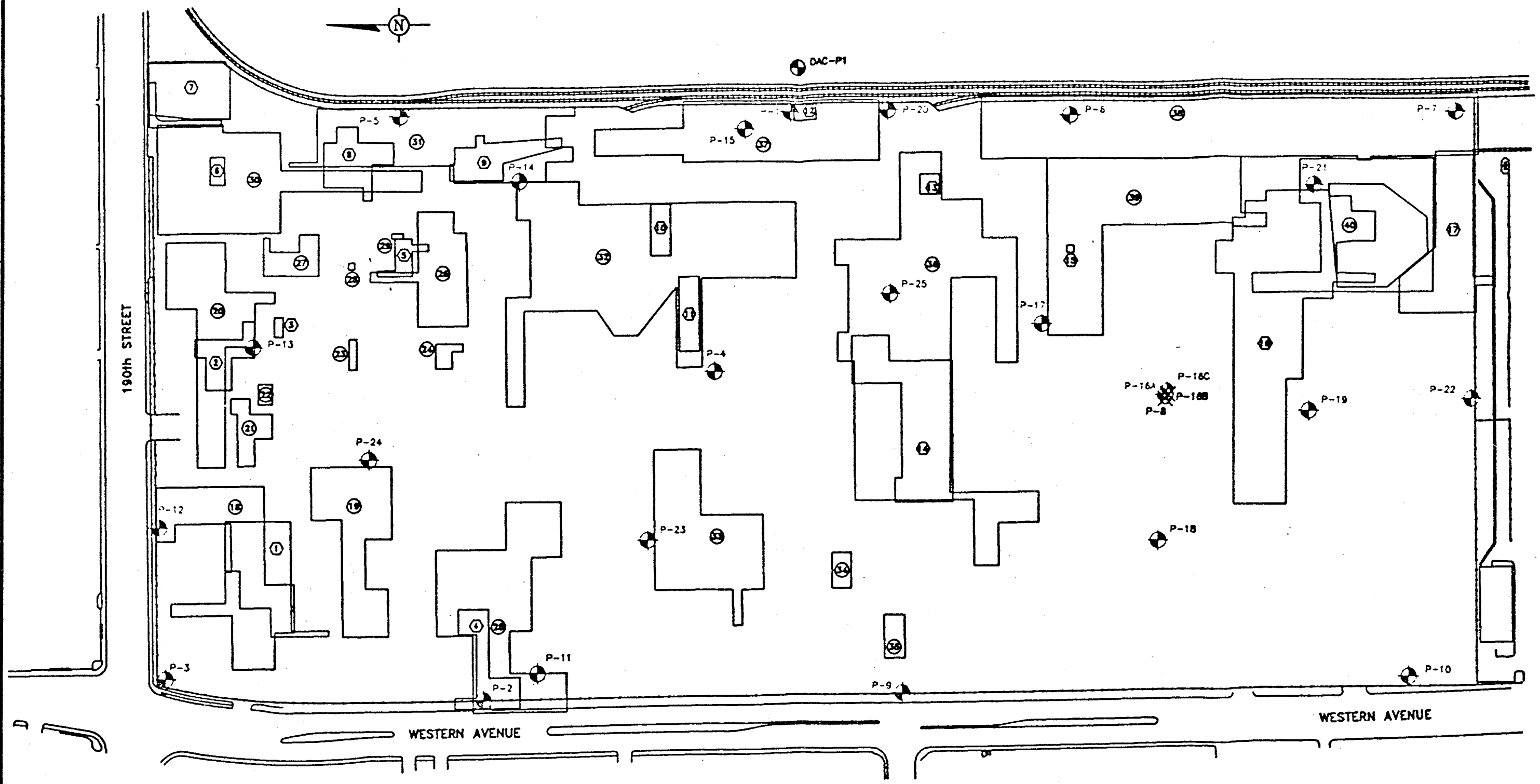
GROUNDWATER SAMPLING LOCATIONS

MARTIN MARIETTA TECHNOLOGIES, INC./INTERNATIONAL LIGHT METALS DIV.
TORRANCE, CA

FIGURE
6-5

DRAFTER: | APPROVED: SKR | CHECKED: BB | DRAWING: AMPL | FILE: 5IR0581 | PRJCT NO.: CA0217.012 | DATE: 5-9-95

BOE-C6-0093836



LEGEND

DAC-P1 McDONNELL DOUGLAS MONITORING WELL

P-5 GROUNDWATER MONITORING WELL LOCATION AND DESIGNATION

P-8 ABANDONED MONITORING WELL LOCATION AND DESIGNATION

① ⑱ AREAS OF INVESTIGATION (AOIs)

GERAGHTY & MILLER, INC.
Environmental Services

0 200 FT

GROUNDWATER MONITORING WELL LOCATION MAP

LOCKHEED MARTIN CORP./INTERNATIONAL LIGHT METALS FACILITY
TORRANCE, CA

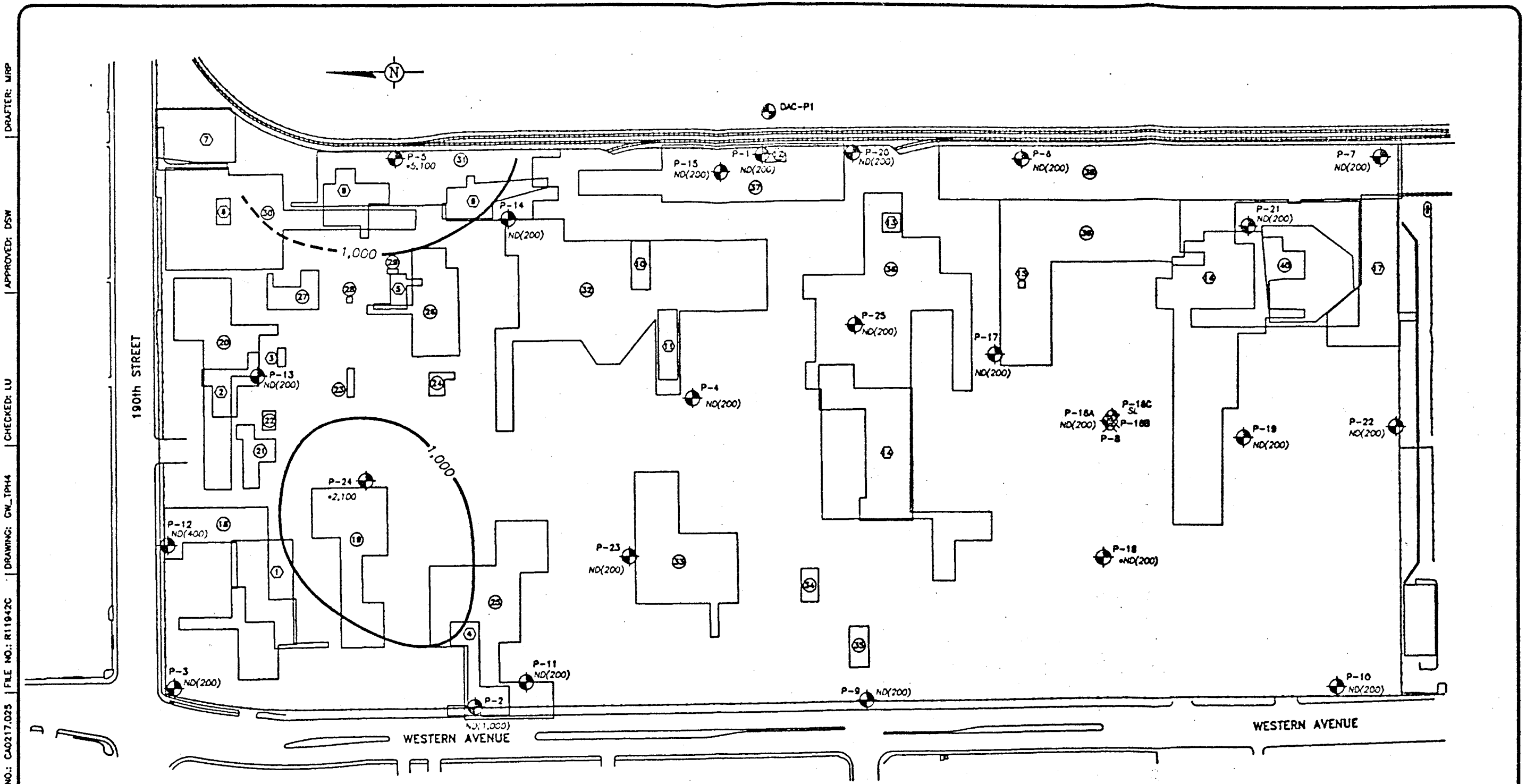
FIGURE 3-1

DRAFTER: SC/MRP/JDB | APPROVED: DSW | CHECKED: TBG/BAB | DRAWING: GW_MWL | FILE NO.: R12000C | PROJ. NO.: CA0217.025 | DWG DATE: 29 NOV 93

BOE-C6-0093837

INTEGRATED
ENVIRONMENTAL SERVICES, INC.

Exhibit 6
LMC TPH-Diesel Distribution in Shallow Groundwater
For September 1996
(G&M 1996b)



LEGEND

DAC-P1	McDONNELL DOUGLAS MONITORING WELL
P-5	GROUNDWATER MONITORING WELL LOCATION AND DESIGNATION
P-8	ABANDONED MONITORING WELL LOCATION AND DESIGNATION
2,100	CONCENTRATION OF TPH-D IN MICROGRAMS PER LITER (ug/L)
ND(200)	NOT DETECTED ABOVE PRACTICAL QUANTITATION LIMIT (PQL), IN PARENTHESES
•	DENOTES AVERAGE BETWEEN SAMPLE AND SAMPLE DUPLICATE. AVERAGES OF THE PQL FOR NON-DETECT SAMPLES SHOWN IN PARENTHESES.
SL	SLOTTED LOWER THEREFORE NOT UTILIZED IN ISOCONCENTRATION MAP
1,000	CONTOUR OF EQUAL TPH-D CONCENTRATION DASHED WHERE INFERRED

GERAGHTY & MILLER, INC.
Environmental Services

0 200 FT

TPH-D IN GROUNDWATER SEPTEMBER 1996

LOCKHEED MARTIN CORP./INTERNATIONAL LIGHT METALS FACILITY
TORRANCE, CA

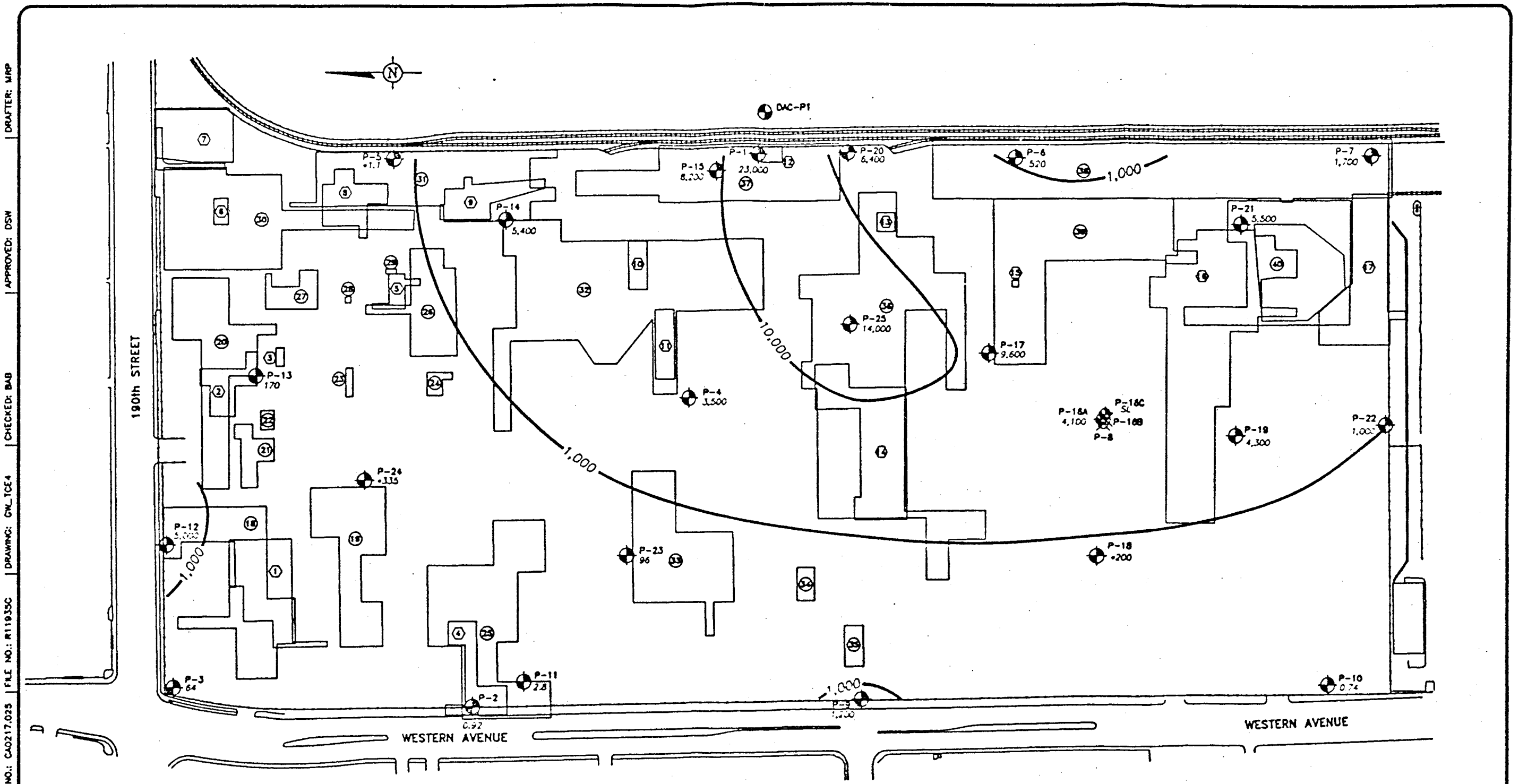
FIGURE 3-8

DRAFTER: MRP | APPROVED: DSW | CHECKED: LU | DRAWING: GW_TPH4 | FILE NO.: R11942C | PRJCT NO.: CA0217.025 | DWG DATE: 11 NOV 96

BOE-C6-0093839

INTEGRATED
ENVIRONMENTAL SERVICES, INC.

Exhibit 7
LMC TCE Distribution in Shallow Groundwater
For September 1996
(G&M 1996b)



LEGEND

DAC-P1	McDONNELL DOUGLAS MONITORING WELL
P-5	GROUNDWATER MONITORING WELL LOCATION AND DESIGNATION
P-8	ABANDONED MONITORING WELL LOCATION AND DESIGNATION
1.1	CONCENTRATION OF TCE IN MICROGRAMS PER LITER (ug/L)
*	DENOTES AVERAGE BETWEEN SAMPLE AND SAMPLE DUPLICATE. AVERAGES OF THE PRACTICAL QUANTITATION LIMIT (PQL) FOR NON-DETECT SAMPLES SHOWN IN PARENTHESES.
SL	SLOTTED LOWER THEREFORE NOT UTILIZED IN ISOCONCENTRATION MAP
1,000	CONTOUR OF EQUAL TCE CONCENTRATION

GERAGHTY & MILLER, INC.
Environmental Services

0 200 FT

TCE IN GROUNDWATER SEPTEMBER 1996

LOCKHEED MARTIN CORP./INTERNATIONAL LIGHT METALS FACILITY
TORRANCE, CA

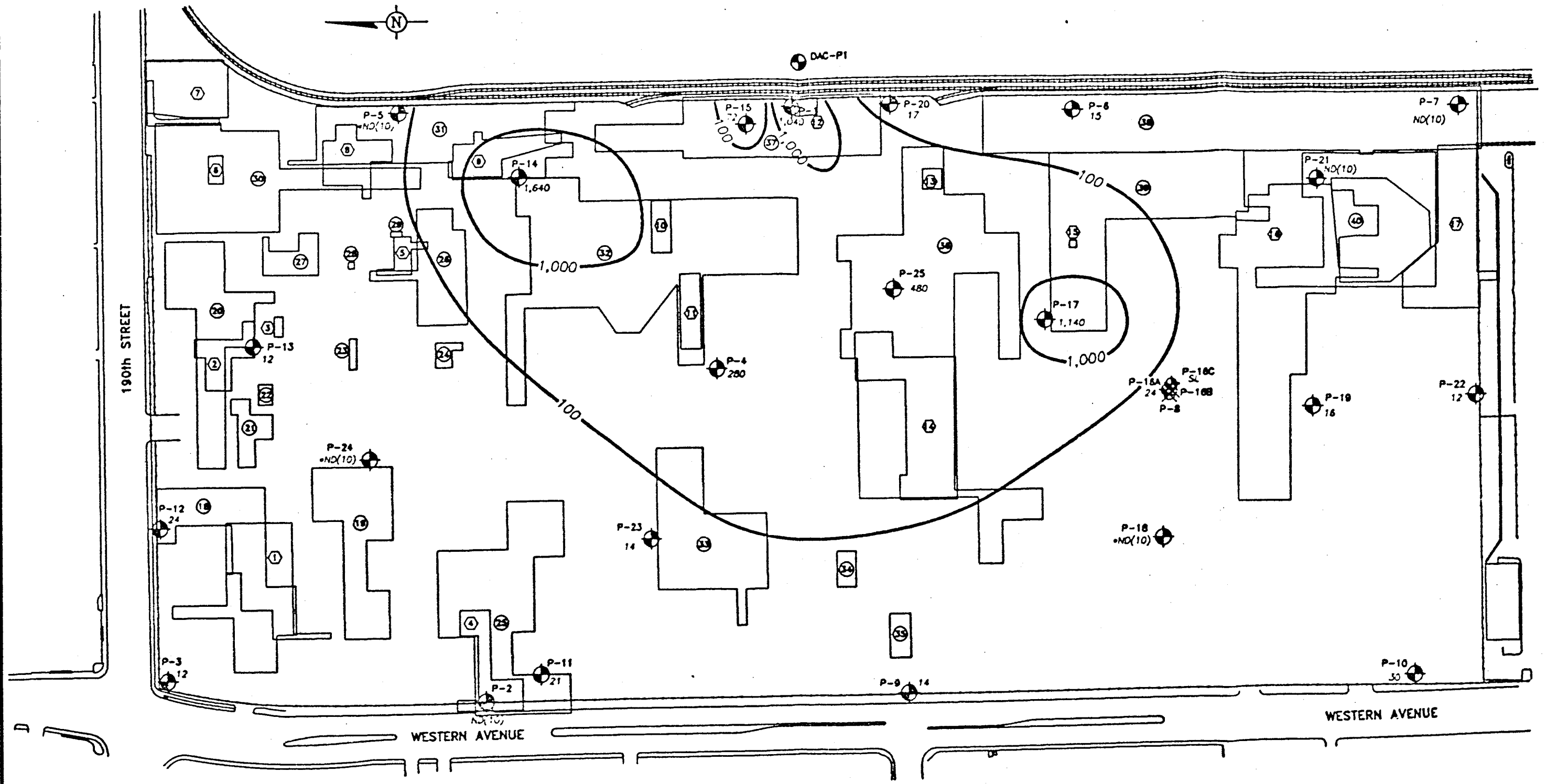
FIGURE
3-5

DRAFTER: MRP | APPROVED: DSW | CHECKED: BAB | DRAWING: GW_TCE4 | FILE NO.: R11935C | PRJCT NO.: CA0217.025 | DWG DATE: 11 NOV 96

BOE-C6-0093841

INTEGRATED
ENVIRONMENTAL SERVICES, INC.

Exhibit 8
LMC Dissolved Hexavalent Chromium Distribution in Shallow Groundwater
September 1996
(G&M 1996b)



LEGEND

- DAC-P1 — McDONNELL DOUGLAS MONITORING WELL
- P-5 — GROUNDWATER MONITORING WELL LOCATION AND DESIGNATION
- P-8 — ABANDONED MONITORING WELL LOCATION AND DESIGNATION
- 480 — CONCENTRATION OF HEXAVALENT CHROMIUM IN MICROGRAMS PER LITER (ug/L)
- ND(10) — NOT DETECTED ABOVE PRACTICAL QUANTITATION LIMIT (PQL), IN PARENTHESES
- * — DENOTES AVERAGE BETWEEN SAMPLE AND SAMPLE DUPLICATE. AVERAGES OF THE PQL FOR NON-DETECT SAMPLES SHOWN IN PARENTHESES.
- SL — SLOTTED LOWER THEREFORE NOT UTILIZED IN ISOCONCENTRATION MAP
- 1,000 — CONTOUR OF EQUAL HEXAVALENT CHROMIUM CONCENTRATION

GERAGHTY & MILLER, INC.
Environmental Services

0 — 200 FT

DISSOLVED HEXAVALENT CHROMIUM IN GROUNDWATER - SEPTEMBER 1996

LOCKHEED MARTIN CORP./INTERNATIONAL LIGHT METALS FACILITY
TORRANCE, CA

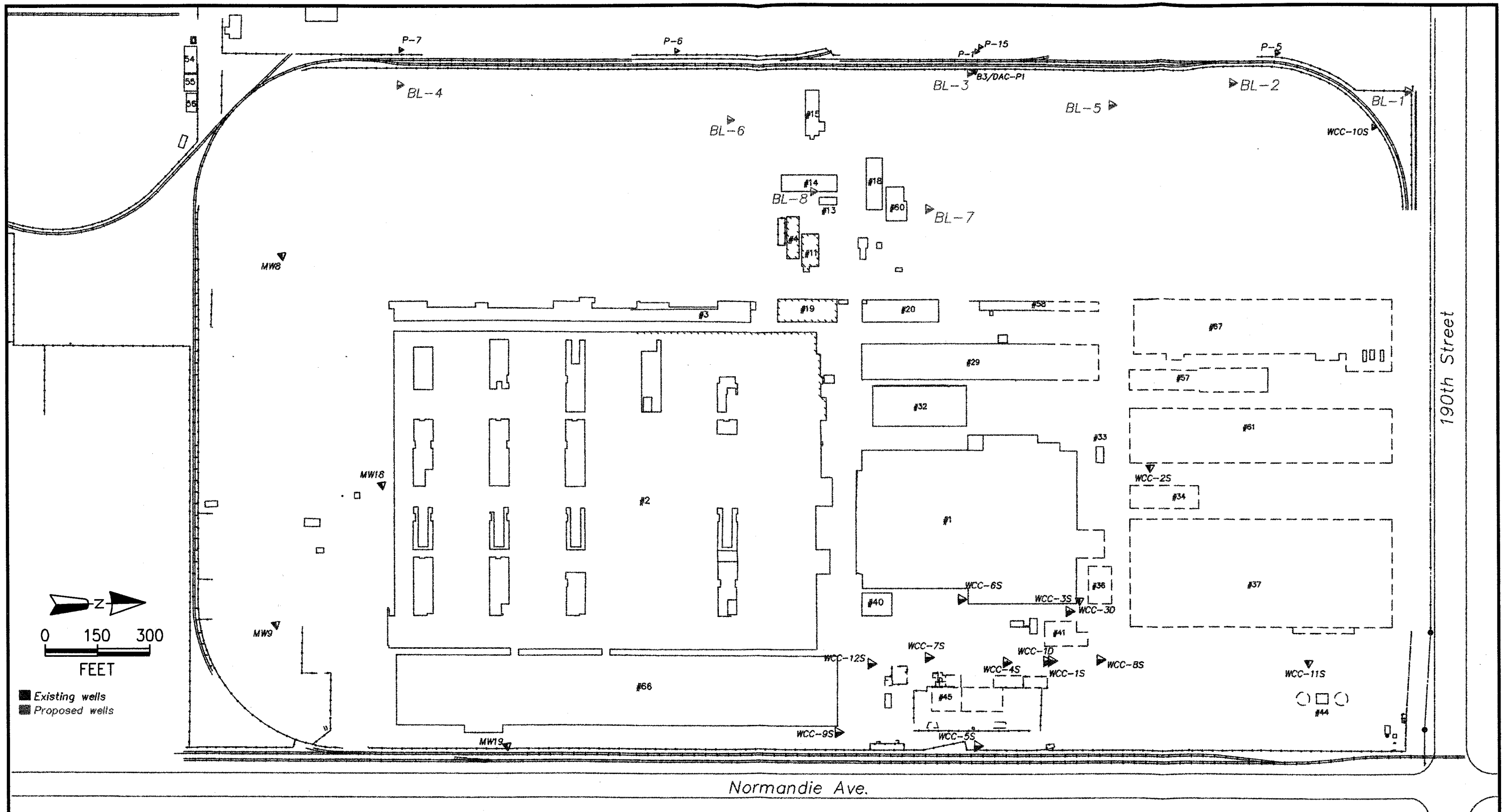
FIGURE
3-13

DRAFTER: MRP/JDB | APPROVED: DSW | CHECKED: BAB | DRAWING: GWL_HEX4 | FILE NO.: R11949C | PRJCT NO.: CA0217.025 | DWG DATE: 20 NOV 96

BOE-C6-0093843

INTEGRATED
ENVIRONMENTAL SERVICES, INC.

Exhibit 9
Proposed Offsite Groundwater Monitoring Well Locations



INTEGRATED
Environmental Services, Inc.
3990 Westerly Place, Suite 210
Newport Beach, CA 92660 (714) 852-9050

TITLE:
Boeing C-6 Facility
Existing and Proposed Monitor Well Locations

DWN: JDL	DES.: JHL	PROJECT NO.: Boeing C6	
CHKD: JHL	APPD: JSB	FIGURE NO.: Exhibit 9	
DATE: 3-12-98	REV.: 4		

F:\Projects\Boeing C-6\BRC-LMC Parcel B\Exhibit 9 Well Locations.dwg

BOE-C6-0093845