CDM

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Omega Chemical Superfund Site

Final On-Site Soils Remedial Investigation Report

November 14, 2007

Submitted to:

U.S. Environmental Protection Agency
Region IX

Prepared for:

Omega Chemical Site
PRP Organized Group

Prepared by:

CDM
111 Academy Way, Suite 150
Irvine, California 92617

Project No. 10500-37240-T2.OSS.REPORT

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November 14, 2007

Mr. Chris Lichens
Remedial Project Manager
U.S. Environmental Project Manager Agency-Region IX
75 Hawthrone Street (SFD-7-4)
San Francisco, CA 94105

Re: Final Remedial Investigation Report,
Omega Chemical Superfund Site, Whittier, California

Dear Mr. Lichens:

Enclosed is the final Remedial Investigation (RI) Report for the Omega Chemical Superfund Site, Whittier, California. The RI incorporates the comments that were provided in the conditional approval letter submitted by the USEPA on October 18, 2007, and the additional comments provided by USEPA on October 29, 2007. In addition, the final RI Report has been updated to include a discussion regarding the initial and expanded phases of the SVE pilot test.

Should you have any questions, regarding the above, please contact me.

Sincerely,
Omega Chemical Site PRP Organized Group

Edward Modiano
Project Coordinator

Cc: Tom Perina, CH2MHIL
Lori Paranass, DTSC
Dave Chamberlin, CDM
Sharon Wallin, CDM

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The information contained in this *On-Site Soils Remedial Investigation Report*, dated November 14, 2007, has received appropriate technical review and approval. The conclusions and recommendations presented represent professional judgments and are based upon findings from the investigation identified in the report and the interpretation of such data based on our experience and background. This acknowledgment is made in lieu of all warranties, either expressed or implied.

Reviewed and Approved by

PROFESSIONAL GEOLOGIST
SHARON L. WALLIN
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Sharon Wallin, P.G.
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List of Acronyms

AA - ambient air

API - American Petroleum Institute

ASTM - American Society of Testing and Materials

ATSDR – Agency of Toxic Substances and Disease Registry

Bgs - below ground surface

Cal/EPA - California Environmental Protection Agency

Cardinal - Cardinal Environmental Consultants

CCR - California Code of Regulations

CDM – Camp Dresser & McKee Inc.

CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act

CFR - Code of Federal Regulations

COPC – chemicals of potential concern

CHHSLs – California Human Health Screening Levels

DCA - dichloroethane

DCE - dichloroethene

DHS - Department of Health Services

DOT - Department of Transportation

DNAPL – dense non-aqueous phase liquid

DQO – data quality objectives

DSR - Data Summary Report

DTSC - Department of Toxic Substances Control, a branch of Cal/EPA

DWR - California Department of Water Resources

ECD - Electron capture detector

EE/CA - Engineering Evaluation/Cost Analysis

ELAP - Environmental Laboratory Accreditation Program

England & Hargis - England & Associates and Hargis + Associates

ESA - Environmental Site Assessment

FID - flame ionization detector

FS - Feasibility Study

GAC - granular activated carbon

GC/MS - gas chromatography/mass spectrometry

HASP - health and safety plan

HBRGs – Health Based Remediation Goals

Hg - Mercury

HHRA – Human Health Risk Assessment

HI – Hazard Index

HVAC - heating, ventilating, and air conditioning

IA - indoor air

IDW - investigation-derived waste

LARWQCB - Los Angeles Regional Water Quality Control Board

LCS – laboratory control sample

mg/kg - milligrams per kilogram

mg/L - milligrams per liter

mg/m3 - milligrams per cubic meter

MCL – maximum contaminant level

MIP - membrane interface probe

ml/min - milliliters per minute

msl - mean sea level

MS/MSD – matrix spike/matrix spike duplicate

MTBE - methyl tertiary butyl ether

NELCO - New England Lead Burning Company

NOV - Notice of Violation

NPL - National Priorities List

Omega - Omega Chemical Corporation

OPOG - Omega Chemical Site PRP Organized Group

OSS – On-Site Soils

OU - operable unit

OVM - organic vapor monitor, usually equipped with a PID

PCB - polychlorinated biphenyl

PCE - tetrachloroethene

PID - photoionization detector

ppbv/v - parts per billion volume / volume

PPE - personal protective equipment

PRGs – Preliminary Remediation Goals

PPM - parts per million

PRP - Potentially Responsible Party

QA/QC - quality assurance/quality control

RCRA - Resource Conservation and Recovery Act

RI - Remedial Investigation

RPD - relative percent difference

SB - soil boring

SCEM - site conceptual exposure model

SCFM – standard cubic feet per minute

SG - soil gas

Site - Omega Chemical Superfund Site

SOW – Statement of Work

SS - surface sample

SSD - sub-slab depressurization

SVE - soil vapor extraction

SVOC - semi-volatile organic compounds

TCA - trichloroethane

TCE – trichloroethene

TDS – total dissolved solids

TOC - total organic carbon

TM – Technical Memorandum

TVOC - total volatile organic compounds

UAO - unilateral administrative order

UC - utility corridor

USCS – Unified Soil Classification System

USEPA - U.S. Environmental Protection Agency

UST - underground storage tank

VOC - volatile organic compound

VP - vapor point

µg/L - micrograms per liter

µg/kg - micrograms per kilogram

Section 1

Section 1
Introduction

On behalf of the Omega Chemical Site PRP Organized Group (OPOG), Camp Dresser & McKee Inc. (CDM) has prepared this On-Site Soils Remedial Investigation (OSS RI) Report for the Omega Chemical Superfund Site (Site). This report was prepared in accordance with Task 2 of the Statement of Work (SOW) in *Consent Decree No. 00-12471 between the United States Environmental Protection Agency (USEPA) and OPOG* (USEPA, 2001). The Consent Decree was lodged on November 24, 2000 and entered into the US District Court on February 28, 2001. Task 2 required OPOG to "Implement a Vadose Zone Remedial Investigation/ Feasibility Study (RI/FS) For Contaminant Releases On, At, or Emanating From the Former Omega Property". Therefore, the term "Site" as used throughout this document encompasses the former Omega Chemical property as well as adjacent and nearby properties where the underlying vadose zone has been impacted by contamination derived from the former Omega Chemical property.

The former Omega Chemical property consists of the two parcels located at 12504 and 12512 Whittier Boulevard. The former Omega Chemical property and Phase 1a area are illustrated on Figure 1-1. The Consent Decree defines the Phase 1a area as the area of soil and groundwater contamination associated with the Omega property and extending downgradient for approximately 100 feet southwest of Putnam Street, Whittier, California. A groundwater remedy in the Phase 1a area is currently being implemented along Putnam Street in accordance with Task 1 of the Consent Decree. The groundwater remedy is expected to be operational during the third quarter of 2008.

1.1 Project Objectives

The RI was conducted to characterize the nature and extent of contamination in Site soils to support the data needs of the risk assessment, feasibility study, remedial design, Agency of Toxic Substances and Disease Registry (ATSDR) Public Health Assessment and Natural Resource Trustee. This report documents the methodology used, analytical summary, Site Conceptual Model (fate and transport), findings, and conclusions of the RI. A Human Health Risk Assessment (the "HHRA") for On-Site Soils has also been prepared concurrently with this document and the final HHRA was recently submitted to USEPA (CDM, November 9, 2007).

Section 5 of this RI Report provides the Site Conceptual Model for the Site. Data and graphical depictions thereof provided in that section define the lateral and vertical extent of contamination in the vadose zone for the Site. These data, and accompanying interpretation, are adequate to complete the development, screening, and evaluation of remedial alternatives through the Feasibility Study (FS) process, including estimation of costs associated with the remedial alternatives in the FS. The data are also adequate to complete the HHRA. This RI Report compares observed soil and soil vapor concentrations in the vadose zone to USEPA Preliminary Remediation

Goals (PRGs) and California Human Health Screening Levels (CHHSLs), respectively. Because both of these criteria are relatively generic screening criteria, the HHRA proposes Site-specific Health Based Remediation Goals (HBRGs). Once approved by USEPA, HBRGs will be used to assist in the selection, design, and implementation of the appropriate remedial measures.

Evaluation of remedial action alternatives will be addressed in the Feasibility Study (FS) Report, which will be submitted separately 60 days following USEPA approval of the RI Report or HHRA, whichever is approved later.

1.2 Scope of Work

The initial scope of work for the RI was based upon the activities outlined in the *OSS RI/FS Work Plan* (CDM, September 29, 2003). Additions to the scope of work, preliminary data evaluations, and findings were documented in two work plan addenda and four technical memoranda to USEPA, as follows:

- *OSS Work Plan Addendum SOW for Additional Investigation* (CDM, October 20, 2004).
- *Final OSS RI/FS Work Plan Addendum No. 2 SOW for Additional Investigation* (CDM, August 17, 2005).
- *OSS RI/FS Work Plan Addendum No. 2 Summary of Initial Findings from Soil Vapor and MIP Sampling with Recommendations for Additional Sampling Locations* (CDM, November 1, 2005).
- *OSS RI/FS Work Plan Addendum No. 2 Summary of Additional Findings from Soil Vapor and MIP Sampling* (CDM, January 27, 2006).
- *OSS RI/FS Work Plan Addendum No. 2 Summary of Additional Findings from Soil Vapor and MIP Sampling* (CDM, April 14, 2006).
- *Analytical Results for Final Vapor Probes (VP26, VP27, and VP30)* (CDM, June 30, 2006).

The following tasks were completed during implementation of the RI:

- *Surface soil sampling:* Samples were collected immediately beneath the paved surface from a depth of approximately 0 to 6-inches below ground surface (bgs) at 20 locations at the former Omega Chemical property.
- *Subsurface soil sampling:* Eight borings (GP-1 through GP-8) were initially advanced at the former Omega Chemical property and adjacent Terra Pave property using a direct push drilling system. The borings were continuously logged, and samples were collected at discrete depths. In addition to the eight borings, soil samples were collected and analyzed to confirm membrane interface probe (MIP) detector responses.

- *MIP testing:* MIP testing was performed at 30 different locations at the Site. Soil and soil vapor samples were collected and analyzed adjacent to the MIP boreholes to confirm MIP detector responses.

- *Soil vapor sampling:* Soil vapor sampling was conducted at the Site. Twelve locations were sampled at single depths along utility corridors, while 38 locations were sampled at multiple depths. Many of the soil vapor sampling and analysis activities were conducted adjacent to MIP borings to confirm the concentrations observed using that method.

- *Indoor and ambient air sampling:* Air quality samples were collected at the two buildings located on the former Omega Chemical property, as well as many neighboring buildings to evaluate possible soil vapor migration. Upwind ambient air samples were also collected to determine background concentrations.

- *Heating, Ventilating, and Air Conditioning (HVAC) system evaluations:* HVAC systems at several neighboring facilities were evaluated to determine if the buildings were improperly ventilated, which could influence the indoor air sampling results.

- *Chemical usage surveys:* Chemical inventories and usage surveys were conducted at the former Omega Chemical property and neighboring facilities to determine whether detected chemicals of concern in indoor air quality samples were from present usage or from soil vapor intrusion.

- *Soil vapor testing and mitigation at Skateland:* Sub-slab depressurization (SSD) testing was performed at Skateland to evaluate SSD as a possible remedial alternative. Mitigation measures performed at Skateland included installing air purifiers in the restrooms and kitchen. Field procedures, results, and an evaluation of the data were provided to USEPA in the *Skateland Sub-Slab Depressurization Testing Technical Memorandum* (CDM, December 16, 2005). With OPOG's purchase of the property on October 1, 2006 and the subsequent closing of the skating rink, additional SSD work is no longer required at this property.

- *Soil vapor extraction well installation and pilot testing:* 13 soil vapor extraction (SVE) wells and 3 vapor monitoring points (VMPs) were installed, and initial and expanded soil vapor extraction pilot testing was performed at the former Omega Chemical property to support preparation of the FS.

- *Data evaluation:* Several memoranda were prepared for USEPA which provided the results of the investigations and preliminary findings. This document summarizes those findings as well as those not already documented.

Although this report focuses upon Site soils, soil vapor, and air, groundwater sampling was also conducted as part of the Phase 1a groundwater investigation. Groundwater sampling procedures and analytical results will be presented briefly in this document in support of the Site Conceptual Model.

1.3 Report Organization

This report is organized into seven sections, as follows:

- Section 1 - Introduction
- Section 2 - Background
- Section 3 - Field Activities
- Section 4 - Results
- Section 5 - Site Conceptual Model
- Section 6 - Conclusions
- Section 7 – References

Figures presented in this report are provided at the end of each section where they are first discussed. Appendices are provided at the rear of the document.

Omega Chemical

CDM

Legend

Omega Chemical Property

Phase Ia Area

N
W E
S

0 100 200 400
Feet

Site Location Map

Figure 1-1

Section 2

Section 2
Background

The following section presents information regarding the regulatory history of the former Omega Chemical property, past and present conditions and operations at the former Omega Chemical property, current operations at neighboring properties, and physical setting of the Site.

2.1 Regulatory History

The regulatory history of the former Omega Chemical property was based upon information summarized in the *OSS RI/FS Work Plan* (CDM, September 29, 2003) and in the Request for a Removal Action (USEPA, April 6, 2006).

The Omega Chemical Corporation (Omega) was a refrigerant/solvent recycling operation from approximately 1976 to 1991. Drums and bulk loads of waste solvents and chemicals from various industrial activities were processed to form commercial products. Wastes generated from treatment and recycling activities included still bottoms resulting from distillation of spent solvents, aqueous fractions, and non-recoverable solvents.

Environmental regulatory action at the Omega Chemical property began with several notices of violations (NOVs) from the Los Angeles County Department of Health Services (DHS). On November 1990, Los Angeles County Superior Court issued a preliminary injunction to prevent further acceptance of hazardous waste by Omega. In February 1991, Los Angeles County and San Bernardino County District Attorney's offices issued warrants to search three railcars at the Omega Chemical property. The search revealed illegal storage and transport of 700 hazardous waste drums, falsified waste manifests and drum labels. As a result, Los Angeles County Superior Court ordered Omega to cease all operations, remove all hazardous wastes, and close the facility. USEPA entered into an Administrative Order of Consent, in October 1991 requiring Omega to perform several interim measures to mitigate current or potential threats to human health and the environment and to submit a Resource Conservation and Recovery Act (RCRA) facility investigation. At this time, California Environmental Protection Agency (Cal/EPA)/Department of Toxic Substances Control (DTSC) was the lead agency at the Omega Chemical property.

Although the Omega facility officially closed in 1991, the president and owner of the company continued to operate under a different company name on a limited basis accepting primarily refrigerants (Freons). DTSC requested assistance from USEPA to conduct a site assessment in August 1993. The site assessment inspection revealed that approximately 2,900 drums of hazardous waste were at the Omega Chemical property in weathered condition, but not completely corroded nor leaking. In 1995, the Los Angeles County Superior Court found the company manager guilt for contempt of court and was ordered to cease all operations. Operations ceased at the Omega Chemical property at that time.

On May 9, 1995, USEPA issued a Unilateral Administrative Order (UAO) to Potentially Responsible Parties (PRPs) that had shipped more than ten tons of hazardous wastes to the former Omega Chemical property. At that time, USEPA became the lead agency for the Site. The PRPs subsequently formed a group and established the Omega Chemical Site PRP Organized Group (OPOG) to perform the work. Between 1995 and 1996, OPOG removed approximately 2,700 drums from the former Omega Chemical property and conducted a preliminary site investigation. By that time a majority of the drums were in extremely poor condition, and spills were observed in numerous locations. The Site was placed on the National Priorities List (NPL) in January 1999. OPOG entered into the Consent Decree and associated Statement of Work in February 2001. The Statement of Work requires the performance of the following three tasks:

1. Design and implement a ground water containment and mass removal treatment system in the Phase 1a Area.

2. Implement a vadose zone soils RI /FS to characterize releases on, at, or emanating from the Site.

3. Install three sentinel groundwater wells at two or three locations downgradient of the Phase 1a Area and upgradient of water supply well 30R3.

This RI was conducted to partially fulfill Task 2 above.

Upon evaluating data collected for the RI, it was found that soil vapor had migrated into several buildings near or at the former Omega Chemical property including Skateland, an indoor skating rink. USEPA issued a Request for a Removal Action to mitigate the soil vapor intrusion on April 6, 2006. OPOG entered into the First Amendment to the Consent Decree and associated Supplemental Statement of Work to mitigate the indoor vapor exposure at Skateland or conduct an Alternate Response Action (USEPA, April 6, 2006). After undertaking some of the testing work prior to selecting an appropriate mitigation measure, OPOG elected to conduct an Alternate Response Action by purchasing the property, closing Skateland operations, and demolishing the building.

2.2 Former Omega Chemical Property History and Operations

2.2.1 Current Use

Van Owen Holdings LLC of Los Angeles, California purchased the former Omega Chemical property property in 2003. The former Omega Chemical property is divided into two parcels:

- Northern parcel: 12504 Whittier Boulevard. Currently being leased by Star City Auto Body to conduct automotive body repair and painting. The auto body shop

also leases the small paved parking lot north of the warehouse building for automobile parking.

- Southern parcel: 12512 Whittier Boulevard. The former administrative building and paved parking area south of the warehouse have had a variety of tenants since the 2003 purchase of the former Omega Chemical property. The former administration building is currently vacant, and the parking lot is used for temporary storage of wooden pallets by L&M Pallets on a month-to-month lease basis. The building was previously used for administration and equipment storage, while the concrete paved exterior yard was used for parking and temporary storage of heavy construction equipment. Ten soil vapor extraction (SVE) wells were installed at five locations in the parking lot during September 2006, and the area is also being used by OPOG for SVE pilot testing purposes.

2.2.2 Owners and Operations

The known environmental history of the former Omega Chemical property was documented in the *Data Summary Report* (DSR) (CDM, December 4, 2001). The property was developed in 1951 and occupies Los Angeles County Assessor Tract No. 13486, Lots three and four. The property is approximately 41,000 square feet in area (200 feet wide x 205 feet long), which is equal to about one acre. As shown on Figure 2-1, two structures are located on the property – an approximately 140 by 50 foot warehouse and an approximately 80 by 30 foot administrative building. These buildings comprise about one-quarter of the property. A loading dock is attached to the rear of the warehouse. The property is paved with concrete and secured with a seven-foot high perimeter fence and locking gate. The fence is topped with razor wire. Prior to construction of the buildings in July 1951, the property was used for agriculture.

A summary of former Omega Chemical property owners/operators is provided below:

- Late 1930s – property was undeveloped or used for agricultural purposes.
- 1951 – property developed, office and warehouse were constructed for Sierra Bullets. During operation of the Sierra Bullet facility, a 500-gallon underground storage tank (UST) was utilized for storage of kerosene.
- 1963 through 1966 - property purchased and occupied by Fred R. Rippy, Inc.
- 1966 through 1971– property used to convert vans to ambulances.
- 1971 through 1976 – property occupied by Bachelor Chemical.
- 1976 – Omega Chemical (Mr. Dennis O'Meara) purchases Bachelor Chemical Processing (northwestern half) and assumes the property lease from Rippy.

- 1987 – Omega Chemical purchases the leased parcel and adjoining southeastern section from Rippy.
- April 11, 1991 – Omega ordered by the Superior Court of the County of Los Angeles to cease operation, remove all hazardous wastes, and close the facility.
- September 1991 – Omega files Chapter 11 bankruptcy, which was dismissed on September 7, 1993.

The Omega facility provided treatment of commercial and industrial solid and liquid wastes and a transfer station for storage and consolidation of wastes for shipment to other treatment and or disposal facilities. According to the October 29, 1990 Operation Plan for Hazardous Waste Recovery Facility, the Omega facility maintained 11 treatment units comprised of distillation columns, reactors, wipe film processor, liquid extractor, and a solid waste grinder. The facility also maintained 22 stainless steel tanks with capacities ranging from 500 to 10,000 gallons, and 5 carbon steel tanks with capacities of 5,000 gallons.

From approximately 1999 through 2001, the northern parcel (12504 Whittier Boulevard) was leased by Mr. Nicholas Stymuiank who occupied the warehouse and stored miscellaneous equipment and materials in the warehouse and service yards. The warehouse was converted in 2003 for use by Star City Auto Body for auto body repair.

During the past few years, several tenants have occupied the southern parcel (12512 Whittier Boulevard). C&I Electric utilized the property for equipment and billboard storage. Following the termination of the C&I Electric lease, 3 Kings Construction occupied the property. In December 2006, L&M Pallets began leasing the exterior yard for pallet storage.

2.2.3 Review of Historical Aerial Photographs

An Aerial Photographic Analysis of the former Omega Chemical property was completed in April 2000 (USEPA, April 2000). A total of 13 dates of aerial photographs for the years from 1928 to 1994 were reviewed. The objective of the analysis was to document features and activities of environmental significance including surface morphology, property use, and evidence of hazardous waste disposal at the former Omega Chemical property in support of the Site investigation. Observations discussed in the review are summarized below. Figure 2-1 identifies features tentatively identified in the photographic review. Locations of former tanks and a former 500-gallon UST (which was removed in August 1987) are also identified on the figure.

The property was used for agricultural purposes as an orchard between 1928 and 1946. The 1956 photograph shows that the property was developed with a warehouse and office building. Spillage or other surface discoloration was noted in the unpaved

yard south of the warehouse (hereinafter referred to as the "southern yard"). The yard north of the warehouse (hereinafter referred to as the "northern yard") appears to have been paved and was used for parking. In the 1959 photograph, spillage and/or surface staining was again noted in the unpaved southern yard. An area of mounded earthen material was also observed within the southern yard. Staining was also observed in the 1956 and 1959 photographs at nearby properties to the northwest of the property.

The spillage and staining observed at the property in 1956 and 1959 were not noted in the 1963 photograph. The 1966 photograph shows some surface staining, a small access road leading off the property, and mottled-toned surface coloration typical of vegetation stress. The 1970 photograph shows at least half of the southern yard to be paved, with possible disturbed ground in the rear portion of the property. In 1972, paving was observed throughout the property. In addition, a number of vehicles and/or containers were observed in both the northern and southern yards.

The 1978 photograph shows the initial evidence of chemical use at the former Omega facility. Five vertical tanks were observed in the northwestern corner of the property, and stacked drums and small areas of spillage were noted in the northern yard. Two notable areas of staining and/or spillage were observed emanating from both the northwestern and southwestern side of the office building toward the center of the southern yard. The soil within the western portion of the southern yard appears to be exposed with locations of mounded material (possible excavation).

In 1984, a total of nine vertical and two horizontal tanks were observed in the northwestern portion of the property. The northern yard appears to be full of drums and small storage containers. A large stain and/or spillage was observed close to the center of the western side of the office building. A bulldozer and various toned materials suggestive of earthmoving activities were noted in the southwestern portion of the property. The earthmoving activities may have been in preparation for the installation of six vertical tanks observed in this area in the 1989 photograph. The resolution of this photograph was poor; however, up to 12 additional vertical tanks were noted in the northwest corner and stacked rectangular objects were observed in the central portion of the southern yard.

In 1993, seven of the vertical tanks and the two horizontal tanks observed in the northwest corner of the property were no longer present. Instead, five vertical tanks (two different sizes) were located in the northern yard along with stacked crates. The six vertical tanks located within the southwest portion of the property were still present in both the 1993 and 1994 photographs. In 1994, two additional vertical tanks were observed in the northwest portion of the property. The yards still contain stacked crates. The 1994 photo was the final year included in the aerial photographic analysis.

2.2.4 Facility Processes and Chemical Usage

Limited information regarding volumes and types of wastes handled by Omega was available for review. A Phase II Close Out Report, prepared by England & Associates and Hargis + Associates (England & Hargis, 1996) in 1996, summarized available Omega Chemical information for the period from 1985 through mid-1996, as well as background information (ownership and operational history, geology, hydrogeology, etc).

According to the Phase II Close Out Report, Omega operated the facility for recycling and treatment of spent solvent and refrigerant. Drums and bulk loads of waste solvents and chemicals (primarily chlorinated hydrocarbons and chlorofluorocarbons) from various industrial activities were processed to form commercial products, which were returned to generators or sold in the marketplace. An Operation Plan, prepared by Omega in 1990 for proposed expansion of the facility, provided a summary of current and proposed facility processes, tank capacities, incoming and facility-generated waste stream characteristics and handling practices, etc.

Eleven treatment facilities were present in 1990. The majority of these treatment units were located in the general area of the warehouse loading dock. The Operation Plan listed the following storage facilities:

- Storage Tanks A through F – six stainless steel tanks with 10,000-gallon storage capacity per tank.
- Miscellaneous Named Tanks – 16 stainless steel tanks (Heidi, Jenny, Elaine, Amy, etc.) with the following storage capacities: 1 x 5,000 gallon, 1 x 3,500 gallon, 4 x 2,000 gallon, 1 x 1,300 gallon, 1 x 1,200 gallon, 3 x 750 gallon, 1 x 650 gallon, and 4 x 500 gallon.
- Storage Tanks one through five – five carbon steel tanks with 5,000-gallon capacity per tank.

The combined storage capacity of the 27 tanks present at the facility in 1990 was 109,400 gallons. Storage tanks A through F were arranged in an L-shaped pattern in the southern corner of the property. Storage tanks one through five were located in the northern yard, and were arranged in a linear pattern along the side of the warehouse. The locations of the smaller storage tanks were not indicated in the Operation Plan. According to the Operation Plan, the 5,000 and 10,000 gallon storage tanks were used to store solvent wastes prior to distillation. Distillation units had a total treatment capacity of 1,500 gallons per hour. The wiped film evaporation units had a design treatment capacity of 200 gallons per hour.

2.3 Surrounding Properties

Investigations of the three properties immediately adjoining the former Omega Chemical property (Skateland, Terra Pave, and the Medlin & Son South Building (formerly Cal-Air) were included in the *OSS RI/FS Work Plan* (CDM, September 29,

2003). Based upon analytical results of samples collected from these adjoining properties, the investigation was expanded to include four additional nearby properties: the Medlin & Son North Building, L.A. Carts, Oncology Care Medical Associates, and the Bishop Company. The surrounding properties are discussed below.

2.3.1 Former Skateland

Former Skateland was located at 12520 Whittier Boulevard, adjacent to the southeastern boundary of the former Omega Chemical property. The property consisted of an indoor roller-skating rink that was in operation until OPOG purchased the property on October 1, 2006. Review of the aerial photographs indicates that the property was used for agricultural purposes during 1946. The building presently occupying the property was observed on the 1956 photo. There were no environmental documents or reports available for review for the Skateland property.

Analysis of indoor air samples collected from the former Skateland property resulted in substantial additions to the RI scope of work and, ultimately, the purchase of the property. The initial scope of work consisted of indoor air and soil vapor sampling to assess potential migration of soil vapor in May 2004. In order to assist with evaluation of the sampling results, a chemical usage survey was also performed in May 2004. Evaluation of the HVAC system in July 2004 indicated that the unit re-circulated air inadequately, at a rate slower than one air exchange per hour. Acetone-based deodorizers were observed during the HVAC survey, which could have affected the May 2004 indoor air sampling results. However, the deodorizers apparently did not contain any of the chemicals of concern (tetrachloroethene [PCE], trichloroethene [TCE], and 1,1-dichloroethene [DCE]) that were detected in the indoor air samples. With the exhaust fans operational and the deodorizers turned off, indoor air samples were collected again in August 2004. Evaluation of the indoor air samples indicated that soil vapors were likely migrating into the building, possibly via the utility corridors.

Additional tasks were proposed to evaluate indoor air quality in an *Addendum to the OSS RI/FS Work Plan* (CDM, October 20, 2004). Soil vapor sampling was conducted at the former Skateland facility along the utility corridors and around the building in November 2004 and the results and preliminary findings were submitted to USEPA in the *Preliminary Evaluation of Soil Gas Results from November 2004* (CDM, February 3, 2004). Air purifiers were installed in the boys and girls restrooms and kitchen during December 2004. Indoor air quality samples were collected immediately before the purifiers were placed into operation and shortly after, in order to evaluate their effectiveness. CDM conducted SSD testing in September 2005, and submitted a *Skateland SubSlab Depressurization Testing Technical Memorandum* of the findings (CDM, December 6, 2005). CDM conducted a second SSD test to determine whether the concrete masonry unit dividing the rink and party/arcade area was acting as a vapor barrier (CDM, December 16, 2005).

On April 6, 2006, USEPA issued a *Request for a Removal Action* to mitigate vapor migration into the Skateland building (USEPA, April 6, 2006). OPOG entered into an amendment to the Consent Decree and Supplemental Statement of Work to either mitigate the vapor migration or conduct an Alternate Response Action such as purchasing the property and closing the Skateland operation., OPOG elected to conduct an Alternate Response Action by purchasing the property and closing Skateland on October 1, 2006. The former Skateland building was demolished in March and April 2007.

This report summarizes all the testing procedures, results, and risk evaluation performed at the former Skateland facility. Several technical memoranda have been prepared regarding the indoor air and soil vapor sampling efforts conducted in or near the former Skateland facility (CDM, October 20, 2004 and November 30, 2004, and December 16, 2005).

2.3.2 LA Carts Manufacturing

LA Carts is located at 12549 East Washington Boulevard, a short distance south of Skateland. LA Carts manufactures portable food carts, most of which are fabricated from stainless steel sheeting. The LA Carts property is occupied by a 2,000 square foot, one-level building and exterior lot. There is also a smaller (1,500 square feet) shop building in the rear of the property which is open and does not have any doors. The front of the larger building contains two small offices and a reception area. The rear fabrication area comprises the majority of the building. Two large roll-up doors at the rear of the fabrication area were open to the outside, and appeared inoperable. The food carts are assembled in the exterior paved lot. The LA Carts facility was evaluated for HVAC performance, chemical use, and indoor air quality.

2.3.3 Oncology Care Medical Associates

Oncology Care is located at 12535 E. Washington Boulevard., at the northeast corner of Putnam Street and Washington Boulevard. Oncology Care is housed in a 3,720 square foot, U-shaped, one level building, with an exterior paved parking lot. The building has a reception/waiting area in the front, with offices, examination rooms, a medicine storage/mixing room, and treatment room occupying the remainder of the building. Similar to the LA Carts facility, the Oncology Care facility was evaluated for HVAC performance, chemical use, and indoor air quality.

2.3.4 Bishop Company

The Bishop Company is located at 12519 E. Putnam Street, south-southwest of the former Omega Chemical property. The facility consists of a medium-sized two story building and a large warehouse. The two-story building houses a reception area and office space on the ground floor, with individual offices and a break room on the second floor. Within the warehouse is a self-contained sales room (approximately 1,600 square feet), complete with ceiling and AC unit. The AC unit servicing the sales room is approximately 15 years old and near the end of its service life. It re-circulates

chilled air, and does not have an intake for outside air. There is a fairly new AC unit on the roof of the two-story office, which also does not have an outside air intake.

Similar to the LA Carts and Oncology Care facilities, the Bishop Company facility was evaluated for HVAC performance chemical use, and indoor air quality. Two vapor and MIP borings were drilled near the Bishop property to evaluate the migration of subsurface contaminants to this facility.

2.3.5 Terra Pave

The Terra Pave, Inc. facility is located at 12511 East Putnam Street, adjacent to the southwestern boundary of the former Omega Chemical property. The southeastern part of the Terra Pave facility is leased by Dick Madsen Roofing. The DSR (CDM, December 4, 2001) reviewed a Phase 1 Environmental Site Assessment (ESA) for information regarding historical activities at the Terra Pave property (Cardinal Environmental Consultants [Cardinal], 1991).

The Phase I ESA Report was prepared for the New England Lead Burning Company (NELCO), which operated the Terra Pave property beginning in the mid-1950s. According to the Phase I ESA, the property was unoccupied during a September 1991 site visit by Cardinal staff. The Phase I ESA indicated that NELCO purchased lead in sheet, pipe and solid rods and fabricated the desired product by burning (welding) the lead to the required shape. The welding was performed in the building located along the northeastern portion of the property (Building two), adjacent to the former Omega Chemical property. The type of work performed in the remaining building (Building one) was primarily carpentry work and did not involve lead welding. Building one was also used for offices and warehousing. The exterior of the property was used for storage of equipment and loading materials or finished goods for shipment. The report noted that the undeveloped portions of the property consisted of exposed soil and miscellaneous rubble. Drainage patterns incised in the soil were observed trending in a southerly direction towards Putnam Street.

The Phase I ESA briefly discussed the findings of environmental investigations performed between 1989 and 1991 to evaluate the property for the presence of residual lead. To mitigate this concern, NELCO subcontracted Vector Three Environmental Inc. of Brea, California, to clean the interior of all facilities and remove superficial lead from the topsoil. Removal activities were monitored by Cardinal staff and they indicated that remaining lead levels were extremely low, based on results of confirmatory dust wipe and soil samples. Information regarding lead levels prior to and after removal activities and the depth of the soils removal was not provided. The building where lead welding took place is located directly adjacent to the former Omega Chemical property, and lead welding occurred prior to the time when the former Omega Chemical property was paved. It is possible that lead in airborne particulates from the Terra Pave facility was deposited onto surface soils of the former Omega Chemical property.

CDM implemented the Phase 1a field investigation during June and July 1999 to evaluate the extent of groundwater contamination at and immediately downgradient of the former Omega Chemical property. As part of the Phase 1a field investigation, monitoring well OW-1b was installed on Terra Pave property. Analysis of soil samples collected during the drilling of this monitoring well indicated the presence of VOC contamination in the vadose zone. PCE was the compound most frequently detected in soil samples collected from monitoring well OW-1b; PCE concentrations ranged from 4.7 micrograms per kilogram (μg/kg) at a depth of 120 feet bgs to 3,300 μg/kg at a depth of 70 feet bgs.

Several activities were conducted to evaluate the potential migration of VOCs to this neighboring property for this RI. Similar to the former Skateland facility, indoor air samples were analyzed for VOCs and a chemical use survey was conducted to evaluate the influence of VOC-containing materials used in the building on the indoor air analytical results. Several soil, MIP, and soil vapor borings were conducted.

2.3.6 Medlin & Son North Building

The Medlin & Son North Building is located at 12476 East Whittier Boulevard. The building is a one-level, approximately 3,000-square foot building which contains a laser operated metal cutting machine, laser gases, and miscellaneous shelving for various metal stock. A large covered shed is attached to the rear of the building. There are several small interior offices that are used for storage.

An HVAC system assessment and chemical use survey were conducted at this facility. One indoor air sample was collected from this building during the most recent sampling event conducted in September 2006.

2.3.7 Medlin & Son South Building (Former Cal-Air Facility)

The former Cal-Air facility, now owned and operated by Medlin & Son, is located at 12484 Whittier Boulevard, adjacent to the northwestern boundary of the former Omega Chemical property. The DSR reviewed a Phase I ESA prepared by Centec Engineering (Centec, 1997) for information regarding the former Cal-Air property. The report was prepared for Maple Brothers Industrial, Inc. According to the report, a machine shop and office were constructed at the property in 1954. The property was occupied by Accessory Products, Inc. until approximately early 1976. In September 1976, Cal-Air Conditioning Company added three new offices and occupied the property until 1996. The building on the property consists of a conglomeration of structural types, representing many additions and expansions during the years the property was occupied. A below-grade room and "test tunnel" is reportedly located along the southern side of the building. According to a City Building Department document, the test tunnel was to be used for non-hazardous test work on government projects. At the time of the assessment, the property was unoccupied and access to the test tunnel access was blocked by a heavy metal door and a large amount of water in the vault of the front entrance.

In October 1987, four USTs that used to contain gasoline and diesel fuels were removed from the property by Toxguard Systems, Inc. Laboratory analytical results indicated 72 parts per million (ppm) of hydrocarbons in one of the soil samples collected from under the USTs, with no detectable concentrations in the remaining seven samples submitted for analysis. The Phase I ESA noted significant surficial staining on the wall and floor in the extreme northwest portion of the warehouse.

2.4 Physical Setting

2.4.1 Climate

The climate of the area is characterized as semi-arid, with an average annual precipitation of approximately 16 inches. Precipitation occurs mainly during the winter and spring months.

2.4.2 Surface Topography

The land surface at the former Omega Chemical property slopes to the southwest to south-southwest at approximately 0.016 feet per foot, and is situated at approximately 220 feet above mean sea level (msl).

2.4.3 Regional Geology and Hydrogeology

The Site is located in the Montebello Forebay area of the Central Groundwater Basin of the Coastal Plain of Los Angeles (California Department of Water Resources [DWR], 1961). The Montebello Forebay is an important area of groundwater recharge. Groundwater flow in the area is generally towards the southwest, originating in an area of recharge and flowing toward an area of discharge.

The Site is underlain by low permeability silty and clayey soils of the upper Pleistocene Lakewood Formation. The Bellflower aquiclude (the Bellflower unit is actually more accurately described as an aquitard) is part of the undifferentiated Lakewood formation throughout much of the Whittier area, and likely underlies the Site. The Lakewood Formation is locally derived from erosion of the Puente Hills to the northeast, and may be overlain by a thin cover of Holocene slopewash and alluvium that can be difficult to distinguish from the Lakewood Formation on the basis of lithology. Furthermore, local merging and interfingering of geologic units near the basin margin makes positive identification of individual geologic units encountered in borings problematic.

The direction of regional groundwater flow is generally to the southwest. The nearest active downgradient water supply wells are located more than one mile from the former Omega Chemical property. The closest active well (well 30R3) is located on Dice Road by Burke Street, approximately 1.25 miles downgradient of the former Omega Chemical property. This well is screened from 200 to 900 feet bgs and at least two aquitards appear to be present between the shallowest aquifer and the top of the well screen.

2.4.4 Local Geology and Hydrogeology

This discussion of local geology and hydrogeology is based on an evaluation of lithologic logs, soil conductivity, and geophysical borehole data from borings advanced at the Site. It is necessary to understand the nature of subsurface materials underlying the Site to gain an understanding of contaminant migratory pathways. Therefore, detailed descriptions of subsurface materials noted at the Site are provided below.

Figures 2-2 through 2-6 show geologic cross-sections of the Site. In the vicinity of the former Omega Chemical property, groundwater is typically encountered between 70 and 80 feet bgs, and flows to the southwest. The lithologic and MIP logs used for construction of the cross-sections are included on a compact disc which is provided in Appendix A.

Regional hydrogeologic information is inconclusive on the presence or absence of major regional named aquifers in this portion of the Whittier Area. A cross-section about 1.5 miles south of the former Omega Chemical property is presented in Bulletin 104 (DWR, 1961) that suggests that the uppermost aquifers present are the Gage and Jefferson Aquifers. The upper portion of the shallow aquifer may represent the Gage aquifer, while the lower aquifer is potentially the Hollydale or Jefferson aquifer. The Gage aquifer is the major water bearing member of the Lakewood formation in the Whittier area, where it consists of about 30 feet of sand with some interbedded clay. It can attain maximum depths of 150 feet. The Jefferson aquifer is part of the Lower Pleistocene San Pedro formation that underlies the entire Whittier Area. The formation is composed of sand and gravel with interbedded clay, likely of marine origin. It ranges in thickness from 20 to 40 feet and reaches a maximum depth of 350 feet.

Below the Gage and Jefferson aquifers are deeper members of the Lower Pleistocene San Pedro formation. From shallowest to deepest, they are the Hollydale, Lynwood, Silverado, and Sunnyside aquifers. The Hollydale aquifer may be located beneath the Site, as the Site is located in the western part of the Whittier Area. It ranges in thickness from 10 to 25 feet and reaches to a maximum depth of 100 feet, and merges with the overlying Gage near South Whittier. The Lynwood aquifer ranges in thickness from 50 to 100 feet and extends to a maximum depth of 460 feet; the Silverado aquifer ranges in thickness from 110 to 300 feet, and extends to a depth of 750 feet; while the Sunnyside aquifer consists of 200 to 300 feet of sand and gravel and reaches a depth of 1,000 feet. Site borings have not penetrated any of these deeper formations.

Vadose Zone

The vadose zone has been characterized by a combination of soil borings and a MIP investigation. It is generally comprised of clayey silts with occasional sand lenses. The shallower interbedded silty clays and clays are characterized by alternating layers of high and low soil conductivity materials. Corroborating the MIP conductivity findings are the continuous soil boring logs, which show fine grained materials

(silts, silty clays, clays, corresponding to higher conductivity) with occasional thin lenses of fine sand (lower conductivity).

An important lithologic layer starting at an approximate depth of 30 feet bgs (hereinafter referred to as the 30-foot unit) was found dipping to the west and southwest. The 30-foot unit has a characteristic double peak signature on the MIP conductivity logs, with a lower conductivity interbed in the middle of the unit likely consisting of siltier materials. Nearly all borings show a 1- to 4-foot thick unit with lower conductance, interpreted to be a sandy to silty lithology with less clay overlying the marker bed. The "30-foot zone" itself is between 3.5 to 11 feet thick. The top of the zone slopes generally to the west-southwest with a southwesterly trough directly beneath the center of the Site (Figure 2-7). It should be noted that the configuration of the surface in the area of the northernmost data point (MIP25) has limited control, and that this point appears to be an outlier distorting the slope contours. The "30-foot zone" appears to be an important factor in contaminant fate and transport at the Site, which will be further discussed in Section 5.

Saturated Zone

Groundwater investigations performed to date have indicated the presence of the two aquifer zones present at the Site, separated by a low permeability confining zone. The first sandy zone is encountered near the first occurrence of groundwater. It originates a short distance southwest of the former Omega Chemical property and thickens dramatically to the west (cross-sections C-C' and D-D', Figures 2-5 and 2-6). MIP borings and soil borings advanced at the former Omega Chemical property indicate that the sandy unit does not exist beneath the former Omega Chemical property. The sandy unit was observed in borings along Putnam Street (west of the former Omega Chemical property) and is up to 35 feet thick at downgradient well OW-4/4B. In the MIP borings at the western edge of the former Omega Chemical property, the sandy zone is characterized by low conductivity between 45 and 60 feet bgs. The unit is characterized by fine to medium sands.

The shallow unconfined aquifer may also thin toward the north as shown by cross-section A-A' along Putnam Street, which is perpendicular to the general flow direction (Figure 2-3). This cross-section incorporates boring logs for wells and borings advanced by OPOG, as well as logs available in USEPA files for other sites. The shallow aquifer configuration shows the presence of a lower permeability zone splitting the upper aquifer north of PZ1. Data from boring B-4 suggests that the lower permeability split was eroded or never deposited, or that this older boring was logged at intervals that may have skipped this thin lower permeability zone. The uppermost sand unit within the upper aquifer appears continuous below the water table elevation from H-7 at the northern end to EW-5 at the southern end of the section.

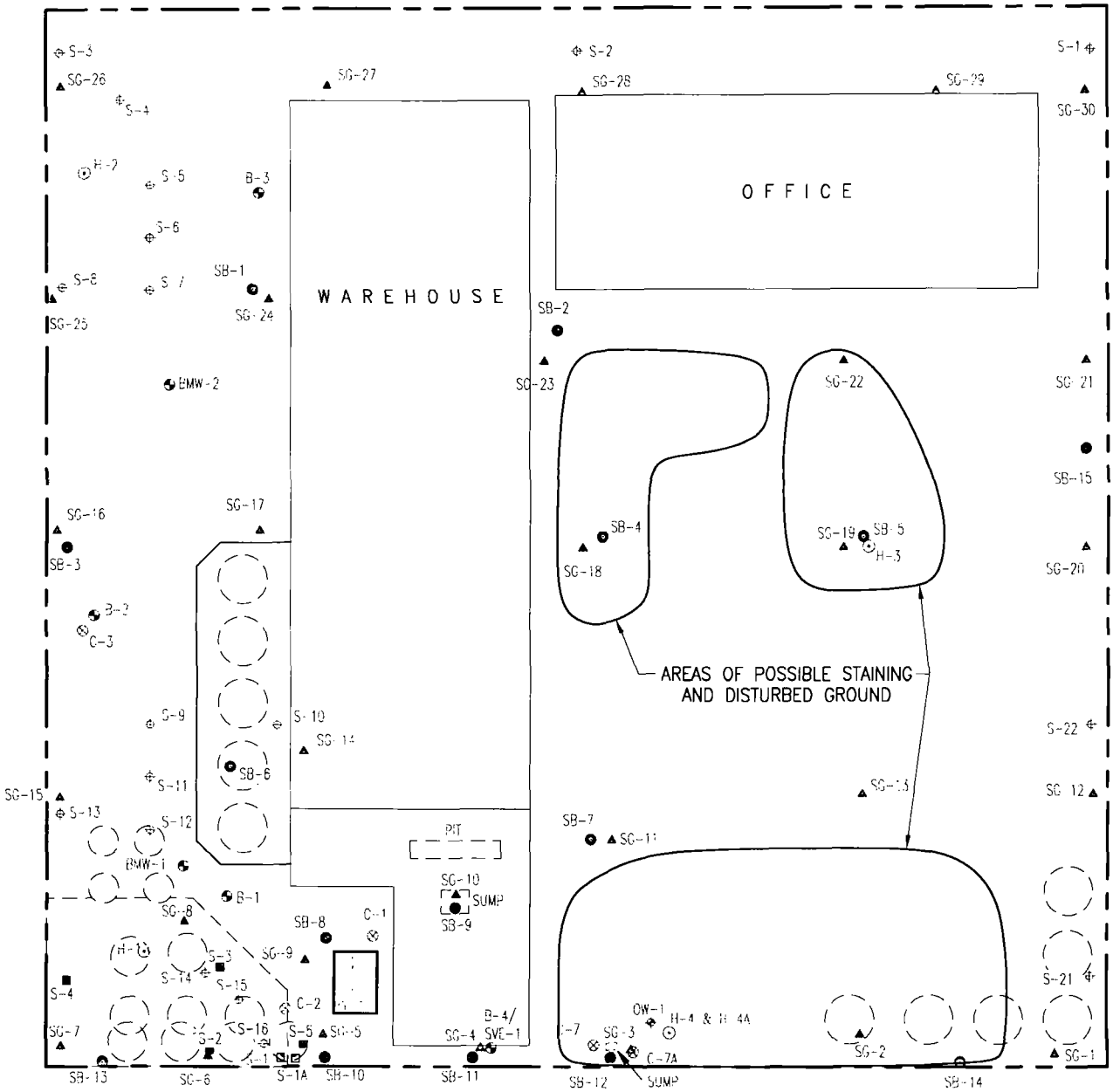
Based on water levels at the OW4 and OW8 locations, where both deep and shallow zone completions are available, the groundwater elevations are significantly higher in the shallow aquifer. A similar difference in water level, with an indicated downward

gradient, was observed at the cluster at OW1/1b. This indicates that a significant confining zone limits flow between these zones.

Similar to the shallower unconfined aquifer, the deeper confined aquifer may also thin under the former Omega Chemical property and thicken to the west. Only the deeper wells to the west penetrate into this unit; it was not observed at well OW-1B at Terra Pave. The deeper confined aquifer is characterized by sand with some silt.

Groundwater Flow and Aquifer Characteristics

Groundwater flow in the upper aquifer has been consistently towards the southwest based on depth to water and groundwater elevation data collected and contour maps prepared since mid-2001. Numerous aquifer tests have been performed on Omega wells over the past 7 years, as follows: slug tests ands step-drawdown testing on wells OW-1b, OW-2, and OW-3 in 1999; short-term (approximately 4 hours) constant discharge testing on wells OW-2, OW-3, OW4a, and OW8 in 2003; and more recently approximately 24-hours of constant discharge testing performed in September 2006 on five wells installed in mid-2006 (EW-1 through EW-5) that are proposed for groundwater extraction as part of the Phase 1a area groundwater remedy. A technical memorandum detailing testing procedures and an evaluation of the testing results was prepared and submitted to USEPA in late-2006 (CDM, November 7, 2006).



LEGEND

- ■ Leroy Crandall Soil Boring (1985)
- ○ ENSR Soil Boring (1988)
- ENSR Groundwater Monitoring Well (1988)
- ● England/Hargis Soil Boring (January 1996)
- ▲ England/Hargis Soil Gas Sample (December 1995)
- England/Hargis Monitoring Well (June 1996)
- ⊙ England/Hargis Hydropunch (March 1996)
- England/Hargis Soil Boring (March 1996)
- ERT Soil Gas Sample (1988)
- Feature Removed

Fomer 500 Gallon UST Location

Note: All locations approximate.

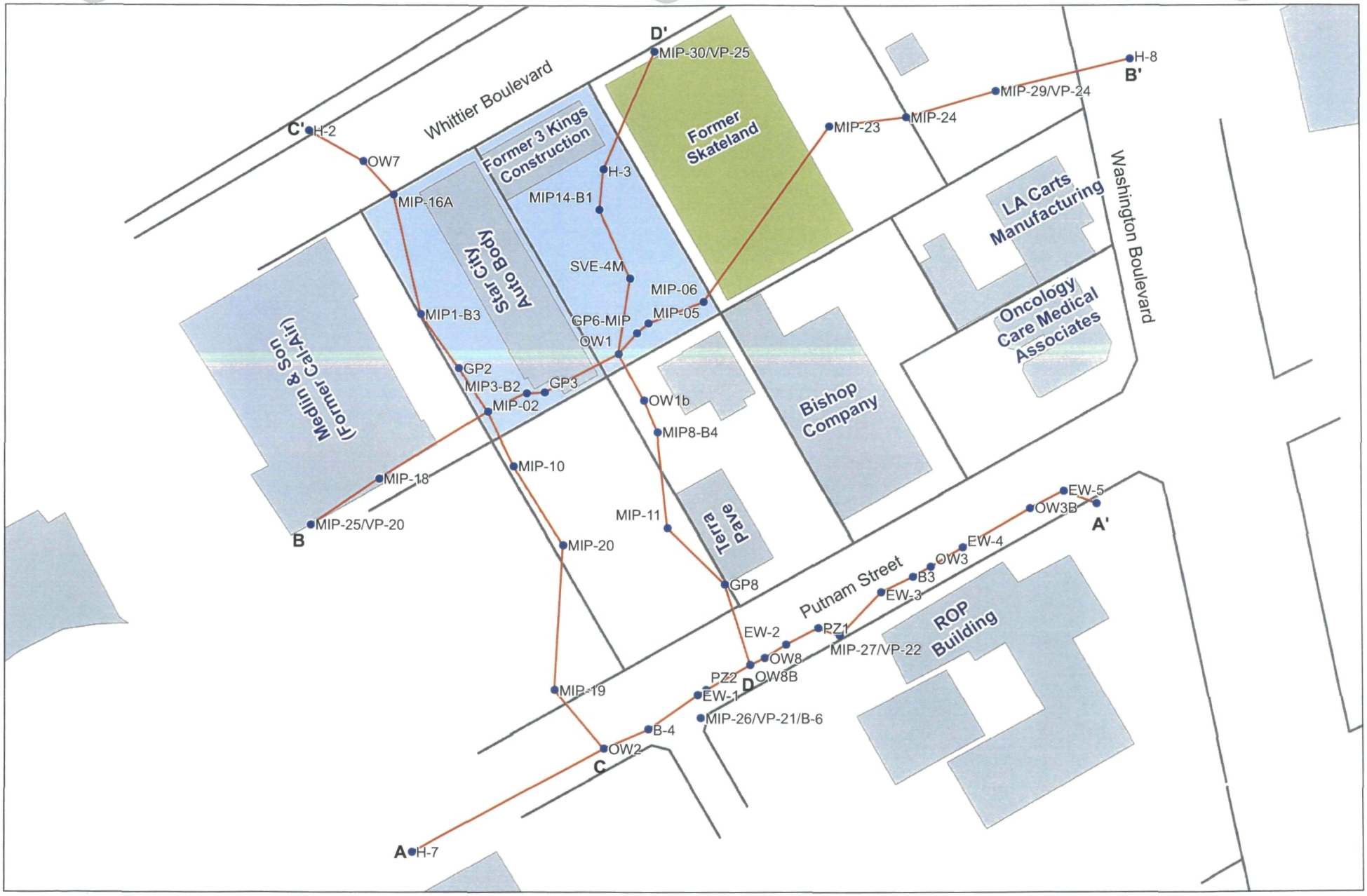
OMEGA CHEMICAL

Potential Source Areas And Historic Sample Locations

CDM

Figure 2-1

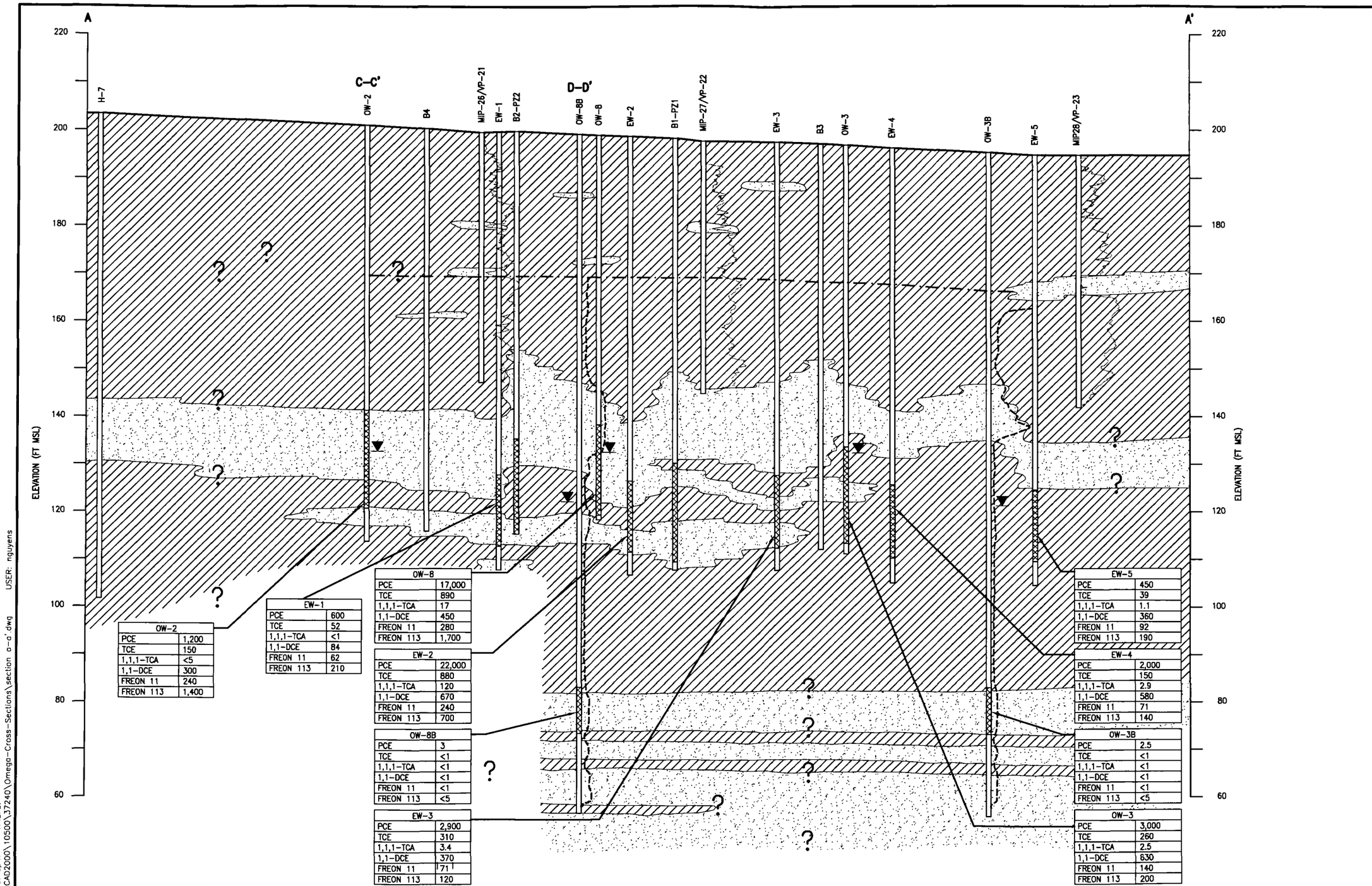
DATE: Dec 06, 2006 11:55am XREFS: PropSamp
DWG: C:\Documents and Settings\nguyens\Desktop\Omega\00-sheets\PSAO-HistPhot.dwg USER: nguyens



CDM

Omega Chemical
Geologic Cross-Section
Plan View

Figure 2-2



HORIZONTAL SCALE
1" = 60'
30 0 60

VERTICAL SCALE
1" = 20'
10 0 20

LEGEND

FT MSL — FEET ABOVE MEAN SEA LEVEL

GROUND SURFACE

RESISTIVITY LATEROLOG

TOP OF 30 FT UNIT

MEMBRANE INTERFACE PROBE SOIL CONDUCTIVITY PROFILE

SAND/SILTY SAND

SILT/CLAY

STATIC WATER LEVEL AUGUST 2006

SCREENED INTERVAL

NOTES

GROUNDWATER SAMPLES COLLECTED AUGUST & SEPTEMBER 2006

CONCENTRATIONS ARE REPORTED IN MICROGRAMS PER LITER (UG/L)

MIP-26/VP-21/B-6 WAS PROJECTED ONTO THE CROSS SECTION LINE

LITHOLOGY AT MIP LOCATION AND TOP OF 30 FOOT UNIT BASED ON INTERPRETATION OF SOIL CONDUCTIVITY LOG

PCE = TETRACHLOROETHENE

TCE = TRICHLOROETHENE

TCA = TRICHLOROETHANE

DCE = DICHLOROETHENE

FREON 11 = TRICHLOROFLUOROMETHANE

FREON113 = 1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE

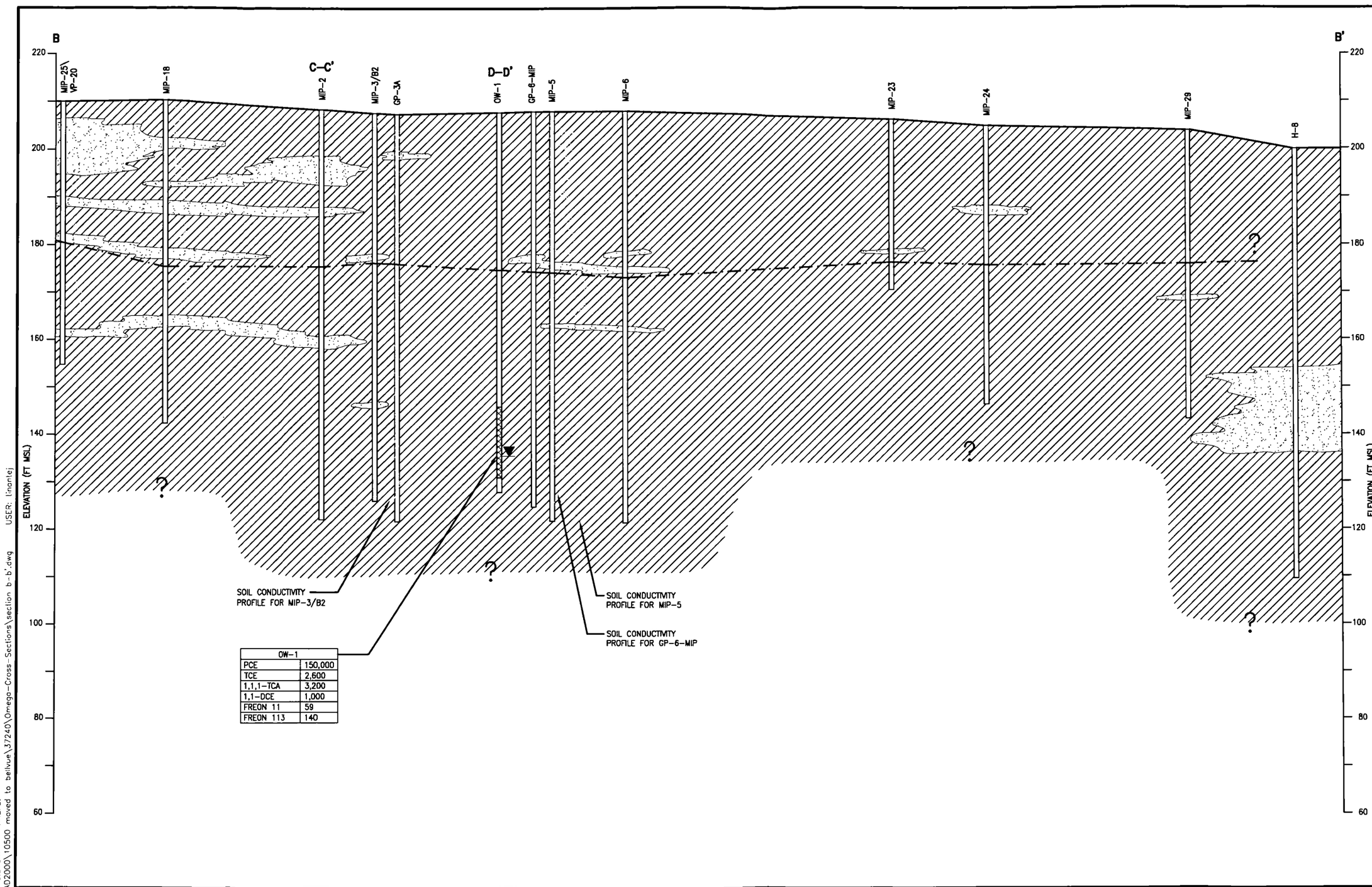
OMEGA CHEMICAL

GENERALIZED CROSS-SECTION A-A'

FIGURE 2-3

CDM

DATE: Mar 22, 2007 6:46pm XREFS:
DWG: \\wicsvr1\cad\ACAD2000\10500\37240\Omega-Cross-Sections\section a-a'.dwg USER: nguyens



OW-1	
PCE	150,000
TCE	2,600
1,1,1-TCA	3,200
1,1-DCE	1,000
FREON 11	59
FREON 113	140

HORIZONTAL SCALE

1" = 60'

30 0 60

VERTICAL SCALE

1" = 20'

10 0 20

LEGEND

FT MSL FEET ABOVE MEAN SEA LEVEL

GROUND SURFACE

TOP OF 30 FT CLAY UNIT

MEMBRANE INTERFACE PROBE SOIL CONDUCTIVITY PROFILE

SAND/SILTY SAND

SILT/CLAY

STATIC WATER LEVEL AUGUST 2006

SCREENED INTERVAL

NOTES

GROUNDWATER SAMPLES COLLECTED AUGUST & SEPTEMBER 2006

CONCENTRATIONS ARE REPORTED IN MICROGRAMS PER LITER (UG/L)

LITHOLOGY AT MIP LOCATION AND TOP 30 FOOT UNIT BASED ON INTERPRETATION OF SOIL CONDUCTIVITY LOG

PCE = TETRACHLOROETHENE

TCE = TRICHLOROETHENE

TCA = TRICHLOROETHANE

DCE = DICHLOROETHENE

FREON 11 = TRICHLOROFLUOROMETHANE

FREON113 = 1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE

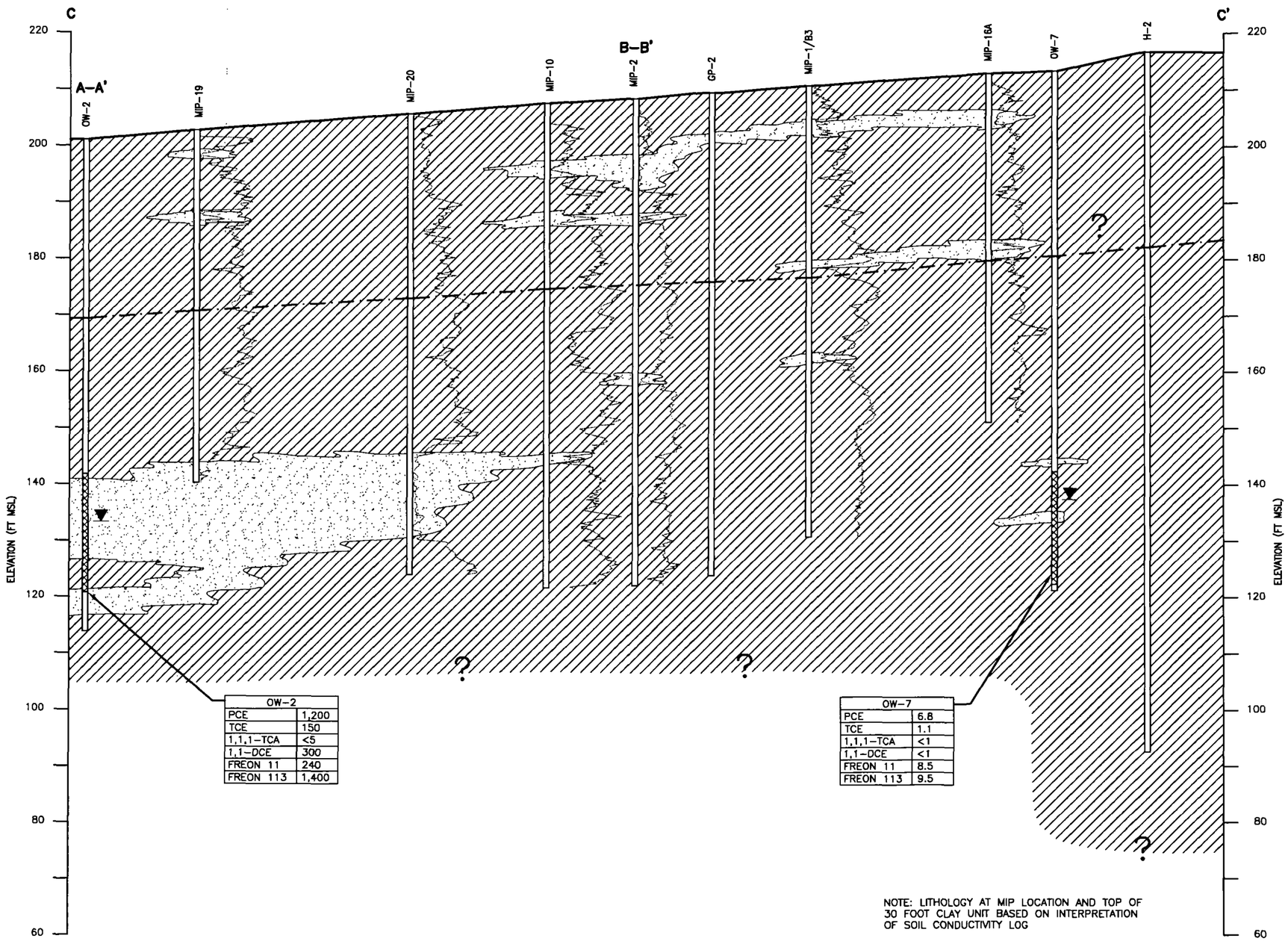
OMEGA CHEMICAL

GENERALIZED CROSS-SECTION B-B'

FIGURE 2-4

CDM

DATE: Apr 11, 2007 10:27am
DWG: C:\King City\ACAD2000\10500 moved to bellvue\37240\Omega-Cross-Sections\section b-b'.dwg
XREFS:
USER: lnantej



OW–2	
PCE	1,200
TCE	150
1,1,1–TCA	<5
1,1–DCE	300
FREON 11	240
FREON 113	1,400

OW–7	
PCE	6.8
TCE	1.1
1,1,1–TCA	<1
1,1–DCE	<1
FREON 11	8.5
FREON 113	9.5

NOTE: LITHOLOGY AT MIP LOCATION AND TOP OF 30 FOOT CLAY UNIT BASED ON INTERPRETATION OF SOIL CONDUCTIVITY LOG

HORIZONTAL SCALE
1" = 60'
30 0 60

VERTICAL SCALE
1" = 20'
10 0 20

LEGEND

FT MSL — FEET ABOVE MEAN SEA LEVEL

GROUND SURFACE

TOP OF 30 FT CLAY UNIT

MEMBRANE INTERFACE PROBE SOIL CONDUCTIVITY PROFILE

SAND/SILTY SAND

SILT/CLAY

STATIC WATER LEVEL AUGUST 2006

SCREENED INTERVAL

NOTES

GROUNDWATER SAMPLES COLLECTED AUGUST & SEPTEMBER 2006

CONCENTRATIONS ARE REPORTED IN MICROGRAMS PER LITER (UG/L)

PCE = TETRACHLOROETHENE

TCE = TRICHLOROETHENE

TCA = TRICHLOROETHANE

DCE = DICHLOROETHENE

FREON 11 = TRICHLOROFLUOROMETHANE

FREON113 = 1,1,2–TRICHLORO–1,2,2–TRIFLUOROETHANE

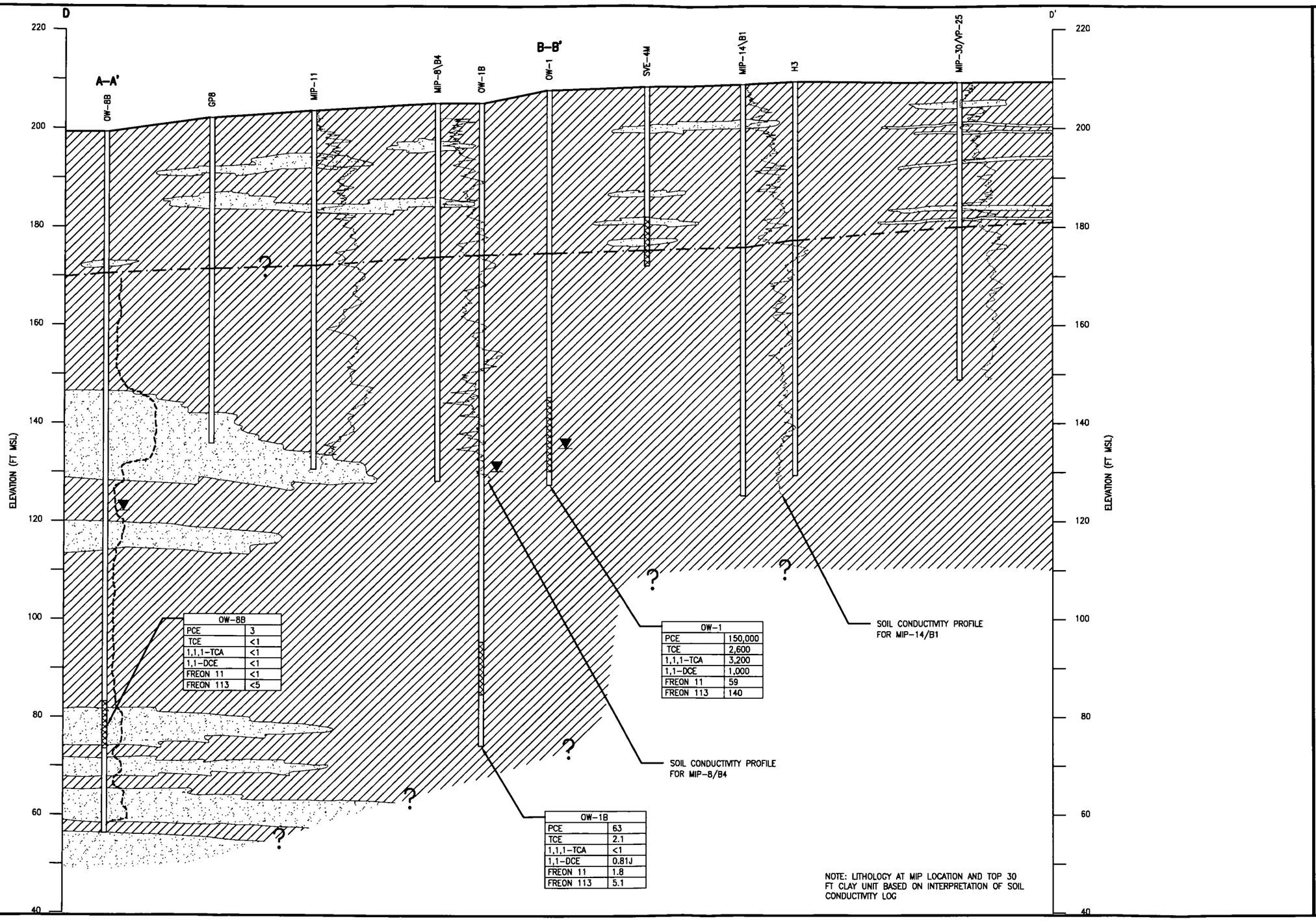
OMEGA CHEMICAL

CDM

GENERALIZED CROSS-SECTION C-C'

FIGURE 2-5

DATE: Jan 18, 2007 11:43am XREFS:
DWG: \\wlcsvr1\cad\ACAD2000\10500\37240\Omega-Cross-Sections\section c-c'.dwg USER: nguyens



HORIZONTAL SCALE
1" = 60'
30 0 60

VERTICAL SCALE
1" = 20'
10 0 20

LEGEND

FT MSL	FEET ABOVE MEAN SEA LEVEL
———	GROUND SURFACE
- - - -	RESISTIVITY LATEROLOG
—·—	TOP OF 30 FT CLAY UNIT
———	MEMBRANE INTERFACE PROBE SOIL CONDUCTIVITY PROFILE
	SAND/SILTY SAND
	SILT/CLAY
▼	STATIC WATER LEVEL AUGUST 2006
	SCREENED INTERVAL

NOTES

GROUNDWATER SAMPLES COLLECTED AUGUST & SEPTEMBER 2006

CONCENTRATIONS ARE REPORTED IN MICROGRAMS PER LITER (UG/L)

PCE = TETRACHLOROETHENE

TCE = TRICHLOROETHENE

TCA = TRICHLOROETHANE

DCE = DICHLOROETHENE

FREON 11 = TRICHLOROFLUOROMETHANE

FREON113 = 1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE

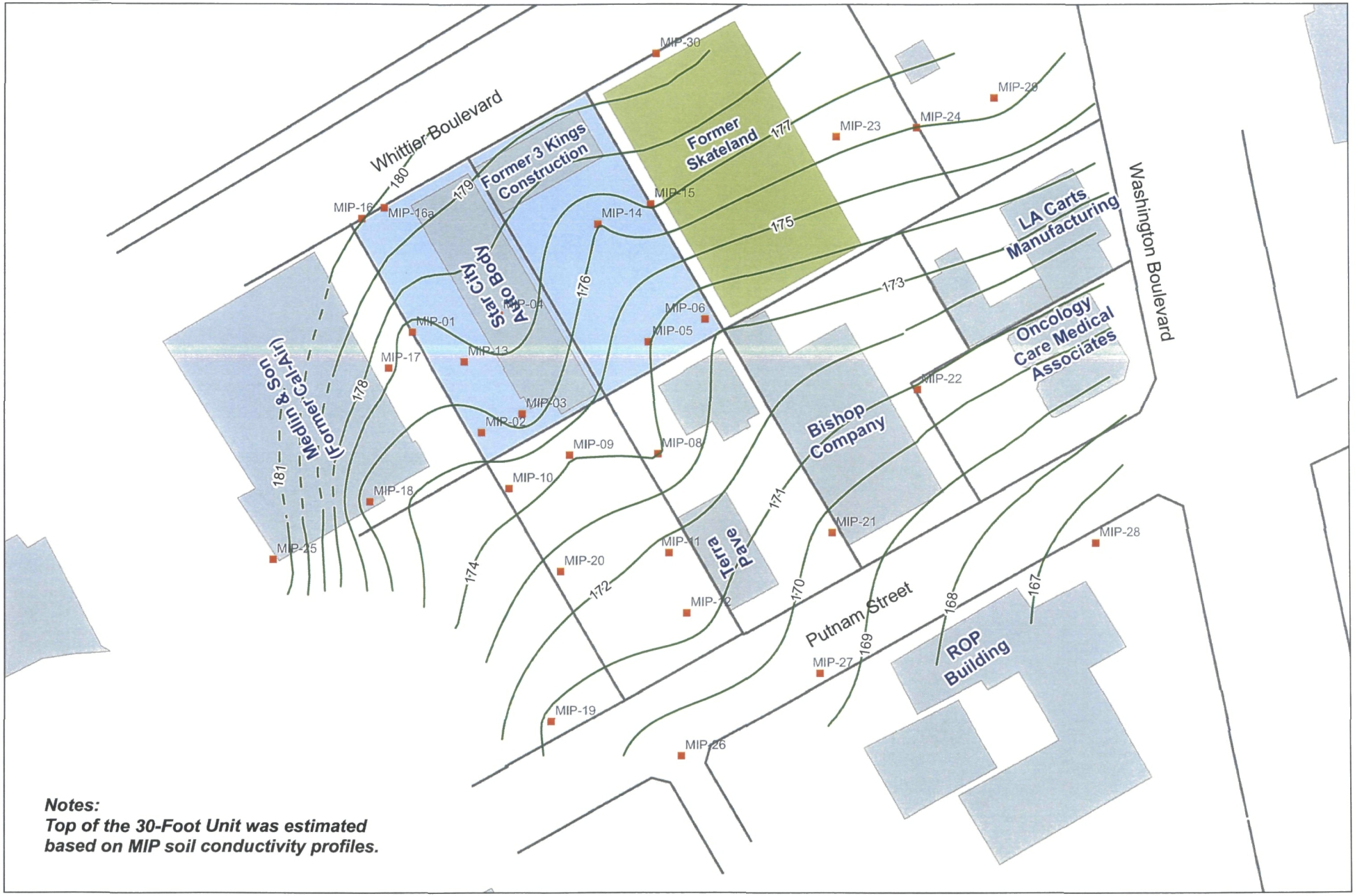
OMEGA CHEMICAL

CDM

GENERALIZED CROSS-SECTION D-D'

FIGURE 2-6

DATE: Jan 18, 2007 1:18pm XREFS:
DWG: \\wicsvr1\cad\ACAD2000\10500\37240\Omega-Cross-Sections\section d-d'.dwg USER: nguyens



Notes:
Top of the 30-Foot Unit was estimated based on MIP soil conductivity profiles.

Legend

- Property Boundary
- Former Omega Chemical Property
- Existing Building
- Former Building
- Iso-elevation Contour, Top of 30' Unit (ftMSL) [Dashed where inferred]
- MIP Location

N

0 25 50 100
Feet

CDM

Omega Chemical
Elevation
Top of 30- Foot Unit

Figure 2-7

Section 3

Section 3
Field Activities

3.1 Sampling Objectives, Rationale, and Locations

The objective of the field investigation was to collect the data needed to: characterize the nature and extent of contamination in Site soils to support the data needs of the risk assessment, feasibility study, remedial design, and a ATSDR Public Health Assessment, and Natural Resource Trustee. The data requirements for these goals were identified in the *OSS RI/FS Work Plan* (CDM, September 29, 2003). Historic data were evaluated against the data requirements, and data gaps were identified. The original scope of work for the RI was based upon filling the identified data gaps. Historic data were presented previously in the *Data Summary Report for On-Site Soils* (CDM, December 4, 2001). A brief summary was also provided in the *On-Site Soils RI/FS Work Plan*. The following types of data were collected: analytical data from surface soil, subsurface soil, soil vapor, indoor and outdoor air samples; field lithologic observations during coring; soil conductivity and in situ soil/soil vapor VOC data from MIP borings; and physical soil parameters. In addition to collecting samples, HVAC surveys and chemical usage surveys were conducted during walk-throughs of the buildings on the former Omega Chemical property and other adjacent and nearby facilities.

As data were evaluated from the original scope of work, data gaps were identified in the new consolidated data set. To continue meeting the goals of the RI, additional sampling locations were proposed to and approved by USEPA. These preliminary data evaluations and proposed additional tasks were documented in several memoranda to USEPA from 2004 to 2006. Three technical memoranda summarizing MIP and soil gas sampling results and proposed additional sampling locations are provided in their entirety on the compact disc contained in Appendix B. USEPA comments to these three technical memoranda and OPOG responses to comments, where available, are also provided in Appendix B.

This report compiles the conclusions from the preliminary data evaluations while adding detail to the field and quality assurance quality control (QA/QC) procedures utilized throughout the sampling program. All sample locations are shown in Figure 3-1, with the exception of the air quality sample locations which are shown on Figure 4-27. Analytical summary tables for all samples collected during the RI are included on the compact disc which is provided in Appendix A.

3.1.1 Surface Soil

Twenty surface soil samples were collected at the former Omega Chemical property on April 6 and 7, 2004 (Figures 3-1 and 3-2). The surface soil samples were collected to: 1) characterize the nature and extent of contamination in surface soils to the extent necessary to select the appropriate remedy, 2) generate data to support the HHRA; 3) evaluate potential source areas identified in historical aerial photographs; and

4) generate soil physical characteristics data to evaluate the potential for vapor migration through surface soils.

Sixteen of the 20 surface soil samples were collected based on a systematic sampling strategy. Systematic sampling was selected as the primary sampling design for surface soils. This type of sampling strategy is effective for risk assessment and geostatistical characterizations (USEPA, 1988). Systematic sample locations were established across an area of concern by laying out a grid of sampling locations that follow a regular pattern (square). Rectangular grid patterns were established. The location of the first grid point was randomly selected; the locations of the remaining grid points were determined along a 40-foot fixed spacing grid. Sample locations along the grid were revised slightly to account for the presence of buildings.

The remaining four surface soil sampling locations were targeted for potential source areas (SS-12, 13, 14) and an area of known surface soil contamination (SS-04). The sampling results may overestimate contamination because they are located in possible source areas. The source areas were identified in historic aerial photographs. Because several of the 16 systematic sampling locations were already located in potential source areas, three additional sampling locations should be sufficient for source evaluation.

One soil sample was collected in an area where lead was previously detected in shallow soil sample SB-12 (depth of 1.7 feet bgs) at a concentration of 890 mg/kg. The high lead concentration is bounded by lower concentrations in surrounding sample locations except in the southwest direction. The last surface soil sample was located to evaluate the extent of lead-impacted soil in the southwest direction.

All surface soil samples were collected immediately beneath the paved surface from a depth of approximately zero to six-inches bgs and were analyzed for semi-volatile organic compounds (SVOCs) by USEPA Method 8270, metals by Method 6010B/7471A, pesticides by Method 8081, and poly-chlorinated biphenyls (PCBs) by Method 8082. Two of the systematic surface soil samples were analyzed for soil physical characteristics (moisture, water permeability, hydraulic conductivity, and grain size distribution) to evaluate possible VOC vapor migration through soil into air.

3.1.2 Subsurface Soil

Subsurface soil samples were collected to: 1) provide additional lithologic information; 2) generate data to evaluate the potential for vapor migration; 3) evaluate the potential effectiveness of remedial alternatives; 4) to confirm MIP or soil vapor sampling results and 5) to characterize the distribution of contaminants. Figures 3-1 and 3-3 show the locations of the subsurface soil borings.

Soil Sampling, October 27 to 28, 2003

Borings GP-1, GP-2, and GP-3A were drilled between October 27 and 28, 2003 as proposed in the OSS RI/FS Work Plan (CDM, September 29, 2003). Data from analysis

of samples collected from the borings were used for both the OSS RI and the Phase 1a groundwater investigation. Vironex, Inc. of Santa Ana, California provided direct push drilling services. All borings drilled during this time period were located at the former Omega Chemical property. Total depths were 85 feet bgs.

Detailed drilling, soil sampling, sampling handling, and documentation procedures are provided in Section 3.3.3. Soil samples were collected continuously in acetate liners in five-foot intervals. The bottom six inches of the five-foot interval were divided from the longer interval, labeled, and cooled. The sample liners were opened and examined for coarse grained materials such as sand or gravel. Coarse grained materials were immediately placed into an 8-ounce jar, labeled, and cooled. Soils immediately adjacent to chilled samples were field-screened using an organic vapor monitor (OVM) equipped with a photoionization detector (PID).

The Encore samples and soil core within the acetate sleeve were submitted to Del Mar Analytical Laboratories of Irvine, California, for the following chemical analyses:

- VOCs (USEPA Method 8260B). Encore sub-samples were collected for USEPA extraction method 5035
- 1,4-dioxane (USEPA Method 8270C modified)

The remaining samples were submitted to PTS Laboratories of Santa Fe Springs, California, for physical soil parameters:

- Cation exchange (USEPA Method 9081)
- Oxidation reduction potential (American Society of Testing and Materials [ASTM] D1498)
- Moisture (ASTM D2216)
- Hydraulic conductivity and water permeability (ASTM D5084)
- Grain size distribution (ASTM D422/4464M)
- Redox potential (SM 2580B)
- Total organic carbon (TOC, by the Walkley-Black method)

Boring GP-3A was a replacement for boring GP-3, which was located near the Omega loading dock at a former 500-gallon kerosene UST. The UST had been abandoned by removal and backfilled with gravel. The direct push drilling rig method was insufficient to maintain an open borehole or drill past the backfilled materials. Boring GP-3A was drilled away from the former UST excavation area as a replacement boring for GP-3. MIP screening was originally intended to be conducted at GP-3, but because of the presence of odorous soils, additional samples were collected for VOC

and 1,4-dioxane analysis and the MIP screening was conducted at a borehole drilled at a later date.

Soil sampling, January 20 to 22, 2004

Borings GP-4 through GP-8 were drilled between January 20 to 22, 2004 as proposed in the OSS RI/FS Work Plan and the revised work plan addendum dated October 20, 2004. Boring GP-6 was located at the former Omega property, while borings GP-4, GP-5, GP-7 and GP-8 were located at the adjacent Terra Pave property. Total depths of the borings were 85 feet bgs except for GP-8, which was terminated at 66 feet bgs due to refusal.

MIP screening was conducted at GP-4, GP-5, and GP-6 on January 19, 2004, prior to the subsurface soil sampling. Results from the MIP screening were used to select four or five depths at GP-4 and GP-5 to analyze for VOCs (USEPA Method 8260B) and 1,4-dioxane (USEPA Method 8270C Modified). Samples from GP-6 were analyzed for VOCs and 1,4-dioxane as well as the physical soil parameters conducted in October 2003. For boreholes GP-7 and GP-8, which were not screened with the MIP tool, samples were collected based upon field PID measurements.

Detailed drilling, soil sampling, sampling handling, and documentation procedures are provided in Section 3.3. All samples for VOC analysis were sampled using Encore™ sampler for USEPA extraction method 5035.

Soil sampling, April 13, 2004

Two soil borings were conducted to collect 6-foot deep soil samples on April 13, 2004 as proposed in the *OSS RI/FS Work Plan*. The soil borings were conducted concurrently with soil vapor sampling near soil vapor borings SG-04 and SG-08. The samples were analyzed for physical parameters only and were used to supplement the soil vapor data. The physical parameters were:

- Grain size distribution (ASTM D422/4464M)
- Hydraulic conductivity and water permeability (ASTM D5084)
- Moisture (ASTM D2216)

Subsurface soil sampling, December 2005 and March 2006

Seven additional soil borings were conducted as part of the work proposed in the *On-Site Soils RI/FS Work Plan Addendum No. 2, Summary of Initial Findings from Soil Vapor and MIP Sampling with Recommendations for Additional Sampling Locations* (Appendix B, CDM, November 1, 2005) and *On-Site Soils RI/FS Work Plan Addendum No. 2, Summary of Additional Findings from Soil Vapor and MIP Sampling* (Appendix B, CDM, January 27, 2006). The soil borings were conducted to confirm the validity of the MIP findings, provide information regarding contaminants derived from the former Omega Chemical property, and examine the lithology for more permeable

pathways from suspected source areas. Sample depths were selected based upon the MIP results.

Borings B1 (MIP14/VP11), B2 (MIP3), and B3 (MIP1) performed at the former Omega Chemical property, were conducted from December 16 to 19, 2005 as recommended in the *OSS RI/FS Work Plan Addendum No. 2 – Summary of Initial Findings from Soil Vapor and MIP Sampling with Recommendations for Additional Sampling Locations* (Appendix B). These borings were advanced to 75 feet bgs regardless of sample depth.

Borings B4 (MIP8/VP13), B5 (MIP22/VP18), B6 (MIP26/VP21), and B7 (VP14/MIP21) were conducted from March 7 to 9, 2006 as requested by USEPA at the Terra Pave property. These borings were advanced one to five feet below the deepest sample.

All boreholes were logged continuously in five-foot intervals by an on-site CDM geologist. All soil samples were analyzed for physical parameters as determined by the MIP soil conductivity results, while selected samples were analyzed for chemicals of concern, as determined by the MIP electron capture detector (ECD), PID, and flame ionization detector (FID) results. The following are the chemical and physical parameters that were analyzed:

- VOCs (USEPA Method 8260B) Encore sub-samples were collected for USEPA extraction method 5035.
- 1,4-dioxane (USEPA Method 8270C modified)
- Density (American Petroleum Institute [API] RP40)
- Moisture (ASTM D2216)
- Hydraulic conductivity and water permeability (ASTM D5084)
- TOC (USEPA Method 9060 or the Walkley-Black method)

3.1.3 Soil Vapor

Soil vapor samples were collected to generate Site boundary data for use in the risk assessment, provide data for use in evaluation of vapor migration, provide additional characterization of potential source areas, and confirm MIP concentrations. Soil vapor locations are shown in Figures 3-1 and 3-4. Only the results of soil vapor sampling conducted from 2004 to 2006 were considered in the evaluation of Site conditions; the historic (pre-2004) sample locations are shown on Figure 3-4. All soil vapor samples from 2004 through 2006 were analyzed for VOCs by method TO-15. The soil vapor samples were collected over several events as described below.

Soil vapor survey – April 12 to 13, 2004

The first soil vapor survey conducted for this RI was conducted from April 12 to 13, 2004. Soil vapor survey locations SG-1 through SG-12 were selected using either systematic (grid) sampling or in potential source areas as identified in historic aerial

photographs as summarized in Table 3-1. Each location was sampled at 6 and 12 feet, bgs. The soil vapor sampling locations and depths were based upon investigations conducted prior to the OSS RI/FS Work Plan. Soil vapor probes were installed and sampled as described in Section 3.3. Immediately after sampling the probes with an evacuated Summa canister, a sample was collected in a Tedlar bag and field screened with a handheld PID.

Table 3-1
SG-01 to SG-12: Sampling Rationale and Locations

Location ID	Rationale
SG-01, 02, 03	To evaluate extent of VOC contamination at the adjacent former Cal-Air property.
SG-04 to SG-09	To provide systematic collection of vapor analysis throughout the former Omega Chemical property.
SG-10, 11, 12	To evaluate potential source areas at the former Omega Chemical property, based on historic aerial photos.

Soil vapor and utility corridor survey – November 9 to 12, 2004

A second soil vapor sampling event at 21 locations was conducted between November 9 and 12, 2004. The event consisted of deeper sampling of soil vapor at locations SG-07 through SG-12 based upon evaluation of the initial shallow soil vapor sampling results, and a focused sampling of backfill along utility corridors (UC boreholes). Depths and rationale are provided below.

Table 3-2
SG-07 to SG-15 and UC-1 to UC-12: Sampling Rationale and Locations

Location ID	Depths (ft bgs)	Rationale
SG-07 to SG-12	18, 24	To assist in determining the relative importance of lateral transport of vapors from shallow soil contamination in comparison to vertical transport derived from the "off-gassing" from groundwater. Because of elevated concentrations at shallow depths and the depth of groundwater (approximately 70 feet bgs), groundwater was not believed to be a source of observed soil vapor VOCs at the time.
SG-13, 14, 15	6, 12	To determine if there are preferential pathways and to assist with evaluation of remedial options at the Skateland facility (which has since been demolished).
UC-1 to UC-12	Between 2 and 11, depending upon the depth of the utility	To evaluate the extent and nature of VOC contamination in soil vapor in the backfill materials surrounding utility lines. The utility lines are potential significant preferential vapor migration pathways. Final locations were based upon the utility maps provided by the City of Whittier and the initial field-screened hand auger boreholes

The soil vapor probes for the SG locations were installed using a direct push rig on November 11, 2006 and sampled in Summa canisters. The drillers utilized the

hydraulic hammer to drill deeper than 18 feet. Summa canisters filled very slowly at the 24-foot depth at SG-8 and SG-9.

The utility corridor soil vapor sampling was conducted in two phases to prevent damaging subsurface utilities. The first phase was performed by advancing a hand auger into backfill material on November 9 and 10, 2004. The fill materials consisted of moist clayey silts and silty clays, except for cobbles at four to five feet bgs at UC-4A, and sand at four feet bgs at UC-11. A sampling probe was driven into the hand augered borehole and a soil vapor probe installed. The probe was evacuated using the pump in the handheld PID instrument and the maximum reading was collected. After all the UC boreholes were hand augered and screened with the PID, sample probes were installed adjacent to the hand augered borehole with a direct push rig and samples were collected in Summa canisters on November 12, 2004

Soil vapor survey – August 15 to 22, 2005

A third soil vapor survey was conducted at 12 locations during the period August 15 to 22, 2005. Depths for this soil vapor sampling event were significantly deeper than the previous investigation with nine of the borings advanced to a depth of 70 feet bgs. After evaluating the previous data, it was hypothesized that volatilization may be occurring from either groundwater and/or the capillary fringe. The event was conducted to: 1) identify probable source areas; 2) determine if elevated soil vapor concentrations are associated with contaminated Site soils; 3) volatilization from groundwater, or both; 4) identify migration pathways from source areas for both soil vapor and groundwater; 5) collect additional characterization data to support remedy selection, including evaluation of both vadose and saturated zones, if appropriate to enhance the effectiveness of the anticipated Engineering Evaluation/Cost Analysis (EE/CA); and 6) characterize the extent of source area contamination. Table 3-3 provides the rationale for the sampling locations. Sample depths were variable and are discussed in the text below.

Table 3-3
VP1 to VP12: Sampling Rationale and Locations

Location ID	Rationale
VP-6, 7, 8 VP-9/MIP-5	To identify potential source locations, near or downgradient of former sumps.
VP-4, 5 VP-3/MIP-2	To identify potential source locations, near or downgradient of former tank areas.
VP-1, 2, 10, 12 VP-11/MIP-14/B1	To determine if previously identified shallow soil vapor contamination persisted at depth.

Three of the locations (VP-5, VP-7, and VP-10) were sampled at approximately 6, 12, 18, 24 and 40 foot depths. Nine of the locations (VP-1, VP-2, VP-3, VP-4, VP-6, VP-8, VP-9, VP-11, and VP-12) were sampled at the above depths, plus the 50, 60 and 70 foot depths. Generally, the shallowest three depths were nested within one direct push

borehole (6, 12, and 18 feet bgs), the next three depths were nested in a second borehole (24, 40, and 50 feet bgs), while the deepest two depths were installed in a third borehole (60 and 70 feet bgs). Therefore, three boreholes were cored at the deeper sampling locations. Field PID measurements were taken at all sampling depths and locations. Exceptions to the above were the following:

- VP-01: The initial boring collapsed to 7.5 feet bgs. The remaining probes were installed in two boreholes: the shallow borehole contained 6-, 12-, 18-, and 24-foot bgs probes, while the deeper borehole contained the 40-, 50-, 60-, and 70-foot probes.

- VP-03: Due to the presence of shallow gravel between 13 and 18 feet bgs, deeper vapor probes were unable to be installed using the standard 1-1/2-inch diameter rods. Larger diameter 2-1/2-inch drilling rods were used to keep the borehole open while installing the deeper probes. Drilling rods broke at the threaded joints during withdrawal, although an alternate location several inches away of the original attempt was successful.

- VP-06: The borehole squeezed after the 70-foot probe had been constructed. Instead of constructing the 60-foot probe, a shallower 50-foot probe had been constructed instead. The 60-foot probe was constructed in an adjacent borehole with the 24- and 40-foot intervals.

- VP-08: A strong odor was noted while boring VP-08 was hand augered to clear to utilities. Drilling was difficult between 50 and 70 feet, and the drilling rods broke at the threaded joints upon withdrawal. An alternate location was successfully completed approximately eight inches northwest of the original attempt.

- VP-09: The borehole squeezed after the 40- and 50-foot vapor probes had already been installed. Therefore, the 24-foot sampling interval was built with the shallow 6-, 12-, and 18-foot probes.

Soil vapor survey – December 12 to 15, 2005

A fourth soil vapor survey was conducted at seven locations during the period December 12 to 15, 2005. Table 3-4 provides the rationale for selecting each of these locations. The sampling interval in these probes was based on a co-located MIP probe, or at the previously specified depths if a MIP probe was not adjacent. The exception was at VP-19, where vapor probes were installed to the depths from the previous sampling event (6, 12, 18, 24, 40, 50, 60, 70 feet bgs). Squeezing at approximately 60 feet bgs was observed at VP-19. Sampling depths were variable and are discussed in the text on the following page.

Table 3-4
VP-13 through VP-19: Sampling Rationale and Locations

VP ID	Other ID	Rationale
VP-13	MIP-8 B4	To check for contaminant signature that is potentially different from the former Omega Chemical property signature and to assess concentration gradients away from the former Omega Chemical property. Sampling occurred to the water table.
VP-14	MIP-21 B7	To check for potential source related to sewer line leaving Terra Pave. Sampling occurred to the water table.
VP-15		To check for declining concentrations away from suspected source areas. Sampling occurred to the water table. This was located upgradient of the highest groundwater concentrations observed in wells along Putnam Street.
VP-16	MIP-18	To check for contaminant signature that is potentially different from the former Omega Chemical property signature on the parcel to the north. Sampling will occur to the water table.
VP-17	MIP-19	To evaluate the extent of contamination in a northern direction along Putnam Street.
VP-18	MIP-22 B5	To evaluate the southern extent of contamination.
VP-19	MIP-16A	To check for declining concentrations away from suspected source areas.

Soil vapor survey – March 6 to 9, 2006 and May 31, 2006

A fifth soil vapor survey was conducted at eight locations during the period March 6 to 8, 2006. Another three locations were sampled on May 31, 2006 due access issues along the grassy parkway between the Whittier Boulevard frontage road and the main thoroughfare, and at Medlin & Son North building. Many of these locations were co-located with MIP sample borings, and the depth of the soil vapor samples was chosen based upon MIP results. These vapor sample locations were primarily above the "30 foot unit". The rationale for the additional borings/sampling provided in Table 3-5. Squeezing was observed at VP-25. All five soil vapor probes were installed in one borehole at VP-21. Sample depths were variable, and are discussed in the text below.

Table 3-5
VP-20 to VP-30: Sampling Rationale and Locations

Direction	Location ID	Rationale
East	VP-25/MIP-30 VP-26 VP-27	A MIP boring and soil vapor sampling were requested by DTSC east the former Omega Chemical property to confirm decreasing contaminant concentrations in this direction.
North	VP-20/MIP-25 VP-29 VP-30	Total VOCs (TVOCs) in soil vapor samples increase going from VP-03 to VP-16 in the 47-50 foot depth range (212 to 2,335 milligrams per cubic meter [mg/m^3]). Investigation at this area was intended to determine if the relatively high TVOC concentration seen at the 47 foot depth at VP-16 and the 30-foot unit extend further to the northwest, and to assist in identifying other sources on this property.
West	VP-21/MIP-26/B6 VP-22/MIP-27	TVOCs in soil vapor samples from several depths were higher at VP-14 and VP-15 than samples to the east of these locations. These

Direction	Location ID	Rationale
	VP-23/MIP-28 VP-28	additional sampling locations were intended to look for decreasing contaminant concentrations to the west and southwest of VP-14, 15, 17 and 18.
South	VP-24/MIP-29	This location was intended to document lower contaminant concentrations to the south of MIP-24 where contamination was indicated in the 30-foot unit. The boring also provided information on the transition zone to thicker sands in the saturated zone that is observed near Washington Street.

3.1.4 MIP

The MIP is a direct push tool that produces real-time, continuous, soil conductivity and qualitative organic vapor monitor profiling. MIP profiles were collected to: determine the nature and extent of contamination; generate data for use in the risk assessment; provide data for use in evaluation of vapor migration; provide characterization of potential source areas; and to provide lithologic information. Similar to soil vapor and soil sample sampling, MIP sampling was conducted over several events. MIP sampling locations are shown on Figure 3-1 and 3-5. The results of the MIP sampling program are discussed in Sections 4 and 5 of this document. The MIP logs are included on the compact disc which is provided in Appendix A.

Because MIP organic vapor monitor profiling heats the surrounding soil and analyzes the vapors with a PID, FID and/or ECD to measure bulk concentrations of volatile compounds, the qualitative data generated are considered a measure of both soil and soil vapor concentration. Soil and soil vapor samples were collected in adjacent boreholes to determine concentrations of individual VOCs to compare with the MIP organic vapor profiling. Likewise, soil conductivity data required physical soil data to properly assign lithology.

MIP Sampling – January 19, 2004

MIP sampling was originally conducted at three locations to better understand the value and utility of the MIP technology. Three MIP boreholes (GP4-MIP, GP5-MIP, and GP6-MIP) were advanced to 85 feet bgs on January 19, 2004. GP6-MIP was advanced to 83 feet bgs until refusal. The organic vapor profiles were used to select soil sample depths at the adjacent borings GP4, GP5, and GP6. After evaluating the MIP data, it was found that MIP profiles were particularly useful for finding source areas and slight changes in lithology that could be potential contaminant migration pathways.

MIP Sampling – September 26 to 30, 2005

A second round of MIP sampling was conducted at 15 locations based upon the results of the soil vapor survey performed in August 2005. This MIP sampling was performed to define the nature and extent of contamination as well as to identify pathways of migration of contaminants in both the vadose and saturated zones. MIP borings were pushed to 85 feet bgs or until refusal. Specific rationale for MIP sampling locations is presented in the following table.

Table 3-6
MIP1 to MIP15 Sampling Rationale and Locations

MIP ID	Other ID	Total Depth	Rationale
MIP1	B3	80	To target data gap areas, suspected source areas, and define limits of contamination at the former Omega Chemical property.
MIP2	VP-3	86	
MIP3	B2	80	
MIP4		83	
MIP5	VP-9	85	
MIP6		85	
MIP13		83	
MIP14	VP-11	84.5	
MIP15		82	
MIP7		80	To define the presence, geometry, and degree of contamination in the postulated sand channel deposits along this trend. Potential source areas may be "back-tracked" from the downgradient locations.
MIP8	B4	77	
MIP9		80	
MIP10		85	
MIP11		73.1	
MIP12		60	

Refusal due to tight subsurface conditions for the MIP probe occurred at all but four locations. Because the MIP was relatively delicate compared to standard direct push rods and drive points, the probe and rods were damaged at three locations during the first three days of drilling:

- MIP1: The MIP probe and eight feet of drill rod were broken at the threaded joints during withdrawal.
- MIP11: The MIP probe and 48 feet of drill rod were broken during withdrawal. The drill crew was able to remove all but the MIP probe and eight feet of drill rod.
- MIP14: Although the MIP borehole was advanced to the desired depth of 85 feet bgs, the drive/probe head was found to be burned and unusable during removal of the tools.

For the last two days of MIP sampling, activities were halted when low to non-observable penetration rates occurred during hydraulic hammering to prevent additional equipment damage.

MIP Sampling – December 5 to 9, 2005

Eight additional MIP borings were advanced upon evaluation of the previous sampling round. All borings were terminated prior to reaching the desired depth of 85 feet due to tight subsurface conditions. The rationale for sampling is provided in the table below.

Table 3-7
MIP16 to MIP23: Sampling Rationale and Locations

MIP ID	Other ID	Total Depth	Rationale
MIP-16	VP-19	45	Located upgradient of elevated organic compound concentrations in MIP-1 and in VP-01. This boring was intended to define the eastern limit of contamination.
MIP-16A		64	This boring was a replacement for MIP-16, which was only drilled to 45 feet bgs before refusal.
MIP-17		69	Located on adjacent property north of elevated concentrations of Freons detected in soil vapor at VP-1. This boring was intended to assist in source definition to determine if a source is located on the adjacent parcel and to assess extent of contamination to the north of the former Omega Chemical property.
MIP-18	VP-16	68	This boring was located on the downgradient side of the building adjacent and north of the former Omega Chemical property. This boring was intended to assess the northern extent of contamination and to assist in identifying potential non-Omega sources.
MIP-19	VP-17	62	This boring was located near Putnam Street at the projected northern limit of coarse materials in the saturated zone. This boring provided lithologic information to assist in the pathway assessment and determine the extent of vadose and saturated zone contamination.
MIP-20		81	This boring was located downgradient of the suspected source area on the former Omega Chemical property and was intended to assess the presence of coarse material in both the vadose zone and saturated zones that may serve as migration pathway. This assisted in defining the extent of contamination in both vadose and saturated zones.
MIP-21	VP-14 B7	59	This boring was located downgradient of an apparent pathway for contaminant migration above the 30-foot unit that was apparent in MIP-7, MIP-8 and the GP-5 location from 2003. This provided both lithologic characterization of potential pathways in the vadose and saturated zones, and assisted in defining the extent of contamination.
MIP-22	VP-18 B5	63	This boring was intended to define the contaminant extent to the south of the Phase 1a area. This boring provided information on the transition zone to thicker sands in the saturated zone that are observed near Washington Street.
MIP-23		36	This boring was located south of the Skateland building and was intended to assess the southern limit of vadose and saturated zone contamination that was observed at MIP-15.

MIP Sampling – February 27 to June 1, 2006

The final round of MIP sampling was conducted during February to June 2006. Six additional MIP borings were advanced to meet the RI OSS Work Plan Addendum No.2 objectives. The rationale for the sampling locations was the same as shown in Table 3-5, but is reiterated below in Table 3-8. Results of the MIP sampling were used to determine the soil vapor sampling depths for the associated probe. As before, all borings were terminated prior to reaching the desired depth of 85 feet due to tight subsurface conditions.

Table 3-8
MIP25 to MIP30: Sampling Rationale and Locations

Direction	Location ID	Total Depth	Rationale
East	VP-25/MIP-30	56	A MIP boring and soil vapor sampling were requested by DTSC east of the former Omega Chemical property to confirm decreasing contaminant concentrations in this direction.
North	VP-20/MIP-25	53	TVOCs in soil vapor samples increased going from VP-03 to VP-16 in the 47-50 foot depth range (212 to 2,335 mg/m^3). Investigation at this area was intended to determine if the relatively high TVOC concentration seen at the 47 foot depth at VP-16 and the 30-foot unit extend further to the northwest, and to assist in identifying other sources on this property.
West	VP-21/MIP-26/B6 VP-22/MIP-27 VP-23/MIP-28	53 53 53	TVOCs in soil vapor samples from several depths were higher at VP-14 and VP-15 than samples to the east of these locations. These additional sampling locations were intended to look for decreasing contaminant concentrations to the west and southwest of VP-14, 15, 17 and 18.
South	VP-24/MIP-29	60 61	This location was intended to document lower contaminant concentrations to the south of MIP-24 where contamination was indicated in the 30-foot unit. The boring also provided information on the transition zone to thicker sands in the saturated zone that is observed near Washington Street.

3.1.5 Soil Vapor Extraction (SVE) Pilot Testing

Initial SVE Well Installation

Ten soil vapor extraction (SVE-1S through SVE-5S and SVE-1M through SVE-5M) wells were installed at the former Omega Chemical property from September 7 to 11, 2006 in accordance with the USEPA approved *Soil Vapor Extraction Pilot Test Work Plan* (CDM, 2006c). They were installed in the portion of the former Omega Chemical property formerly leased by 3 Kings Construction. This location was chosen because:

- Elevated contaminant concentrations exist at all pertinent vadose sampling depths in the area
- The area was secure by fencing
- The area was large enough to accommodate all equipment and wells without disruption to other business activities.

The SVE wells were installed with a hollow stem auger drilling rig as five pairs, with each pair consisting of a well screened from 12 to 22 feet bgs and from 26 to 36 feet bgs. The SVE wells screened from 12 to 22 feet bgs (SVE-1S through SVE-5S) were installed to target shallow soil vapor above the 30 foot clay layer, while the SVE wells screened from 26 to 36 feet bgs (SVE-1M through SVE-5M) targeted the "30 foot unit."

Because each pair was estimated to have a zone of influence of 30 feet, the pairs were installed approximately 30 feet apart from one another. Locations of the initial SVE wells are shown on Figures 3-1 and 3-6. Drilling procedures are provided in Section 3.3.

Initial SVE Well Testing

The SVE well testing was conducted to provide additional data to select, design, and implement the overall soils remedy at the former Omega Chemical property. The testing was expected to:

- Confirm the feasibility of SVE for Site conditions above the "30 foot unit"
- Confirm the ability of vapor phase granular activated carbon (GAC) to treat extracted vapors to appropriate discharge limits
- Estimate the contaminant mass removal rate in extracted vapors to size and select the treatment systems for potential full-scale system and evaluate air discharge permit issues
- Estimate the achievable SVE treatment zone sizes for the thin sand that is generally present above the 30-foot unit and the shallower interval about this unit to select well spacing and construction
- Provide VOC mass removal data from SVE wells screened in two intervals to help determine the VOC vertical distribution in the shallow vadose zone.

The initial SVE testing consisted of two types of tests: step testing and multi-week pilot testing. The step testing was performed to evaluate the relationship between the applied vacuum at the SVE wells and the resulting vapor flows, and the resulting vacuum distributions in the subsurface around the wells. The multi-week test was conducted to provide design information for potential implementation of the SVE technology once near-equilibration conditions were established. Several weeks of operation were conducted because the vacuum distribution was expected to be slow-developing due to the low permeability soils. The procedures and results of the SVE testing were provided in a separate memorandum to USEPA (Technical Memorandum for Soil Vapor Extraction Pilot Test Initial Findings, CDM, February 5, 2007). The results of the initial SVE pilot testing are presented in Section 4.6.

Additional SVE Well Installations and Expanded SVE Pilot Testing

Expanded pilot testing was recommended in the February 5, 2007 Technical Memorandum. The expanded pilot testing was performed in the Star City Auto Body portion of the former Omega Chemical property according to the methods described in the Revised Second Addendum to February 5, 2007 Technical Memorandum (CDM, April 20, 2007).

Between May 20 and June 10, 2007, three SVE wells (SVE-6S through SVE-8S) and six vapor monitoring probes (VMP-1 through VMP-6) were installed at the former Omega Chemical property. The SVE wells were installed using hollow-stem auger drilling methods, and the VMPs were installed using direct-push drilling methods. Locations of the additional SVE wells and VMPs are illustrated on Figure 3-6.

Expanded pilot testing was performed during the period June 14 through July 20, 2007. The expanded pilot test consisted of three phases of testing, as follows: pneumatic communication testing, step testing, and multi-week extended testing. These tests were conducted to characterize the extent of pneumatic communication through the 30-foot unit and to provide further design information about SVE system operation at near-equilibrium conditions.

Field procedures, field measurement data, analytical results, and findings were presented in the Technical Memorandum Expanded Soil Vapor Extraction Pilot Test Findings (CDM, August 31, 2007). The results of the expanded testing are briefly summarized in Section 4.6 of this document.

3.1.6 Air

Indoor and outdoor ambient air samples were collected to assess potential VOCs in indoor air quality and to provide background VOC concentration data, respectively. Indoor air samples were collected at the following properties: Star City Auto Body, the building formerly occupied by 3 Kings Construction, Terra Pave, Skateland, Medlin (both north and south buildings), LA Carts, Oncology Care Medical Associates (Oncology), and Bishop Company. Because VOCs in indoor air may originate from subsurface contamination or from chemical usage at the particular building, chemical usage surveys were also conducted at several properties, as follows: Star City Auto Body, Skateland, and Terra Pave in 2004; and LA Carts, Oncology, Bishop Company, and Medlin north building in 2006. Two sets of indoor air samples were collected to evaluate the performance of air purifiers installed in the Skateland facility. All air samples were analyzed for volatile organic compounds by method TO-15 and the results are presented in Section 4.

Outdoor locations were collected upwind, between the former Omega Chemical property and the particular building, or at HVAC intakes. The upwind ambient air locations were selected based upon the results of a 12-hour wind survey. Maximum upwind chemical concentrations were subtracted from Omega Chemical data to estimate contributions from the former Omega Chemical property to chemical concentrations in ambient air.

Also included in this section are tasks that were performed to evaluate conditions affecting air quality. Chemical usage surveys and inventories were performed to determine the source of chemicals found in the indoor air quality samples. HVAC systems (where present) were evaluated to determine whether proper ventilation was being provided, and where intakes were located. Building interiors were evaluated

for cracks which are potential pathways for vapor migration. Air purifiers were installed in Skateland to mitigate soil vapor intrusion. SSD testing was performed at Skateland to determine whether SSD was a possible long-term mitigation measure at that facility.

Wind Survey – May 10, 2004

Prior to all indoor or outdoor air sampling, RES Environmental Inc. conducted a 12-hour wind survey from 7 am to 7 pm. The wind speed and wind direction were recorded throughout the testing period, as well as the barometric pressure, temperature, and relative humidity. These data were collected to determine appropriate upwind ambient air sample locations.

Air Sampling – May 11, 2004

The initial indoor locations were selected in occupied areas, distant from chemical storage areas. The locations were chosen with the concurrence of USEPA and an industrial hygienist (CDM, 2003a). Ten indoor air and five outdoor ambient air samples were collected on May 11, 2004:

Table 3-9
Indoor Air Sampling Locations – May 11, 2004

Building	Address	Location
Star City Auto Body	12504 Whittier Blvd	1) Main work area 2) Rear area of the shop
Former 3 Kings Construction	12512 Whittier Blvd	1) Interior office area 2) Storage and work area
Skateland	12520 Whittier Boulevard	1) Skate rental counter (by the window) 2) Center of skating rink
Medlin & Son South Building (former Cal-Air)	12484 Whittier Boulevard	1) Front office area 2) Production area
Terra Pave	12511 East Putnam Street	1) First floor office area 2) Second floor office area

Table 3-10
Outdoor Ambient Air Sampling Locations – May 11, 2004

Type	Description
Former Omega Chemical property	Between Star City Auto Body and Medlin & Son South Building (former Cal-Air)
Former Omega Chemical property	Between Star City Auto Body and former 3 Kings Construction
Upwind	Rippy Parking Lot
Upwind	Former Merchant Metals Parking Lot
Roof Intake	Medlin & Son South Building HVAC intake

Chemical Usage Survey – May 28, 2004

A chemical usage survey was performed at neighboring Skateland (12520 Whittier Boulevard) and at Star City Auto Body (12504 Whittier Boulevard) on May 28, 2004 to evaluate the possible sources of indoor air contaminants.

Skateland HVAC Survey – July 2004

CDM conducted an HVAC survey at neighboring Skateland (12520 Whittier Boulevard) to determine whether it was providing adequate ventilation. Adequate ventilation and intake location is a major factor in indoor air quality.

Skateland Air Sampling – August 4, 2004

An additional indoor air sampling event was conducted at the neighboring Skateland facility to determine whether increasing outside ventilation and reducing chemical usage would sufficiently lower indoor air contaminant concentrations (CDM, 2004a). Seven samples were collected from the: 1) kitchen; 2) skate rental counter (by the window); 3) boys' restroom; 4) office; 5) dance floor; 6) center of rink; and 7) a rear interior corner by the storage room. Two outdoor air samples were collected by the front door and adjacent to the sewer manhole. The manhole sample location was selected where a recent repair was made to the connection between the facility's sewer line and the city's collection line.

Terra Pave Chemical Use Survey – November 9, 2004

A chemical use survey was conducted at neighboring Terra Pave (12511 East Putnam Street) to evaluate possible sources of indoor air contaminants.

Skateland Air Purifier Installation and Testing – December 2004 and January 2005

Three air purifiers were installed at three locations inside the neighboring Skateland building: at the boys' restroom, the girls' restroom, and the kitchen. The objective of the air purifier installation was to inhibit migration of soil vapor VOCs into the Skateland facility (CDM, 2004b). It was proposed that the soil vapors were preferentially migrating along utility corridors.

Indoor air quality testing was performed to evaluate the effectiveness of the air purifiers. Samples were collected prior to purifier startup (December 30, 2004) and after approximately two weeks of operation on January 2005. Samples were collected at four locations: the girls' restroom, the boys' restroom, the kitchen, and the center of the skating rink.

Air Sampling – September 14, 2005

Re-sampling of the indoor air at the buildings was performed again in September 2005 (CDM, 2005d). The following 12 indoor air and two ambient air samples were collected:

Table 3-11
Indoor Air Sampling Locations – September 14, 2005

Building	Address	Location
Star City Auto Body	12504 Whittier Blvd	1) Main work area 2) Rear area of the shop
Former 3 Kings Construction	12512 Whittier Blvd	1) Interior office area 2) Storage and work area
Skateland	12520 Whittier Boulevard	1) Kitchen 2) Center of skating rink 3) Girls' Restroom 4) Boys' Restroom
Medlin & Son South Building (former Cal-Air)	12484 Whittier Boulevard	1) Front office area 2) Production area
Terra Pave	12511 East Putnam Street	1) First floor office area 2) Second floor office area

Table 3-12
Outdoor Ambient Air Sampling Locations – September 14, 2005

Type	Description
Former Omega Chemical property	Between Star City Auto Body and Medlin & Son South Building (former Cal-Air)
Upwind	Rippy Parking Lot

SSD Investigation and Testing

SSD testing was a proposed mitigation measure for reducing indoor air contamination at the neighboring Skateland facility. SSD is typically utilized to reduce the pressure of sub-slab materials and extracting sub-slab vapors before they enter the building. The system typically consists of a blower or fan connecting one or more pipes within the sub-slab materials. The extracted vapors are either vented directly or treated prior to atmospheric discharge. Typically petroleum hydrocarbons and chlorinated solvents are treated with granular activated carbon. The objectives of the SSD investigation and testing were to evaluate the feasibility of applying SSD at Skateland. Specifically, the objectives were to:

- Evaluate the permeability of sub-slab materials
- Estimate the VOC concentrations in sub-slab vapors to determine the need for vapor treatment and provide a basis for selecting a treatment type if needed
- Determine the vapor extraction rate that can be achieved from the sub-slab at various levels of vacuum
- Estimate the vacuum distribution that is established around a suction point to help determine spacing between extraction points.

The feasibility of applying SSD was determined by applying three general criteria: effectiveness, implementability, and cost. For effectiveness, the ultimate objective of the SSD system was to reduce indoor air contaminant concentrations. The objective is met to the degree that the system can remove contaminants from the majority of sub-slab materials. SSD was considered feasible with regard to effectiveness and implementability if a measurable vacuum (less than or equal to 0.001 inch of water) was produced at all pressure measuring holes that were 15 feet from the suction holes and completed in the sub-slab materials, and if this condition can be met with reasonably sized equipment. If this condition cannot be met, the sub-slab materials were considered too low in permeability for practical implementation of SSD. If a high permeability layer was not present, SSD may be implementable in the sub-slab native soils if the same condition above were met.

HVAC Evaluation and Chemical Usage Survey – June 19, 2006

A building HVAC evaluation and chemical usage survey were performed on June 19, 2006 at the following nearby locations:

- Oncology Care Medical Associates (12535 East Washington Boulevard)
- Bishop Company (12519 East Putnam Street)
- LA Carts Manufacturing (12549 East Washington Boulevard)
- Medlin & Son North Building (12476 East Whittier Boulevard)

These surveys were performed to analyze factors that may influence indoor air quality. The chemical usage survey was performed to evaluate possible sources of indoor air contaminants, while the HVAC evaluation was performed to analyze the ventilation adequacy at each facility. Buildings were also evaluated for floor cracks and other potential pathways for soil vapor migration. Building layouts and facility usage were evaluated to select locations for future indoor air monitoring.

The results and rationale for proposed indoor air quality sampling locations were submitted to USEPA in a HVAC Evaluation and Chemical Use Inventory Results and Proposed Indoor Air Quality Sampling Locations Technical Memorandum (CDM, July 18, 2006).

Air Sampling – September 8, 2006

Following the completion of the June 2006 HVAC and chemical usage survey, additional air sampling was performed on September 8, 2006 at four properties near the former Omega Chemical property. A total of 11 samples were collected (nine indoor air and two ambient air).

Table 3-13
Indoor Air Sampling Locations – September 9, 2006

Building	Address	Location
Bishop Company	12535 E. Washington Blvd.	1) Administration Office 2) Interior Store 3) Warehouse
LA Carts	12549 E. Washington Blvd.	1) Administration Office 2) Large Production Room 3) Small Production Room
Medlin & Son North Building	12476 E. Whittier Blvd.	1) Building Interior
Oncology Care Medical Associates	12535 E. Washington Blvd.	1) Administration office 2) Nurses Station

Table 3-14
Outdoor Ambient Air Sampling Locations – September 9, 2006

Type	Description
Exterior	Exterior fence in rear of Bishop property
Rooftop	Oncology Care facility rooftop by intake vent

3.1.7 Groundwater

Although this RI report focuses upon soil, soil vapor, and air sampling results, groundwater results will be presented to support the Site Conceptual Model. Periodic groundwater sampling has been implemented at the Omega wells since May 2001. Quarterly sampling was conducted during May 2001, August 2001, November 2001, and February 2002. The wells have been sampled semi-annually during February and August of each year beginning in 2002. The most recent sampling event was conducted during February 2007. The purpose of the groundwater sampling was to assist in the selection, design, and implementation of the groundwater remedy in the Phase 1a area, and to support the development of the Site Conceptual Model. Well locations are shown on Figures 3-1 and 3-7.

3.2 Pre-Field Activities

This section describes activities that were completed prior to commencement of field activities. This section also describes demobilization activities that will take place following completion of field activities.

3.2.1 Subcontracting/Procurement

Several activities were performed by subcontractors under the direction or supervision of CDM. The following subcontractors provided services for this RI:

Drilling and Sampling

- Vironex, Inc.: Direct push drilling for soil borings, soil vapor installations, and MIP sampling. Based in Santa Ana, California.
- BC2 Environmental: Hollow stem auger drilling services for SVE well installation. Based in Fullerton, California.
- Blaine Tech Services: Groundwater sampling. Based in Carson, California.

Analytical Laboratories

- Test America (formerly known as Del Mar Analytical): Fixed-based laboratory for soil VOC, 1,4-dioxane, petroleum and metals analytical services. Located in Irvine, California.
- PTS Laboratories: Conducted soil testing for physical parameters. Located in Santa Fe Springs, California.
- Air Toxics Limited: Fixed-based laboratory for air VOC analytical services. Located in Folsom, California.
- B. C. Laboratories: Fixed-based laboratory for surface soil pesticide, PCB, SVOC, metals analytical services. Located in Bakersfield, California.
- Calscience Environmental Laboratories: Fixed-based laboratory for air and soil VOC analytical services. Located in Garden Grove, California.
- Sunstar Laboratories: Fixed-based laboratory for sub-slab depressurization testing VOC analytical services. Located in Tustin, California.

Other

- RES Environmental: Provided Site-specific meteorological services. Located in Colton, California.
- Kerntec Environmental: Provided preliminary building assessment and chemical inventories. Based in Bakersfield, California.

Equipment procurement included procurement of SVE testing materials, disposable sampling equipment and other equipment as required. Health and safety equipment included personal protective equipment (PPE), such as gloves, etc. Miscellaneous equipment such as construction tools, polyethylene liners, etc. were procured on an as-needed basis.

3.2.2 Mobilization/Demobilization

All equipment was delivered to the Site in a clean condition. Mobilization activities included procuring and moving sampling equipment and materials to the Site, as well as health and safety awareness training and Site orientation of field personnel.

Mobilization involved the establishment of a suitable staging area to support the project activities. The staging area included an equipment storage area and general support area. The staging area was located in an area determined by the property owner.

3.2.3 Utility Clearances

For all activities involving digging or drilling, locations were checked for subsurface utilities prior to work. The proposed subsurface sampling locations were outlined in white spray paint and Underground Service Alert was notified at least 48 hours prior to work. If underground utilities were present, any proposed subsurface sampling locations in question were moved to avoid the utility. Borings conducted with a hollow stem auger (diameter of eight inches or greater) were hand augered or evacuated with an air-knife rig prior to drilling to check for utilities.

Prior to the utility corridor soil vapor sampling conducted in November 2004, CDM obtained the approximate location of utilities from the City of Whittier. The borings were hand augered into the materials surrounding the utilities to analyze organic vapors. Direct push drilling was conducted into the utility corridor to install temporary soil vapor probes.

3.2.4 MIP

Response testing was conducted as part of the MIP logging process to monitor the performance of the MIP system and measure trip time. The trip time is the time a contaminant infiltrates the probe, through the trunk line, and into the detectors. The trip time tests are conducted at the beginning of the day, between borings, and at the end of the day. Trip times vary due to weather temperatures and the length of the trunk line. The response test was conducted according to the Geoprobe SOP, technical bulletin MK3010 dated May 2003.

3.3 Field Procedures

This section describes the methods used to collect samples and construct wells. All field work was performed under the supervision of a California Professional Geologist. All maintenance and calibration operations were documented in the field logbook or field data sheets. Prior to use, all field equipment was checked and calibrated to verify that it was in good working order. The calibration, maintenance, and operating procedures for all instruments were based upon manufacturer's instructions and common industry practice.

3.3.1 Pre-Drilling

In addition to the utility clearance tasks performed prior to drilling (Section 3.3.3) most borings located on concrete were cored or saw-cut. To prevent accidental damage to subsurface utilities, all borings were initially advanced with a hand auger or air vacuum rig. Small diameter borings made by the direct push drilling rig were initially advanced using a hand auger. Larger diameter borings for hollow stem auger

drilling were cleared with an air vacuum rig or by hand auger to the desired diameter down to five feet bgs.

3.3.2 Hand Auger

In addition to using the hand auger for pre-drilling activities, the hand auger was used to collect surface soil samples in April 2004 (Section 3.1.1) and advance the initial soil vapor probes for utility corridor sampling in November 2004 (Section 3.1.3).

For surface soil sampling, the hand auger was decontaminated using the triple-rinse method at the beginning of the day, between each sample, and at the end of the day. Each boring was initially cored by Penhall. Attempts at using a core barrel sampler with stainless steel sleeves and a slide hammer were unsuccessful due to the compaction of the soils. Therefore, the core barrel sampler was replaced with a traditional hand auger to sample surface soils. The freshly decontaminated hand auger was used to advance the boring, and new disposable gloves were used to transfer the soil cuttings to stainless steel sleeves. The sample-filled sleeves were sealed on each end with Teflon® sheets and plastic end caps.

For advancing soil vapor probes near utility corridors, the hand auger was advanced to the approximate middle of the backfill materials surrounding the pipelines. A soil vapor probe with a six-inch perforated zone was installed in the borehole. The pump within a PID was used to evacuate the tubing and bring soil vapor to the instrument, and the maximum PID reading was recorded. The field screening results were used to determine the locations for collecting soil vapor samples for laboratory analysis. A second boring was advanced adjacent to the original boring with the hand auger, and the tubing driven in the same manner as above. Summa canisters were connected directly to the end of the tubing, and vacuum from the Summa canisters was used to collect the samples.

3.3.3 Direct Push Drilling

Vironex, Inc. of Santa Ana provided direct push drilling for subsurface soil, MIP, and soil vapor sampling. Direct push drilling consists of a conical drive point and drilling rods that are pushed into the ground, displacing soils around it. The weight of the direct push drilling rig and the force of the hydraulic hammer are used to advance the drill string. The weight of the drilling rig is applied first, while the hydraulic hammer is applied only when additional force is required. Drill cuttings are not produced during direct push drilling except when soil samples are collected. Boreholes produced using direct push drilling are typically less than two inches in diameter.

Subsurface Soil Sampling

For subsurface soil sampling, the tool chain consists of a retractable drive point, a hollow sample barrel fitted with a new cutting shoe on the advancing end, a new disposable plastic liner within the barrel, hollow drilling rods threaded to the top of the barrel, and inner steel rods that hold the retractable drive point in place. The drive point covers the bottom opening of the sample barrel to displace soils and prevent

them from entering the sampler. When a soil core is desired, the operator adds a hollow drilling rod without adding the internal steel rod, allowing the drive point to retract. The hollow outer drilling rods and sample barrel are pushed into the soil while the inner retractable drive point and steel rods remain in place. Undisturbed soil enters the hollow sample barrel and fills the plastic liner. The cutting shoe acts as a one-way valve to prevent soil from exiting the now-filled sample barrel. Both drill strings are removed to retrieve the soil cores. When drilling to the next sampling depth, the drive point displaces any slough in the borehole. All soil borings conducted for the RI (GP-1 through GP-8 and borings B1 through B7 near MIP and VP locations) were sampled continuously. Samples to be submitted for laboratory analysis were sub-sampled for VOC preservation. The remaining core was trimmed with a freshly decontaminated hand saw, and the sleeves were sealed on each end with Teflon® sheets and plastic end caps.

MIP Sampling

For MIP sampling, the drill string consisted of drilling rods and a MIP probe that has a conical tip with a soil conductivity probe to displace soils and measure soil conductivity in microSiemens per meter. The probe heats the surrounding soils up to 120 degrees Celsius to volatilize organic compounds. The volatilized compounds diffuse across a membrane located within the probe. A closed inert gas loop carries these organic vapors to a series of detectors housed at the surface. For this investigation, the detectors consisted of a PID, an FID, and an ECD. The PID generally detected double-bonded compounds from 1 to 20,000 ppm, the ECD detected halogenated compounds from 0.25 to 10 ppm, and the FID detected combustible hydrocarbons from 1 to 100,000 ppm. Because the rate of volatilization was dependent upon soil temperature, attempts are made to advance the MIP probe at a uniform rate so that the soil would heat uniformly. Spikes in bulk VOC concentrations were observed at pauses in drilling, such as when drill rods were being added to the drill string.

Soil Vapor Sampling

For soil vapor sampling, the drill string consisted of a 1.75-inch diameter drive head with an expandable point and point holder, and drilling rods. The expendable point is placed within the point holder and attached to the drive rod. The system is pushed to the total depth and the rods are retracted, leaving the expendable point at total depth and creating a void between the probe tip and drilling rods. The soil vapor probe is installed down the center of the drive rods. For shallow boreholes with cohesive subsurface materials, the driller may choose to drill with a reusable probe tip and remove the entire drill assembly before installing the soil vapor probe in the uncased borehole.

Soil vapor probes were installed using the direct push rig. The soil vapor probes were 1/4-inch diameter Teflon tubing extending from the surface to the desired sampling depth. Permeable sand pack (Lapis Lustre Medium Monterey Sand) was placed approximately one foot below the sampling interval. The bottom six inches of Teflon tubing was perforated and installed through 3/4-inch diameter PVC pipe that was

temporarily placed to guide the tubing to the desired depth. After the tubing was installed to the desired depth and the temporary PVC pipe removed, approximately one foot of sand pack was installed into the borehole to surround the perforated tubing and extend the length of the permeable zone. Up to four sampling intervals were installed within each borehole, with hydrated bentonite crumbles emplaced between sampling intervals to isolate the sampling zones. The bentonite seal was extended from the uppermost sampling interval to approximately 0.5 feet bgs. When more than four sampling intervals were required at any location, additional boreholes were drilled approximately one foot from the original vapor location. The upper end of the soil vapor probe was sealed with a rubber stopper and/or a 1/4-inch diameter steel bolt.

Soil vapor sampling was conducted in accordance with the procedures outlined in the DTSC/Los Angeles Regional Water Quality Control Board Guidance (DTSC and LAWRCB, 2003). One-liter summa canisters were used to collect all soil vapor samples. A flow regulator was placed between the probe and the canister to ensure that the canister was filled at the appropriate flow rate of 200 milliliters per minute (ml/min). Following collection, Summa canisters were labeled with a laboratory-provided sample tag, and shipped to the analytical laboratory with a completed chain-of-custody form.

After soil vapor probes were sampled, the soil vapor probes were abandoned by removal. The Teflon tubing was pulled and cut so that the tubing remained several inches below ground surface. The top six inches of the borehole were finished to match the surrounding ground surface.

3.3.4 Hollow Stem Auger Drilling

BC2 Environmental of Fullerton, California provided hollow stem auger drilling services to drill and install soil vapor extraction wells. The hollow-stem auger rig is a hydraulically powered drill rig that simultaneously rotates and axially advances the hollow-stem augers. Ten-inch outer diameter augers were utilized for drilling and installing the wells. The initial SVE wells consisted of five pairs (ten total) consisting of 22-foot and 36-foot deep well clusters. Boreholes for the initial 10 wells (SVE-1S through SVE-5S and SVE-1M through SVE-5M) were drilled to approximately 23 and 36.5 feet bgs, respectively. Six additional SVE wells (SVE-6S through SVE-8S) for expanded SVE pilot testing were also installed to a depth of 30 feet using the same drilling methods. Soil samples were collected at the 36.5-foot borings only. The 23-foot deep borings were drilled with ten-inch augers fitted with a wooden reaming plug, which was knocked out with a 140-pound hammer prior to installing the well.

Soil samples were collected continuously to collect lithologic information at the 36-foot deep borings. A modified California split-spoon sampler was advanced to the desired depth into the native formation by using a 140-pound hammer with a 30-inch drop. The driller maintained a "blow count" by counting the number of hammer blows to drive the sampler six inches. Three samplers were utilized for every five feet of drilling: two 18-inch long samplers and one 24-inch long sampler.

To acquire a qualitative measurement of organic vapor concentrations, soil in the sampling shoe was placed into a resealable plastic bag labeled with the depth interval. The bagged soil was placed in the sun to warm for at least five minutes to encourage volatility. The bag headspace was screened with a handheld PID by inserting the probe tip fitted with a water vapor filter into the bag. The bag was opened a minimal amount to minimize the loss of volatiles.

The soil core inside the split spoon sampler was placed upon plastic sheeting and immediately screened with a PID. Areas of the core with higher PID readings were removed and placed in a resealable plastic bag for headspace screening. The core was observed for sample recovery and lithology. The on-site geologist maintained a boring log with the following information: blow count, PID headspace screening, sample recovery, Unified Soil Classification System (USCS) to describe soil lithologies, soil type designations, and soil descriptions. Driller's observations such as rocky conditions or slow penetration rates were also recorded.

Upon reaching total depth, four-inch diameter schedule 40 PVC blank casing, ten-foot length 0.020-inch perforated PVC screen, and a 0.25-foot PVC end cap was installed through the hollow augers. The gravel pack (No. 3 Monterey sand) was tremmied through the hollow augers from the total depth of the borehole to approximately two feet above the top of the perforated zone. The bentonite seal (hydrated medium bentonite chips) were installed in the annulus by tremmie with a minimum thickness of 2.5 feet. The augers were withdrawn entirely from the borehole after installing the bentonite seal. The remaining annulus as backfilled with neat Portland cement with five percent powdered bentonite. The wellhead was completed with an 18-inch diameter traffic rated flush-grade well box. The following table shows the vapor extraction well construction details.

Table 3-15
Soil Vapor Extraction Well Construction Details

Well	Date Drilled	Total Depth (ft bgs)	Screen (ft bgs)	Gravel Pack (ft bgs)	Bentonite Seal (ft bgs)
SVE-1S	7 Sep 2006	23	12.5-22.5	10-23	7-10
SVE-1M	8 Sep 2006	36.5	26-36	24-36.5	21-24
SVE-2S	8 Sep 2006	23	12-22	10-23	7-10
SVE-2M	11 Sep 2006	36.5	26-36	23.9-36.5	21-23.9
SVE-3S	7 Sep 2006	23	12.5-22.5	9.8-23	6.8-9.8
SVE-3M	7 Sep 2006	36.5	26-36	24-36.5	20.9-24
SVE-4S	8 Sep 2006	22.5	12-22	9.5-22.5	7-9.5
SVE-4M	8 Sep 2006	36.5	26-36	23.9-36.5	20.5-23.9
SVE-5S	11 Sep 2006	23	12-22	9.9-23	7-9.9
SVE-5M	11 Sep 2006	36.5	26-36	24-36.5	20.5-24
SVE-6S	20 May 2007	30	10-30	7-30	0.5-7
SVE-7S	20 May 2007	30	10-30	7-30	0.5-7
SVE-8S	20 May 2007	30	10-30	7-30	0.5-7

3.3.5 Air Sampling

Indoor air sampling was conducted in accordance with standard U.S. Environmental Protection Agency (USEPA) methods of collection. Indoor and ambient air samples were collected in six-liter, stainless steel Summa canisters under vacuum (approximately 29 inches of mercury). These larger canisters allow lower detection limits for VOCs of interest. At each sampling location, canisters were placed approximately three to five feet above ground or floor surface, to approximate breathing height. The canisters were provided pre-cleaned by Air Toxics LTD laboratory (Air Toxics) located in Folsom, California. Each Summa canister was fitted with a critical-orifice air flow controller that was set and calibrated by Air Toxics for a sampling duration of eight hours.

Following collection, Summa canisters were labeled with a laboratory-provided sample tag, and shipped within 24 hours to the analytical laboratory with a completed chain-of-custody form. All air samples were analyzed by Air Toxics for VOCs using USEPA Method TO-15 SIM analysis.

In conjunction with indoor air sampling, chemical use surveys and an evaluation of HVAC systems and operation was performed at the following properties:

3.3.6 Sample Handling

Labeling

Each collected sample and field QC sample, including duplicates or decontamination rinseate blanks, had a completely filled-in sample label securely attached to it. The label was completely filled in prior to filling the sample container. All field QC samples were shipped "blind" (i.e., the sample is not identified as a QC sample) to the laboratory, but were assigned a unique identification code, discussed below, to facilitate identification of the laboratory results. Labels included the project code number, the location of the sampling site, the type of sample and analysis required, the preservative used, and the time of sampling.

A unique sample identification code was given to each sample for this investigation. At a minimum, the sample was identified by its location name. At borings where multiple depths of samples were collected, the sample was also identified by the sampling depth. Identification codes for many samples also contained a site identifier ("OC" for Omega Chemical), a media identifier such as "SG" for soil gas or "AA" for ambient air, and the sample date.

Packing and Shipment

All filled sample containers were labeled, packed and shipped in accordance with Department of Transportation (DOT) regulations, which included documentation requirements. Filled sample containers had completely filled-out labels and were placed in resealable plastic bags, if appropriate. A chain-of-custody record

accompanied each shipment. All samples were transported by CDM personnel or laboratory courier to the laboratory generally within 24 hours from the time of sample collection.

3.3.7 Equipment Decontamination

Equipment decontamination was conducted for all soil sampling activities and for hollow stem auger drilling. Decontamination occurred before first use and between samples. During soil sample collection, hand augers and direct push sample barrels were decontaminated using the "triple rinse" method. A decontamination station was established with three five-gallon buckets containing a) potable water with laboratory-grade detergent b) potable water, and c) potable water or distilled water. The tools were rinsed and scrubbed at each rinse bucket. For hollow stem auger drilling, the augers and drill bit were cleaned in a decontamination trailer with a pressure washer. All liquids generated from decontamination procedures were contained at the former Omega Chemical property in 55-gallon drums.

3.3.8 Investigation-Derived Waste

Investigation-derived waste (IDW) generated during field activities generally included drill cuttings, decontamination fluids, and solid debris. Soil cuttings were generated from soil sampling and from installing the SVE wells. Soil sample cuttings from direct push drilling were placed in 55-gallon drums, while drill cuttings from SVE well installation were placed in a plastic-lined roll-off bin. All drums were stored at the former Omega Chemical property. Decontamination fluids generated during drilling and sampling activities were stored in 55-gallon drums.

All drums were labeled with a pre-printed, unclassified materials label. The label states that the unclassified materials are being temporarily held pending evaluation of laboratory analyses. The label also notes the Site name, date, type of materials stored, and origin of materials stored.

If the cuttings were considered hazardous, they were transported to approved disposal facilities for treatment and/or disposal accompanied by hazardous waste manifests. If the cuttings were determined to be nonhazardous, they were transported to an approved location for non-hazardous materials.

Used PPE including gloves, Tyvek suits, respirator cartridges, and disposable filters, and other miscellaneous items were double-bagged using plastic trash bags and then disposed as solid waste. Items such as empty cement bags and wrapping materials were placed directly into solid waste dumpsters.

3.3.9 Documentation

Chain-of-Custody

The purpose of chain-of-custody procedures was to document the sample identity and identify who has handled the sample. Custody records trace a sample from its collection through all transfers of custody until it is transferred to the analytical

laboratory. Custody records were used for the samples collected during the field investigation.

Field Custody

CDM field personnel had overall responsibility for sample custody and for field document control during the field investigation. A sample is under custody if one or more of the following criteria are met:

- The sample is in the custodian's (sampler, lab personnel, etc.) possession
- It is in the custodian's view after being in possession
- It was in the custodian's possession and was locked up to prevent tampering
- It is in a designated secure area

Multi-part carbonless copy chains-of-custody were used. A chain-of-custody was filled to accompany each sample shipment from the field to the laboratory. The original custody record traveled with the samples, showing each person who had received and relinquished custody.

Chains-of-custody generally contained the following information:

- The sampler and the responsible project manager: the sampler's name, project manager's name, company name, company address, contact information, and billing information
- The project description: the project name and identification code
- Sample descriptions: sample identification code, sample matrix, date and time of sample collection, number of containers, sample preservatives, and the laboratory analyses requested.
- The turn-around-time for laboratory analysis.
- Signatures of all personnel receiving and relinquishing custody.

The date/time were the same for the signatures relinquishing and receiving custody since custody must be transferred to another person. An exception is when samples are shipped by common carrier such as Federal Express. Sample handling can be tracked by the Federal Express tracking number in this case.

Laboratory Custody Procedures

Custody procedures that were followed by the analytical laboratory are outlined below:

- Upon receipt at the laboratory, each sample shipment was inspected to assess the condition of the shipping container and the individual samples, and the condition or integrity of a received shipment of samples was documented at the time of receipt by the laboratory.

- Enclosed chains-of-custody were cross-referenced with all the samples in the shipment; these records were signed by the sample custodian and placed in the project file. The laboratory sample custodian assigned a unique laboratory number to each sample on receipt identifying the sample through all further handling.

Field Logbooks

Field logbooks were used to record and document all activities at the Site. Entries were made in pen. Field logbooks were bound. The cover of each logbook contained the project name and start date. The inner cover contained contact information for the person responsible for the book. The date and time, sample location, personnel present, events, equipment, instrument calibration, sample methods, and observations were types of items recorded in the logbook. The person making entries signed the bottom of every page.

3.4 Sample Analysis

This section describes analytical methods, sample containers and preservative requirements, and field and laboratory QC samples.

3.4.1 Analytical Methods and Detection Limits

Several laboratories provided analytical services for the RI including Del Mar Analytical (chemical soil testing), B.C. Laboratories (chemical soil testing), PTS Laboratories (physical soil testing), Air Toxics Limited (soil vapor and air VOC testing), and Calscience Environmental Laboratories (chemical soil and soil vapor testing).

All method-specific quality control measures, such as external and internal standard calibration procedures, instrument performance verifications, quantitation using method of standard additions, etc., which are suggested within any referenced method, were performed.

VOCs were analyzed using gas chromatograph/mass spectrometry (GC/MS) methods: USEPA Method 8260 for soil samples and TO-15 SIM for air and soil vapor. Soil samples for VOC analysis were collected using the Encore® sampler. Sample preparation for soil samples was in accordance with USEPA Extraction Method 5035.

Other analyses conducted were metals, semi-volatile organic compounds, pesticides, and PCBs. With the exception of arsenic and mercury, metals in soil were analyzed using USEPA Method 6010B. Arsenic was analyzed using USEPA Method 6020 and mercury was analyzed using USEPA Method 7471A. Semi-volatile organic

compounds were analyzed using USEPA Method 8270C. Pesticides were analyzed using USEPA Method 8081A and USEPA Method 8082 were used to analyze PCBs.

Specified soil samples will also be analyzed for physical characteristics, consisting of redox potential, clay content, organic carbon content, cation exchange capacity, moisture content, and hydraulic conductivity. The analytical methods for these are listed below:

- Redox potential: Standard Method 2580B
- Clay content: ASTM Method D-422 or D4464
- Organic carbon content: SW-846 Method 9060 Mod
- Cation exchange capacity: SW-846 Method 9081
- Moisture content (percent dry weight): ASTM D2216
- Hydraulic Conductivity: ASTM Method D5084

3.4.2 Field Quality Control Samples

Field quality control samples are collected and analyzed to evaluate the quality of the field sampling process. The quality control samples that were used during the field program included duplicate samples, trip blanks, and equipment (decontamination rinsate) blanks. Field sampling quality control procedures are discussed in the following sections. All field QC check samples were submitted "blind" to the laboratory. The laboratory may not use field blanks for duplicate analyses or for matrix spiking. Because all field blanks were submitted "blind", it must be specified to the laboratory which particular field sample(s) are to be used for duplicate and matrix spike analyses.

3.4.2.1 Field Duplicates

Field duplicates were collected to examine laboratory precision. Co-located soil samples were collected by submitting an adjacent portion of the soil core to the original soil sample. Soil vapor duplicate samples were collected sequentially. Ambient and indoor air samples were collected with Summa canisters either with a flow connector or with the canisters side-by-side. All duplicate samples were preserved, packaged, sealed, and analyzed in an identical manner to the original samples. All were given differing names from the original sample so that they were submitted "blind" to the laboratory. Duplicates were collected at the following frequencies for the different sampling events:

- Surface soil samples collected April 6 to 7, 2004: Two duplicates were collected for 20 unique samples.
- Subsurface soil samples collected from October 27 to 28, 2003 (borings GP-1 to GP-3): One duplicate was collected for 14 unique chemical analysis samples.

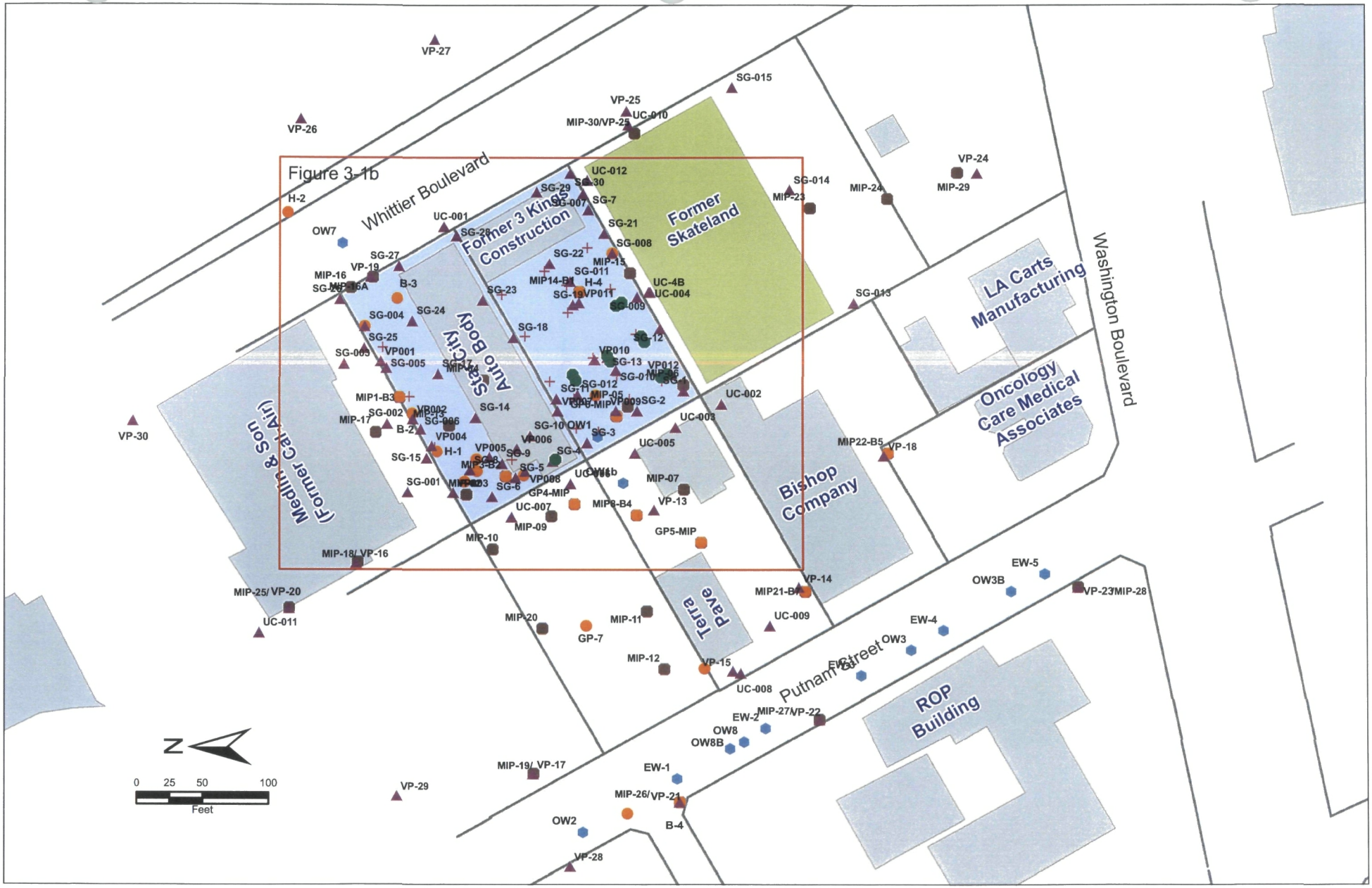
- Subsurface soil samples collected from January 20 to 22, 2004 (borings GP-4 to GP-8): no duplicate samples were collected for the 18 unique chemical analysis samples. These soil sample results were used as a comparison to the MIP logs for borings GP-4 to GP-6.
- Subsurface soil samples collected on April 13, 2004: Only two unique samples were collected for physical parameters only. Therefore, no duplicates were required to be collected.
- Subsurface soil samples collected December 2005 and March 2006 (borings B1 through B7): Four duplicates were collected for 39 unique samples.
- Soil vapor survey from April 12 to 3, 2004 (vapor points SG-01 to SG-12): Seven duplicates were collected for 24 unique samples.
- Soil vapor survey from November 9 to 12, 2004 (vapor points SG-07 to SG-15, and UC-1 to UC-12): Three duplicates were collected for 28 unique samples.
- Soil vapor survey from August 15 to 22, 2005 (vapor points VP-01 to VP-12): Ten duplicates were collected for 87 unique samples.
- Soil vapor survey from December 12 to 15, 2005 (vapor points VP-13 to VP-19): Five duplicates were collected for 42 unique samples.
- Soil vapor survey from March 6 to 9, 2006 and May 31, 2006 (vapor points VP-20 to VP-30): Four duplicates were collected for 41 unique samples.
- Indoor air and outdoor ambient air sampling on May 11, 2004: two duplicates were collected for 15 unique samples.
- Skateland air sampling on August 4, 2004: One duplicate was collected for nine unique samples.
- Skateland air purifier installation and testing, December 2004 and January 2005: one duplicate sample was collected for each testing event, which consisted of four unique samples.
- Air sampling, September 14, 2005: Two duplicates were collected for 14 unique samples.

3.4.2.2 Equipment Blanks

Equipment blanks (i.e., equipment rinsate samples) consisted of the final rinse water from decontamination of equipment. The blank is prepared in the field by pouring the appropriate "blank" water through the sampling equipment and into the appropriate sample containers after equipment decontamination. For blanks targeted for VOC analyses, organic-free water was used as the "blank" water; whereas, deionized/distilled water was used for the collection of blanks targeted for inorganic

analyses. The equipment blank serves as a check to verify the effectiveness of decontamination procedures.

Equipment blanks were performed on all days when soil samples were collected. They were analyzed for the chemicals of concern that were analyzed for other samples collected during the day. Exceptions include the subsurface sampling performed on April 13, 2004, when two subsurface samples were collected for physical parameters only. Because the samples were not analyzed for chemicals of concern, no equipment blank was taken. An equipment blank was also not collected on March 7, 2006 when several soil samples were collected.



Legend

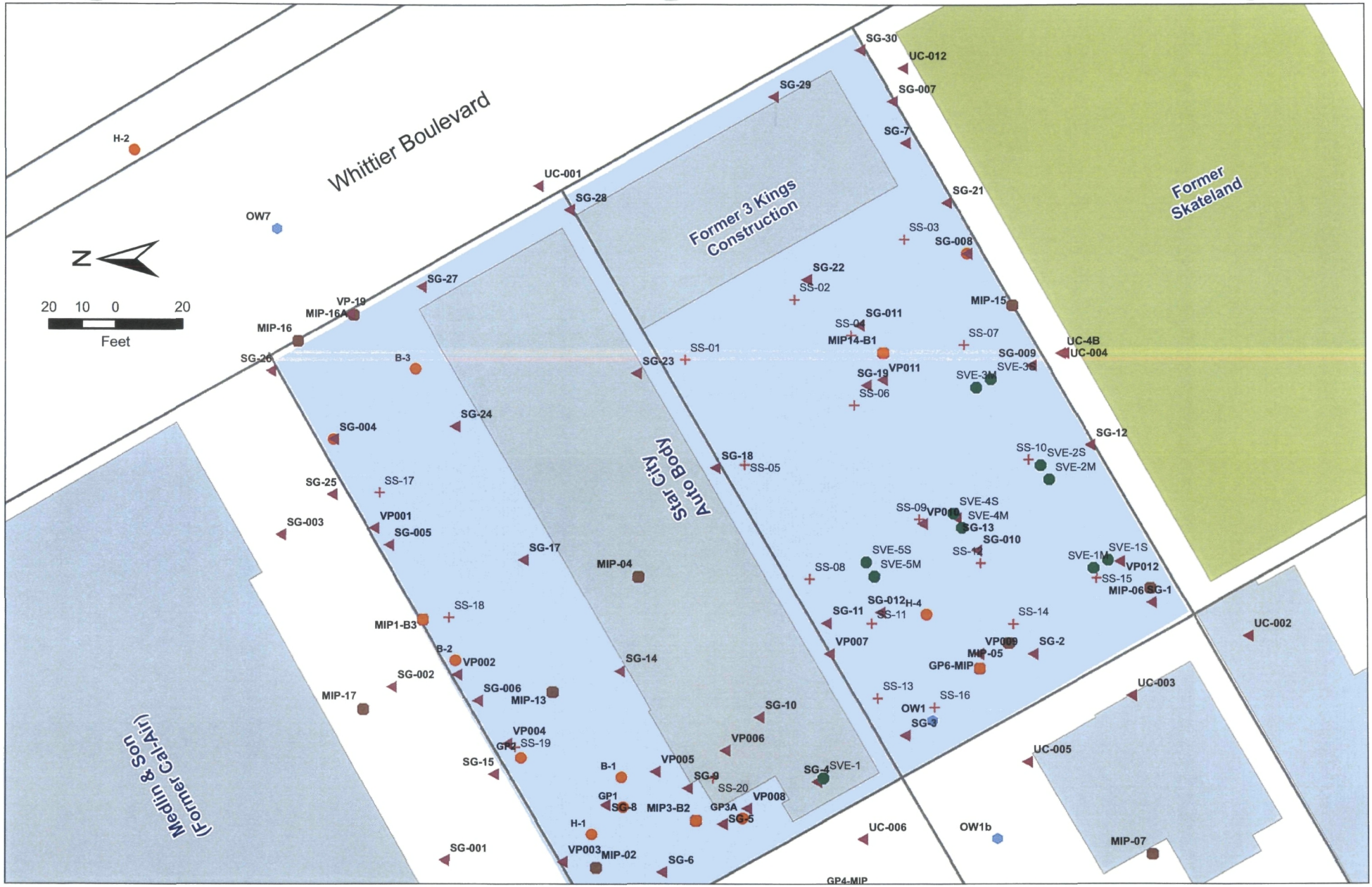
- Property Boundary
- Former Omega Chemical Property
- Existing Building
- Former Building
- Surface Soil Sample Location
- Subsurface Soil Sample Location
- Soil Vapor Sample Location
- Membrane Interface Probe (MIP)
- SoilVaporExtractionWells
- Groundwater Well Location

CDM

Omega Chemical

Sampling Locations

Figure 3-1



Legend

- Property Boundary
- Former Omega Chemical Property
- Existing Building
- Former Building
- Surface Soil Sample Location
- Subsurface Soil Sample Location
- Soil Vapor Sample Location
- Membrane Interface Probe (MIP)
- SoilVaporExtractionWells
- Groundwater Well Location

CDM

Omega Chemical

Sampling Locations (Inset)

Figure 3-1b

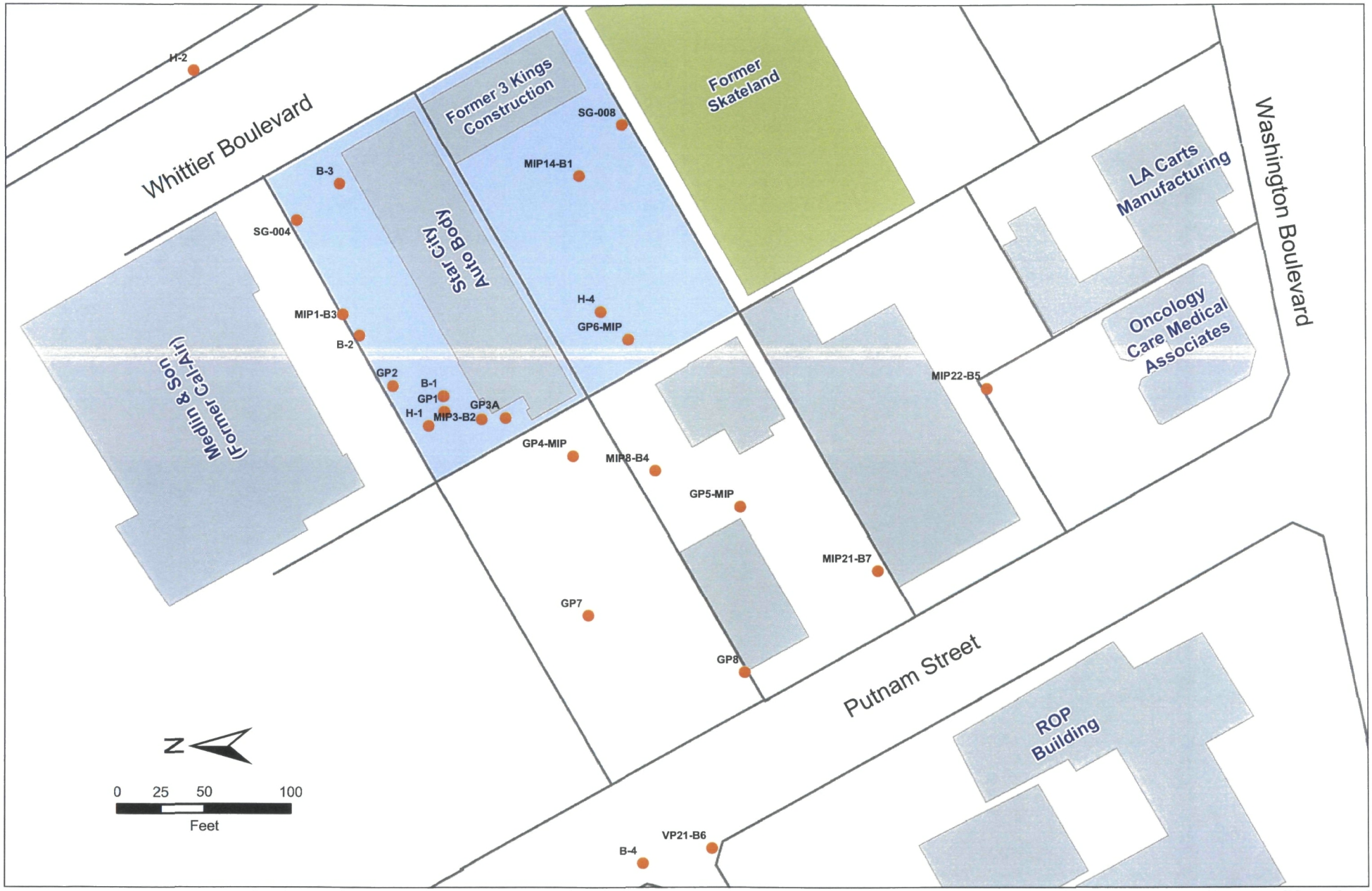
Legend

- Property Boundary
- Former Omega Chemical Property
- Existing Building
- Former Building
- Surface Soil

CDM

Omega Chemical
Surface Soil
Sampling Locations

Figure 3-2



Legend

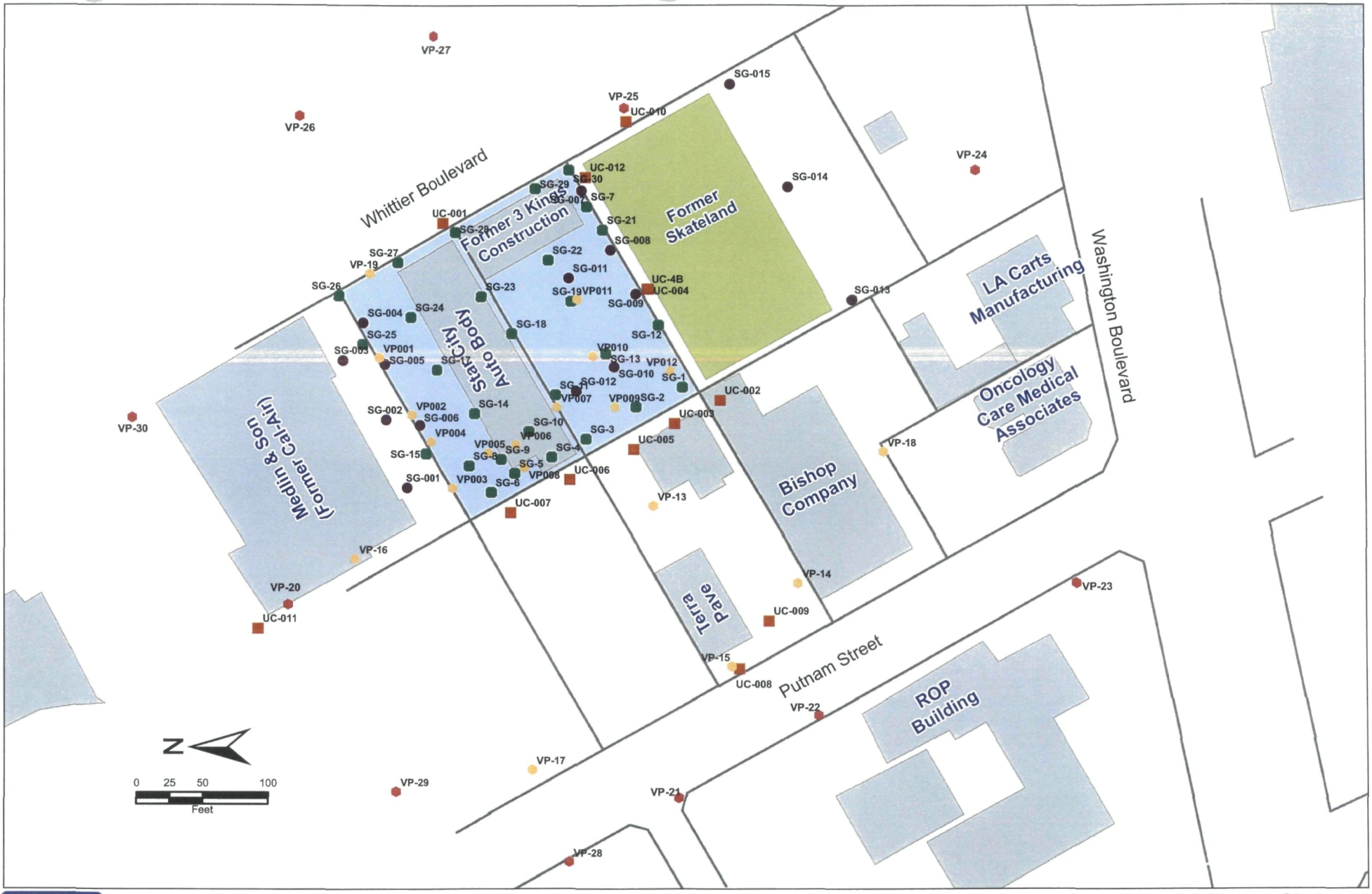
- Property Boundary
- Former Omega Chemical Property
- Existing Building
- Former Building
- Subsurface Soil Sample Location

CDM

Omega Chemical

Subsurface Soil Sampling Locations

Figure 3-3



DRAFT

CDM

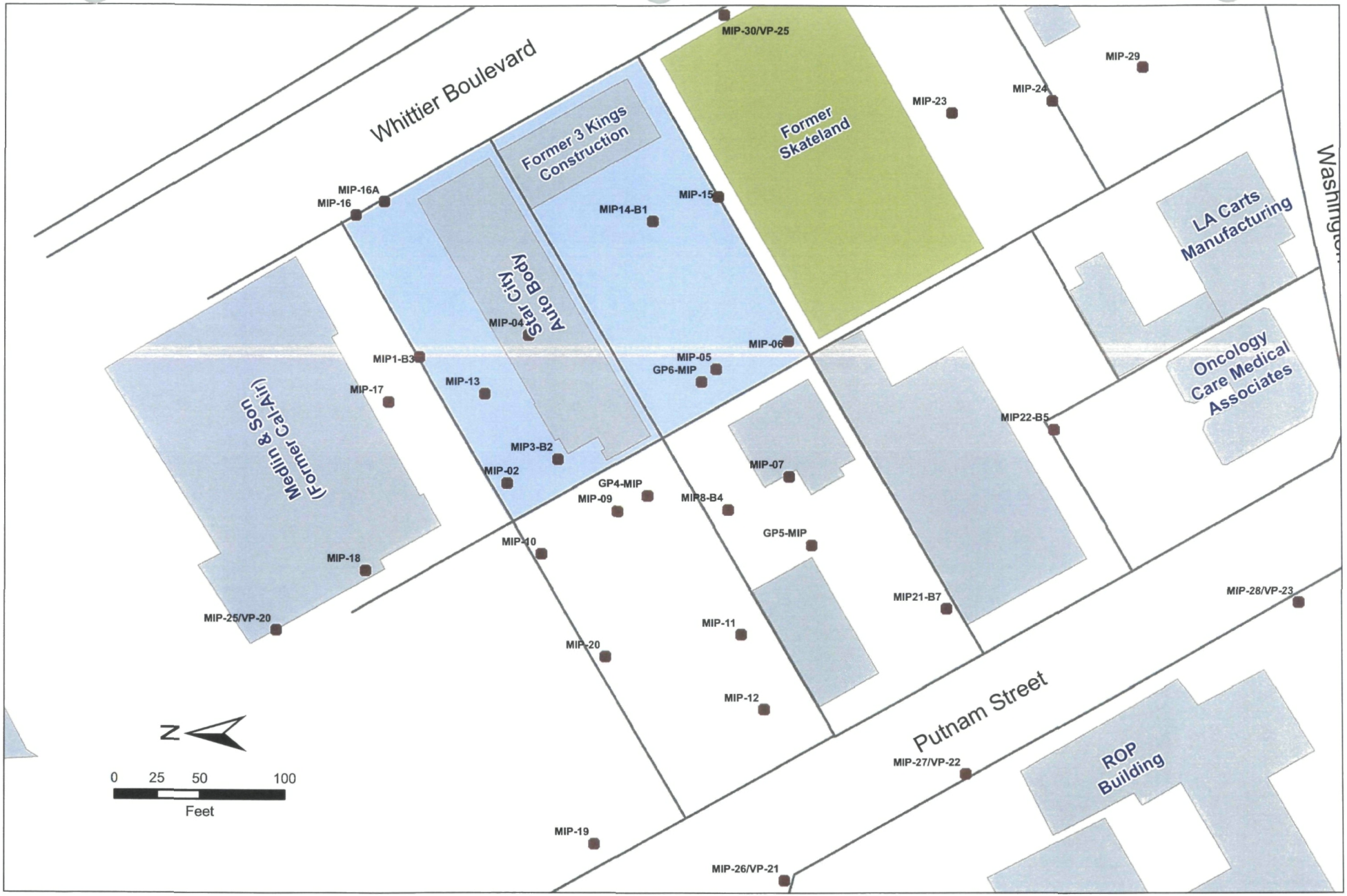
Legend

- Property Boundary
- Former Omega Chemical Property
- Existing Building
- Former Building
- Historical Soil Gas Sample Location(1995)
- RI Soil Gas Sample Location (2004)
- RI Utility Corridor Soil Gas Sample Location (2004)
- RI Vapor Probe Sample Location (2005)
- RI Vapor Probe Sample Location (2006)

Omega Chemical

Soil Vapor Sampling Locations

Figure 3-4



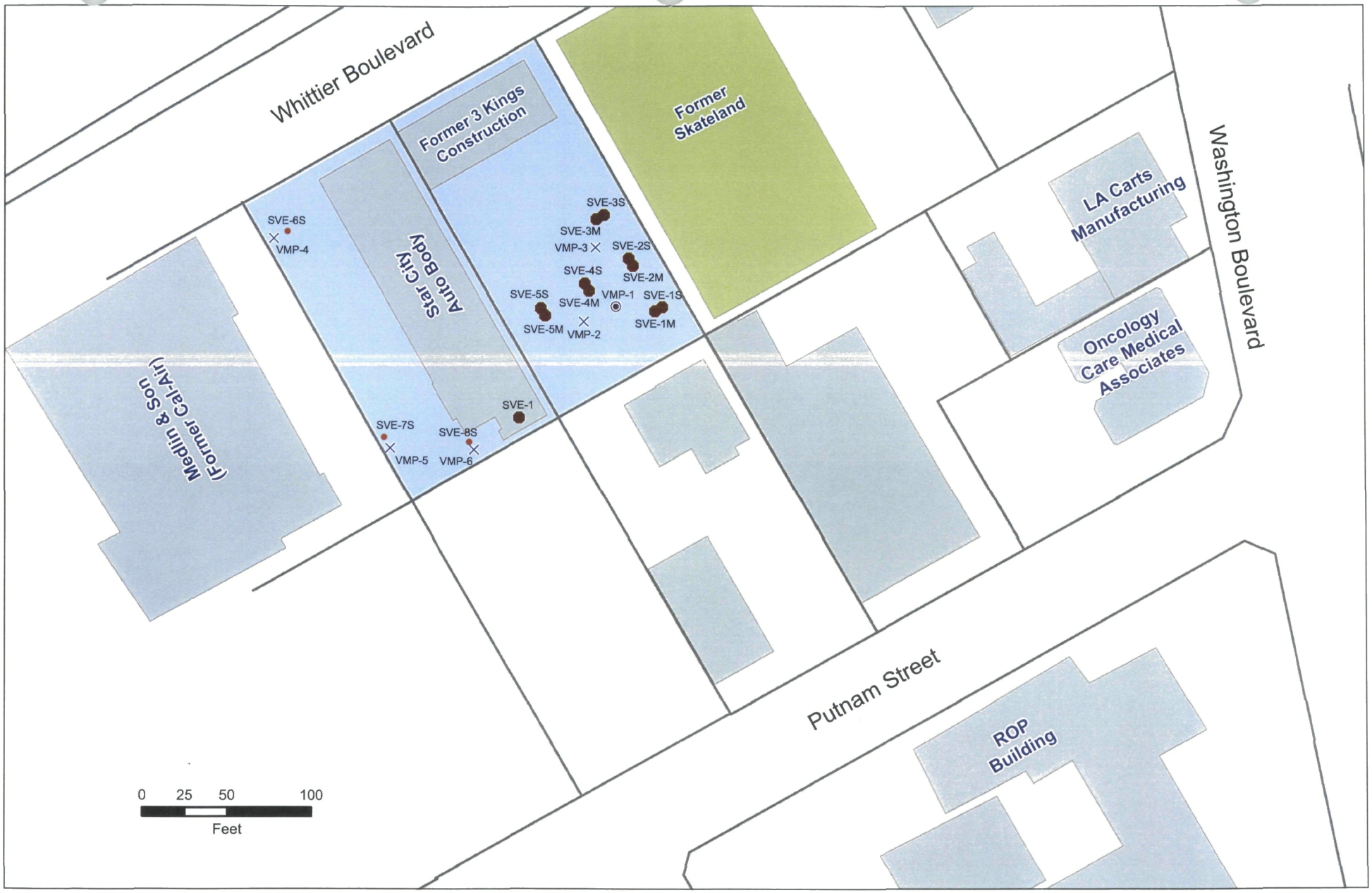
Legend

- Property Boundary
- Former Omega Chemical Property
- Existing Building
- Former Building
- Membrane Interface Probe (MIP)

CDM

Omega Chemical
Membrane Interface Probe Locations (MIP)

Figure 3-5



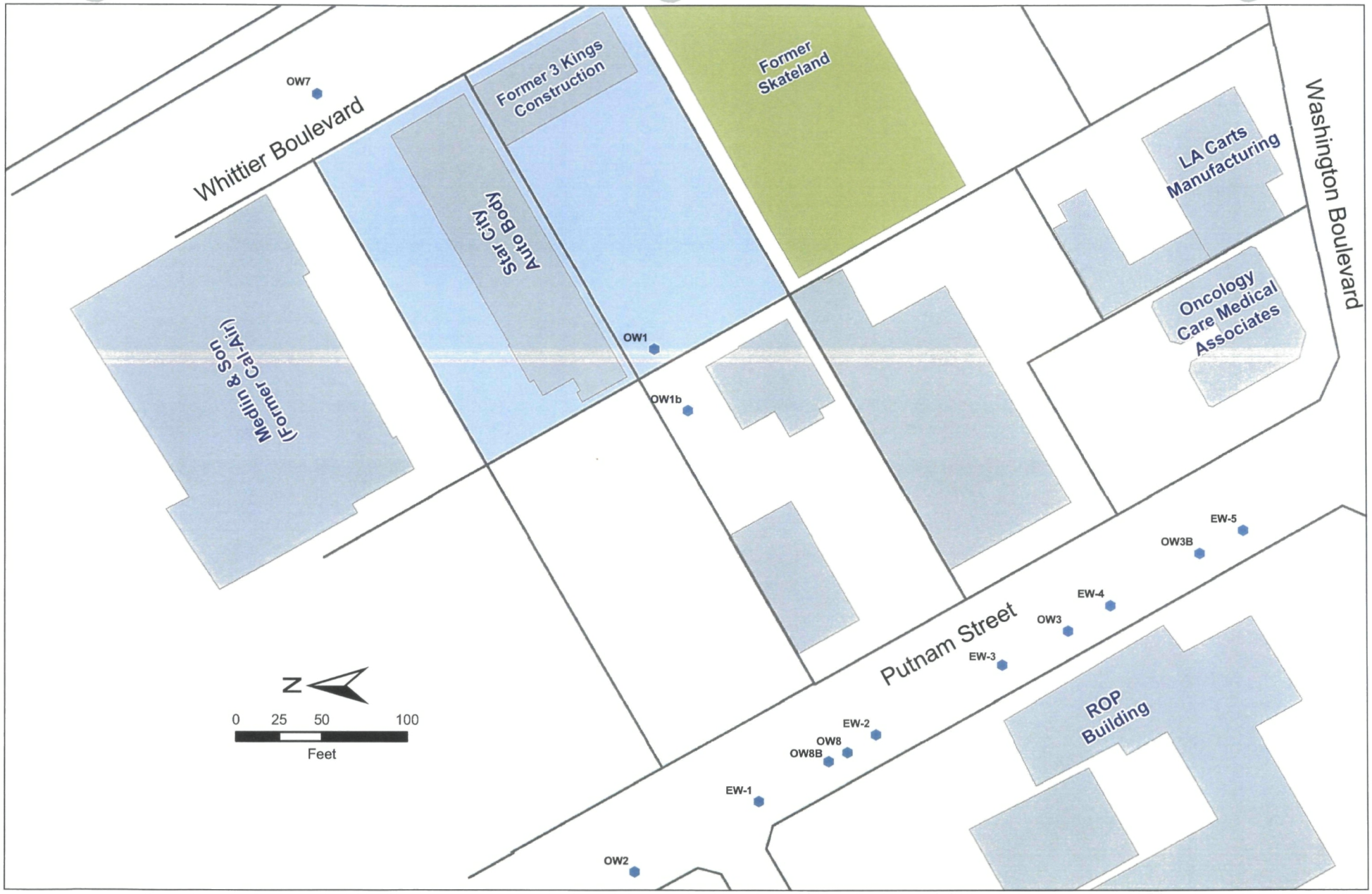
Legend

- Property Boundary
- Former Omega Chemical Property
- Existing Building
- Former Building
- Soil Vapor Extraction Well
- Soil Vapor Extraction Well
- Vapor Monitoring Probe Below the 30 Foot Unit
- Vapor Monitoring Probe In the 30 Foot Unit

CDM

Omega Chemical
Soil Vapor
Extraction Well Locations

Figure 3-6



Legend

- Property Boundary
- Former Omega Chemical Property
- Existing Building
- Former Building
- Groundwater Sample Location

CDM

Omega Chemical
Groundwater Well Locations

Figure 3-7

Section 4

Section 4
Results

This section presents the results of Site investigations and provides a summary of the nature and extent of contamination at the Site, primarily through the included figures and tables. This section is organized by sampling media, with subsections addressing surface soils, subsurface soils, soil vapor, indoor and ambient air. This section also presents the results of Membrane Interface Probe (MIP) investigations and preliminary results from SVE pilot testing that is ongoing at the Site.

Historical soil gas sampling results were not included because evaluation of the historical soil gas sampling results provided in the Phase II Close Out Report (Hargis + Associates, Inc. and England & Associates, October, 1996) indicated several potential deficiencies with the data, as follows: a notation on the analytical results summary table provided in the document indicated that the soil gas results were "preliminary", copies of the analytical reports were not provided and so were not available for review, and the mobile laboratory used was not identified nor were analytical quality assurance/quality control procedures discussed. In addition, non-detections for all tested VOCS were reported for seven samples (SG1 at 6 and 12 feet, SG4 at 16.7 feet, SG8 at 6 feet, SG15 at 6 and 12 feet, and SG31 at 3.5 feet). Though detection limits were higher in 1996 than during the RI, these non-detections are suspect given the elevated concentrations found throughout the former Omega Chemical property during the RI. Therefore, the historical pre-RI soil gas results were not included in the risk analysis. Figure 3-4 illustrates the locations of historical and RI soil gas sampling locations. As shown on the figure, a sufficient number of soil gas samples were collected during the RI to evaluate the extent of soil gas contamination and perform the risk analysis provided in the HHRA for On-Site Soils.

The Site Conceptual Model (Section 5) provides an interpretation of the results presented in this section. Laboratory reports and analytical summary tables are included in the compact disc which is provided in Appendix A.

4.1 Surface Soils

Surface soil samples include all soil media collected at depths of 18-inches or less. As described in Section 3.1, the shallow sampling program was conducted in 2004, and included the collection of samples from 20 locations. The objective of the soil sampling program was to help identify locations where releases to the surface environment may have occurred. The absence of contamination in the surface soils does not imply that releases did not occur, since the former Omega Chemical facility was inactive for a considerable time prior to the sampling. Volatile compounds were not analyzed in these samples, since they may have been lost to processes such as volatilization and venting to the atmosphere. The sampling locations were limited to the former Omega Chemical property.

Table 4-1 presents a summary table for surface soil analyses that have been conducted at the Site. This table summarizes, for each parameter that was analyzed, the number of samples, the number of detections, the minimum reporting limit, and the minimum, maximum and median of detected values for this medium. The most frequently detected parameters in the surface soil samples were metals, since these occur naturally in the soils. Arsenic is the only metalloid compound to show the presence of higher concentration outlier values. Most arsenic concentrations were in the range of three to nine mg/kg, while the single elevated concentration at SS-01 was 21 mg/kg. Statistical evaluation performed as part of the risk assessment indicates that arsenic is present at local ambient levels at the former Omega Chemical property. On this basis, arsenic was eliminated as a chemical of potential concern (COPC) at the Site. Results of the statistical analysis are provided in Appendix B of the risk assessment.

4.2 Subsurface Soils

Extensive subsurface soil sampling has been conducted at the Site during several sampling events. The most recent work, completed in 2005 and 2006, used screening techniques to select sampling intervals to target the highest concentration zones for volatiles. Earlier sampling events used primarily specified intervals for sample collection. Table 4-2 summarizes results from all depths for soil samples collected at the Site. Table 4-3 summarizes the results for samples collected at 30 feet and shallower depths, while Table 4-4 shows the results at depths greater than 30 feet. These summaries include the number of samples and detections, minimum, maximum and medians of the detected values. The most commonly detected compounds were:

- PCE was detected in 148 of 151 samples collected (98 percent), at concentrations ranging from 0.0020 to 1300 mg/kg.
- TCE was detected in 77 of 151 samples collected (51 percent), at concentrations ranging from 0.0022 to 140 mg/kg.
- 1,1,1-TCA was detected in 58 of 151 samples collected (38 percent), at concentrations ranging from 0.00097 to 1200 mg/kg.
- 1,1-DCE was detected in 58 of 151 samples collected (38 percent), at concentrations ranging from 0.0019 to 60 mg/kg.
- Chloroform was detected in 56 of 151 samples collected (37 percent), at concentrations ranging from 0.0014 to 3.0 mg/kg.

The spatial distribution for PCE and TCE are shown as concentration dot plots, where the color of the symbol is used to indicate the concentration, with the colors grading from cooler to warmer tones as the concentration increases. Freons are also a widely distributed compound at the Site that provide insight to sources and transport pathways, so dot plots for total Freons (Freons 11 and 113) are also shown for each depth interval. Total VOCs were plotted for the depth intervals as well. For all dot

plots, the highest reported concentration for the indicated interval for each sampled location is shown. The following dot plots are presented in this section.

Figure Number	Compound	Sample Interval (feet)
4-1	PCE	1 – 30
4-2	PCE	>30
4-3	TCE	1 – 30
4-4	TCE	>30
4-5	Total Freons	1 – 30
4-6	Total Freons	>30
4-7	Total VOCs	1 – 30
4-8	Total VOCs	> 30

In addition to the chemical analyses, physical soil analyses were performed on subsurface soil samples. Laboratory sieve analysis results showed that most soil samples were classified as silt with fine sand. Samples varied from approximately 70 to 90 percent fines (silts and clays), with a fines breakdown of 19 to 30 percent clay, and 48 to 59 percent silt. The remaining mass was predominantly fine sand. Field observations tended to characterize the same samples as clays, silty clays, and clayey silts. The silt samples demonstrated the following characteristics:

- Cation exchange capacity (19 samples): results ranged from 6.1 to 18 milliequivalents per 100 grams, with an average of 12.2 and a median of 13 meq/100 g.
- Bulk density (23 samples): results ranged from 1.52 to 1.77 grams per cubic centimeter (g/cc), with an average and median of 1.61 g/cc.
- Hydraulic conductivity (24 samples): the native state effective hydraulic conductivity results ranged from 1.39×10^{-8} to 9.41×10^{-6} centimeters per second (cm/s), with an average of 7.21×10^{-7} and a median of 3.99×10^{-7} cm/s.
- Moisture content (55 samples): the results ranged from 12 to 35.9 percent by weight, with an average and median of 19 percent.
- Effective permeability (24 samples): the native state effective permeability to water ranged from 0.015 to 9.8 millidarcies, with an average of 0.83 and a median of 0.42 millidarcies.
- Porosity (23 samples): the total porosity ranged from 33 to 49 percent by volume, with an average and a median of 39 percent.
- Redox potential (14 samples): The oxidation-reduction potential ranged from 230 to 320 millivolts (mV), with an average of 277 and a median of 275 mV.

- Total organic carbon (53 samples): The TOC ranged from 510 to 5300 milligrams per kilogram, with an average of 1693 and a median of 1600 mg/kg.

One sample, GP-1 at 35 feet, was classified as a silty medium-grained sand with a hydraulic conductivity of 9.38 x 10^{-5} cm/s, cation exchange capacity of 2.6 meq/100 g, moisture of 6.1 percent, permeability of 103 millidarcies, redox potential of 350 mV, and TOC of 790 mg/kg. Although the hydraulic conductivity for this sample is greater than the silt samples, it is still relatively low compared to that of sandy aquifers.

4.3 Soil Gas Results

Tables 4-5 and 4-6 present statistical summaries of the VOCs detected in soil vapor samples collected from 0 to 30 feet bgs and >30 feet bgs, respectively. Only results from soil vapor samples collected from 2004 to 2006 were considered for this RI report and for the associated HHRA. Within this data set, the most commonly detected compounds were:

- PCE was detected in 226 of 238 samples collected (95 percent), at concentrations ranging from 0.011 to 41,348 mg/m^3.
- Freon 113 was detected in 233 of 238 samples collected (98 percent), at concentrations ranging from 0.0084 to 4,300 mg/m^3.
- 1,1-DCE was detected in 228 of 238 samples collected (96 percent), at concentrations ranging from 0.0048 to 3,400 mg/m^3.
- Freon 11 was detected in 231 of 238 samples collected (97 percent), at concentrations ranging from 0.0057 to 1,517 mg/m^3.
- TCE was detected in 216 of 238 samples collected (91 percent), at concentrations ranging from 0.035 to 610 mg/m^3.

Dot plots have been developed to show the distribution and relative concentrations of total and specific VOCs detected in soil vapor samples. The following dot plots have been presented in the body of this document:

Figure Numbers	Compound	Sample Interval
4-9 and 4-10	Total VOCs	0-30 and >30 ft bgs
4-11 and 4-12	Total Freons (Freons 11, 12, 113)	0-30 and >30 ft bgs
4-13 and 4-14	Freon 113	0-30 and >30 ft bgs
4-15 and 4-16	PCE	0-30 and >30 ft bgs
4-17 and 4-18	1,1-DCE	0-30 and >30 ft bgs
4-19 and 4-20	Freon 11	0-30 and >30 ft bgs
4-21 and 4-22	TCE	0-30 and >30 ft bgs

Pie charts have also been developed for the purpose of showing the "fingerprint" of VOCs present in soil vapor samples at various locations. Figures 4-23 and 4-24 show pie charts for PCE, TCE, Freon 11, Freon 113, and all other VOCs for 0 to 30 feet bgs and >30 feet bgs, respectively. Figures 4-25 and 4-26 show pie charts for other frequently detected chlorinated VOCs (1,1,1-TCA, 1,1-DCA, 1,1-DCE, 1,2-DCA and methylene chloride) for 0 to 30 feet bgs and >30 feet bgs, respectively.

It should be noted that soil gas samples reported by Calscience were reported in units of parts per billion by volume (ppbv). However, data presented in Tables 4-5 and 4-6 are reported in mg/m^3. The Calscience soil vapor data were converted manually from ppbv to mg/m^3 using the following formula:

$$\text{ConcentrationA (mg/m3)} = \frac{\text{ConcentrationA (ppbv)} * \text{MWA}}{24.45}$$

Where:

MW_A = Molecular weight of compound of concern

24.45 = Gas constant at standard temperature (25°C and 1 atmosphere pressure)

4.4 Indoor and Ambient Air

Indoor Air Results Indoor air samples were collected from several buildings at and in the vicinity of the former Omega Chemical property to assess potential VOCs in indoor air quality and to provide background VOC concentration data, respectively. Indoor air samples were collected at the following properties: Star City Auto Body, the building formerly occupied by 3 Kings Construction, Terra Pave, and Medlin (both north and south buildings), LA Carts, Oncology Care Medical Associates (Oncology), and Bishop Company.

Table 4-8 provides a statistical summary of the detected VOCs in ambient air samples. Table 4-9 provides a summary of indoor air sample results. Figure 4-27 presents pie charts for PCE, TCE, 1,1-DCE, Freon 11 and Freon 113 for indoor air samples and shallow soil vapor samples that were collected near buildings where indoor air sampling was performed.

Indoor air samples were collected from the Skateland facility during sampling events in May 2004, August 2004, December 2004, January 2005, and September 2005. The highest PCE concentrations were detected during the May 2004 sampling event, with 1,100 ug/m3 and 880 ug/m3 detected in the original and duplicate samples, respectively, collected from the center of the skating rink floor. PCE concentrations during subsequent sampling events were significantly lower, and ranged from 300 ug/m3 in August 2004 to 56 ug/m3 in January 2005. According to the facility

operator, shortly before the May 2004 sampling event the facility operator applied a new urethane coating to the skating rink floor. As noted below in the chemical use inventory performed following the sampling event, this coating contained PCE and likely contributed, in unknown part, to the elevated PCE detections during the May 2004 sampling event.

PCE concentrations in indoor air samples collected from facilities in the vicinity of the former Omega Chemical property, with the exception of Skateland, ranged from <0.43 to 110 ug/m^3. The maximum PCE concentration of 110 ug/m^3 was detected in the indoor air sample collected from Terra Pave. PCE was detected at significantly lower concentrations at the remaining buildings. Analytical summary tables for ambient and indoor air samples collected during the RI are provided in Tables A-10 and A-11 of Appendix A, respectively.

Chemical Use Inventories and HVAC System Evaluations

Sources other than subsurface contamination cannot be completely ruled out as potential source for some of these compounds. Benzene is used in the manufacturing of plastics, resins, nylon and synthetic fibers, rubbers, lubricants, dyes, detergents, drugs, and pesticides. Benzene is also a natural part of crude oil, gasoline, and cigarette smoke. Carbon tetrachloride is a manufactured chemical that was used in the production of refrigeration fluid and propellants for aerosol cans, as a pesticide, as a cleaning fluid and degreasing agent, in fire extinguishers, and in spot removers. PCE is a solvent used by dry cleaners and mechanics for cleaning. TCE is a volatile organic compound with several industrial and commercial uses.

Chemical use inventories were conducted at the Star City Auto Body and Skateland facilities during May 2004, and at the Terra Pave facility during November 2004. Additional inventories were conducted at the Bishop Company, LA Carts, Medlin North, and Oncology Care facilities by KERNTEC Environmental in June 2006. The findings of these inventories and heating, ventilation, and air conditioning (HVAC) evaluations are summarized as follows:

- **Star City Auto Body –** This facility performs auto body repairs and painting of vehicles. Paints and solvents are stored in a cabinet in the rear of the shop. Painting is generally performed daily, on an as-needed basis. Products stored in the shop included paints, lacquer, thinners, paint remover, urethane, solvents, and miscellaneous other chemicals. Many of the product labels were noted to contain acetone, ethylbenzene, toluene, xylenes, methyl ethyl ketone, and other organic compounds.

  A formal HVAC evaluation was not performed at the Star City Auto Body facility. During numerous visits to the facility during implementation of the RI field program, it was observed that standard procedure was to leave the large rollup doors open during working hours.

Significant VOCs present at the site include propane and chemicals present in cans of paint used in the rear shop building – although it is reported that painting is very limited at the site.

The HVAC evaluation revealed that the offices and reception area are the only areas with AC. The AC unit does not draw outside air, it only chills and re-circulates interior air. The fabrication area does not have an AC unit; ventilation air is provided by the two roll-up doors which appear to remain open during working hours.

- **Medlin & Son** – This facility cuts and forms sheet metal. Compressed gas cylinders of oxygen, nitrogen and hydrogen were observed at the facility. No significant VOC-containing chemicals were identified.

  The building does not have a functioning AC unit. During normal working hours, the large rollup door to the building is left open. There is no ceiling in the building, it is open to the rafters and there are ridge vents at the peak. An AC unit was observed for the interior offices, however, the unit was not in working condition.

- **Oncology Care** – This facility is an outpatient medical facility where patients receive oncology treatment. The chemical inventory only noted several medications and an obvious odor of isopropyl alcohol, which is used for surface disinfecting throughout the facility.

  The HVAC evaluation revealed three AC units on the roof. The units appeared to be fairly new, and did have intakes allowing outside air to be drawn into the building. The medicine storage/mixing room contained two fume hoods for mixing medicines. The larger fume hood apparently discharges fumes from the top of the unit to the indoor air.

Comparison to Previous Sampling Events at Nearby Facilities

Chemical Profiles

In the previous evaluation of facilities surrounding the former Omega Chemical property, a subset of VOCs was defined that is likely related to activities at the former Omega Chemical property and represent the most likely candidates for migration to indoor air. The five chemicals identified were 1,1-DCE, PCE, TCE, Freon 11 and Freon 113. These chemicals are ubiquitous in the subsurface, found in the highest concentrations in soil gas, are detected in all indoor air samples of the facilities near the former Omega Chemical property previously evaluated (Skateland, Terra Pave, Star City Auto Body, Medlin & Son, and 3 Kings Construction). Pie charts which include these five VOCs in soil vapor and indoor air samples have been prepared to facilitate comparisons between chemicals detected in indoor air, and those detected in soil vapor samples collected nearby (Figure 4-27). Tables summarizing all ambient and indoor air sampling results are also provided in Tables A-10 and A-11 of Appendix A, respectively.

As shown in Figure 4-27, the indoor air chemical profiles of the Bishop Company, LA Carts, Medlin North, and Oncology Care facilities all appear to be significantly different between facilities, but consistent within each facility. For example, the chemical profiles of all of the indoor air samples collected from Bishop Co. appear to be similar, but the chemical profiles of the Bishop Company are notably different from the chemical profiles of the indoor air samples collected from Oncology Care.

Since the indoor air, soil vapor, and utility corridor samples were all collected during different sampling events over the past two years, Figure 4-27 does not provide a single snapshot of the vapor profiles. As concentrations and profiles may change over time and with seasonal variations, only gross observations of these profiles can be made. Although the chemical profiles of the Bishop Company look similar to the utility corridor sample UC-2 collected in November 2004 and the chemical profiles in LA Carts could resemble the chemical profiles of the samples taken in and around Skateland, these comparisons are not definitive due to the time lag between these sampling events.

The air sampling results are also discussed at length in the HHRA which is being prepared concurrently with this document.

4.5 MIP

The MIP logs which show responses from three VOC detectors and the conductivity, speed and temperature probes, are included on the compact disc which is provided in Appendix A.

Total VOC results from soil vapor samples collected adjacent to MIP locations have been plotted on the corresponding MIP sensor response graphs (Figures 4-28 to 4-36). Evaluation of these figures and the figures that plot soil total VOC concentrations with the sensor response graphs does not lead to a clear indication as to whether sensor response is mainly from soil vapor or from vapors produced from heating the soil. However, given the role of the MIP in this investigation (continuous qualitative indication of VOC contamination and lithology), and that the MIP was followed by soil and soil vapor sampling and borehole logging, such a distinction is not required.

4.6 Results of Initial and Expanded SVE Pilot Testing

A SVE pilot test began in the Three Kings Construction parking lot on October 17, 2006. The test followed the procedures laid out in the Soil Vapor Extraction Pilot Test Work Plan (CDM, 2006).

The initial test utilized a total of 10 SVE wells arranged in five groups of two wells. Each group had a well screened from 12 to 22 feet bgs (SVE-1S through SVE-5S) and a well screened from 26 to 36 feet bgs (SVE-1M through SVE-5M). The testing began by performing a step test on each of the wells, where three different levels of vacuum were applied and the resulting vapor extraction rate and subsurface vacuum distribution were measured at each step. Multi-week testing followed the initial step

testing. In addition, field measurements of the total VOC concentration in the extracted vapors were taken and samples of these vapors were periodically collected for off-site laboratory analysis. The initial testing results and findings were presented in the Technical Memorandum for Soil Vapor Extraction Pilot Test Initial Findings (CDM, February 5, 2007).

The expanded SVE pilot testing utilized a total of 3 SVE (SVE-6S through SVE-8S) wells and 6 VMPs (VMP-1 through VMP-6). The expanded testing consisted of pneumatic communication testing, step testing, and multi-week extended testing. Field measurements of the total VOC concentration in the extracted vapors were taken and samples of these vapors were periodically collected for off-site laboratory analysis. The expanded testing results and findings were presented in the Technical Memorandum Expanded Soil Vapor Extraction Pilot Test Findings (CDM, August 31, 2007).

The initial and expanded SVE pilot testing findings and conclusions are summarized below:

- SVE is a feasible technology to remediate on-Site vadose zone soils.
- Radius of influence ranging from at least 48 feet to at least 77 feet was achieved when vacuum ranging from 4 to 10 inches of Hg was applied at the various locations. Vapor extraction flow rates ranged from 50 to 145 standard cubic feet per minute at the various locations.
- The vadose zone above the 30-foot unit can be addressed with SVE wells screened from approximately 10 to 25 feet bgs (i.e., the two screened intervals used for the initial testing are not needed).
- Evaluation of the pneumatic communication testing results during the expanded testing indicated that pneumatic communication occurs across the 30-foot unit.
- Total VOC concentrations in extracted vapors typically ranged from 200 to 900 ppmv and increased in locations closest to the Star City Auto Body building. The concentrations of VOCs in extracted vapors from the three Star City Auto Body wells, coupled with the time trend in these wells, indicate a strong source of VOCs at this location.
- During the initial testing, VOC mass removal rates ranged from 2 to 84 pounds per day, depending on the SVE well operated. A total of 415 pounds of VOCs were removed during the initial testing.
- During the expanded testing, VOC mass removal rates ranged from 35 to 53 pounds per day, depending on the SVE well operated. A total of 817 pounds of VOCs were removed during the expanded testing.

- The GAC treatment units were capable of removing the VOCs found in the extracted soil vapors. The analyses of the samples that were collected at the GAC units provided a basis to evaluate and design GAC treatment for a potential full-scale SVE system, if appropriate.

The Technical Memorandum for Soil Vapor Extraction Pilot Test Initial Findings (CDM, February 5, 2007), the Revised Second Addendum to February 5, 2007 Technical Memorandum (CDM, April 20, 2007), and the Technical Memorandum Expanded Soil Vapor Extraction Pilot Test Findings (CDM, August 31, 2007), as well as USEPA's comment letters and OPOG's responses to comments, where available, are provided in their entirety on the compact disc in Appendix B.

4.7 Quality Assurance/Quality Control Samples

A number of QA/QC measures were employed in the field to ensure that the collected investigation samples were of known quality in support of the data quality objectives (DQOs) developed for the project. Field QA/QC samples were collected and tested to provide quality control checks on the representativeness of the environmental samples collected, the accuracy and precision of sample analyses, and sample handling procedures. One or more of the following field QC samples were collected during the various sampling events: duplicate samples, equipment decontamination blanks, and trip blanks. Results from the field QA/QC samples are discussed in the following sections.

4.7.1 Field QA/QC Samples

4.7.1.1 Duplicates

The RI/FS work plan specified a collection frequency of ten percent (1 per 10) of the samples collected. The work plan also specified a criterion for relative percent difference (RPD) of plus or minus (±) 35 percent for soil. A RPD criterion was not specified for soil gas or air samples but a limit of ± 20 percent was used to assess precision. Field duplicate results were evaluated for only those analytes that were detected in both the primary and duplicate samples at concentrations greater than their respective reporting limits. In the event that an analyte was not detected in either the primary or duplicate sample, but was detected at a concentration less than five times the reporting limit in the corresponding sample, then the RPD was not calculated. Although precision was not assessed for these sample pairs (i.e., when an analyte was detected in one sample but not the corresponding duplicate), it should be noted that the highest detected concentration was used in all subsequent data uses (e.g. risk calculations). Data obtained from field duplicate samples provides an estimate of measurement error attributable to the data collection process. Results from the duplicate sample analyses are presented below and are discussed according to sample matrix.

Soil

During the surface soil investigation in 2004, a total of two duplicate (co-located) samples were collected, which represents a collection frequency of ten percent. The

RPDs between the primary and duplicate samples were less than 35 percent for all detected analytes, which meets the precision criterion specified in the RI/FS work plan.

During the subsurface soil investigations conducted between 2003 and 2006, a total of 64 primary samples were collected for chemical analyses. From these primary samples, a total of five duplicate samples were collected and analyzed, which represents a collection frequency of 8 percent. Based upon a comparison of detected analyte concentrations between the primary and duplicate samples, all RPDs were generally less than 35 percent for nearly all samples and all analytes. There were a few exceptions where the RPDs exceeded 35 percent, but in all cases, the detected concentrations were either within five times the reporting limit or were within the same order of magnitude of each other. Therefore, the elevated RPDs were not significant enough to warrant data rejection. Those results that were greater than five times the reporting limit but not within the 35 percent criteria were qualified as estimated, as shown on Table A-12.

Soil Vapor

Between April 2004 and May 2006, a total of 229 soil vapor samples were collected at the Site. During these sampling rounds, a total of 26 duplicate samples were collected, which represents a collection frequency of 11 percent.

Based upon a comparison of detected analyte concentrations between the primary and duplicate samples, all RPDs were generally less than 20 percent for nearly all samples and all analytes. There were a few exceptions where the RPDs exceeded 20 percent. Up to 10 analytes exceeded the 20 percent RPD criterion in 12 duplicate sample pairs. In many cases, however, the analyte concentrations were relatively high and required the samples to be analyzed at higher dilutions, which increased the likelihood of precision errors. In all cases, the higher of the duplicate results was used in subsequent risk analyses. Therefore, the results were still usable and met the project objectives even though slight precision issues were noted. Those soil vapor results that were greater than five times the reporting limit but not within the 20 percent criteria were qualified as estimated, as shown on Table A-13.

Indoor and Ambient Air

Between May 2004 and September 2006, 57 indoor air samples were collected at and in the vicinity of the former Omega Chemical property. During these sampling rounds, a total of nine duplicate samples were collected, which represents a collection frequency of 16 percent.

Except for seven sample pairs, the RPDs between primary and duplicate sample concentrations were less than 20 percent. In these seven pairs, the RPDs for up to three analytes exceeded the 20 percent limit. With respect to several of the exceedances, the detected concentrations were less than five times the reporting limit, so the differences are not considered significant. With the remaining exceedances, the detected concentrations were within the same order of magnitude and the differences

were not significant enough to warrant data rejection. In all cases, the higher of the duplicate values was used in subsequent risk calculations so the elevated RPDs did not impact the usability of the project data. Those air results that were greater than five times the reporting limit but not within the 20 percent criteria were qualified as estimated, as shown on Table A-14.

4.7.1.2 Equipment Decontamination Blanks

Equipment decontamination blanks were collected during soil sampling activities. In total, 15 equipment decontamination blanks were collected between October 2003 and March 2006 during various soil sampling activities. Equipment blanks were analyzed for the same parameters as the soil samples collected the same day. Analyte detections in the equipment blanks were limited to metals, bis(2-ethylhexyl)phthalate, and PCE. In nearly all the cases, the analyte concentrations in the corresponding project samples were significantly greater than the detections in the equipment blanks. Therefore, the low levels of analytes reported in the equipment blanks had no impact on the project results. With respect to bis(2-ethylhexyl)phthalate, this compound was reported in the equipment blank but was not detected in the associated project samples. Therefore, no further action was required. None of the associated project samples required qualification as a result of the equipment blank detections.

4.7.1.3 Trip Blanks

Trip blanks were submitted with shipments of soil gas, air, and soil samples and analyzed for VOCs. In total, seven trip blanks were submitted with shipments of soil gas samples in August and September 2005, five trip blanks were submitted with shipments of air samples between May 2004 and September 2006, and three trip blanks were submitted with shipments of soil samples.

Except for acetone, no other analytes were reported in any of the trip blanks submitted with soil samples. Acetone was detected in one trip blank submitted on December 19, 2005. Because acetone was not detected in any of the corresponding soil samples collect that day, the detection in the trip blank has no impact on the project results.

Except for TCE, no other analytes were reported in any of the trip blanks submitted with soil gas or air samples. TCE was reported in one trip blank submitted with air samples collected on September 8, 2006 at a concentration of 0.24 micrograms per liter (μg/L). TCE was also reported in four air samples collected the same day at concentrations approximately equal to or lower than the concentration reported in the trip blank. The TCE concentrations reported in the project samples would typically be qualified as non-detectable due to possible cross-contamination. However, as a conservative measure for the risk analysis, the TCE concentrations reported in the project samples were reported as is without qualification.

4.7.2 Laboratory QA/QC

During the RI, 100 percent of the analytical data generated during the multiple sampling events were subject to a Level III data review and evaluation to ensure that they were usable and met the project objectives. The data evaluation process included review of all laboratory and field QC elements excluding review of the raw data associated with the data package. While the project work plan specified a 10 percent validation goal (Level IV) for each sample matrix, no significant QC issues were identified during the 100 percent Level III review that would prompt review of the associated raw data. Therefore, it was determined that the Level III data review was sufficient to determine the usability of the project data. USEPA's Functional Guidelines were USEPA's Contract Laboratory Program National Functional Guidelines for Organic and Inorganic Data Review (USEPA, 1999 and 2004) were used to assist in the process of the technical review of the data; however, QC criteria specified in the RI work plan were used as the basis for acceptance or data qualification, except for soil gas and ambient air samples analyzed by EPA Method TO-15. The RI work plan indicated that air and vapor samples were to be analyzed using EPA Method TO-14. However, to achieve lower reporting limits, it was subsequently determined that Method TO-15 was a more appropriate method for the purposes of the RI. Data qualification of air and soil vapor samples was based on QC criteria specified by the laboratories in accordance with Method TO-15.

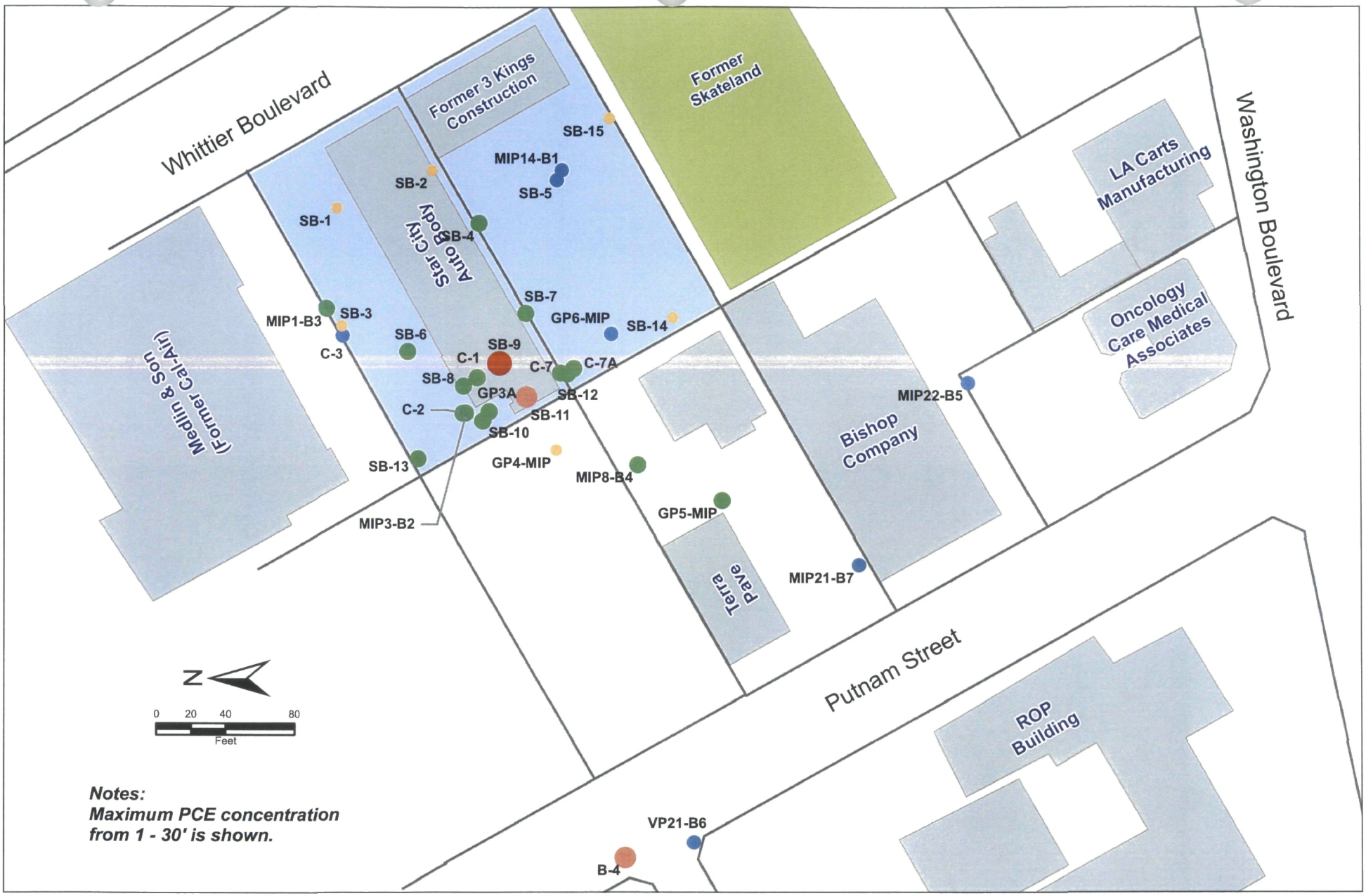
Laboratory data were reviewed for inclusion and frequency of the necessary QC supporting information. Supporting QC documentation that was evaluated for each analytical report included the following major items:

- sample holding times
- method blanks
- matrix spike/matrix spike duplicate (MS/MSD) recoveries
- relative percent difference (RPD) between MS and MSD
- laboratory control sample (LCS) recoveries
- surrogate spike recoveries
- Calibration data

The review included data generated by multiple laboratories including Del Mar Analytical/Test America (chemical soil testing), B.C. Laboratories (chemical soil testing), Air Toxics Limited (soil vapor and air VOC testing), and Calscience Environmental Laboratories (chemical soil and soil vapor testing).

Analytical reports were reviewed and evaluated to assess the overall quality and usability of the project data. Based on the review of the RI data, no laboratory QC issues were reported that were significant enough to reject the data. Due to minor

laboratory QC issues (i.e., method blank contamination, out-of-range MS, MSD or LCS recoveries, etc.), however, some data were qualified with "Js" to indicate estimated results. In summary, none of the RI data were rejected and all data were considered usable for the project purposes. A table of qualified results, the data review level, and the basis for the qualification is presented in Table A-15.



Legend

- Property Boundary
- Former Omega Chemical Property
- Existing Building
- Former Building

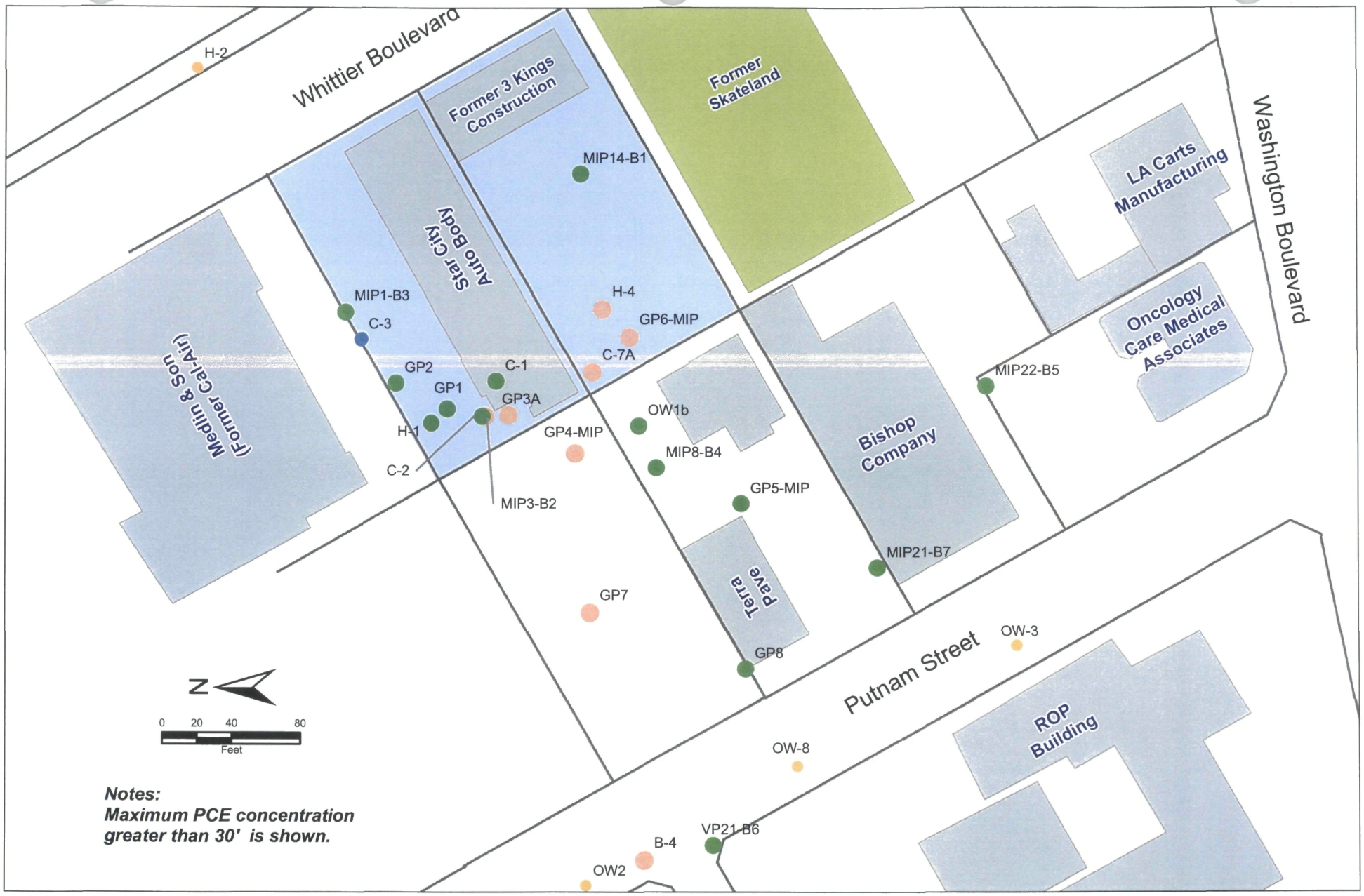
PCE (mg/kg)

- ND - 0.1
- 0.1 - 1
- 1 - 10
- 10 - 100
- 100 - 1,000
- > 1,000

CDM

Omega Chemical

Soil Concentration Distribution (1 - 30 feet)
Tetrachloroethene (PCE)
Figure 4-1



Legend

- Property Boundary
- Former Omega Chemical Property
- Existing Building
- Former Building

PCE (mg/kg)

- ND - 0.1
- 0.1 - 1
- 1 - 10
- 10 - 100
- 100 - 1,000
- > 1,000

CDM

Omega Chemical

Soil Concentration Distribution (> 30 feet)
Tetrachloroethene (PCE)
Figure 4-2

Legend

- Property Boundary
- Former Omega Chemical Property
- Existing Building
- Former Building

TCE (mg/kg)

- ND - 0.1
- 0.1 - 1
- 1 - 10
- 10 - 100
- 100 - 1,000
- > 1,000

CDM

Omega Chemical

Soil Concentration Distribution (1 - 30 feet)
Trichloroethene (TCE)
Figure 4-3

Legend

- Property Boundary
- Former Omega Chemical Property
- Existing Building
- Former Building

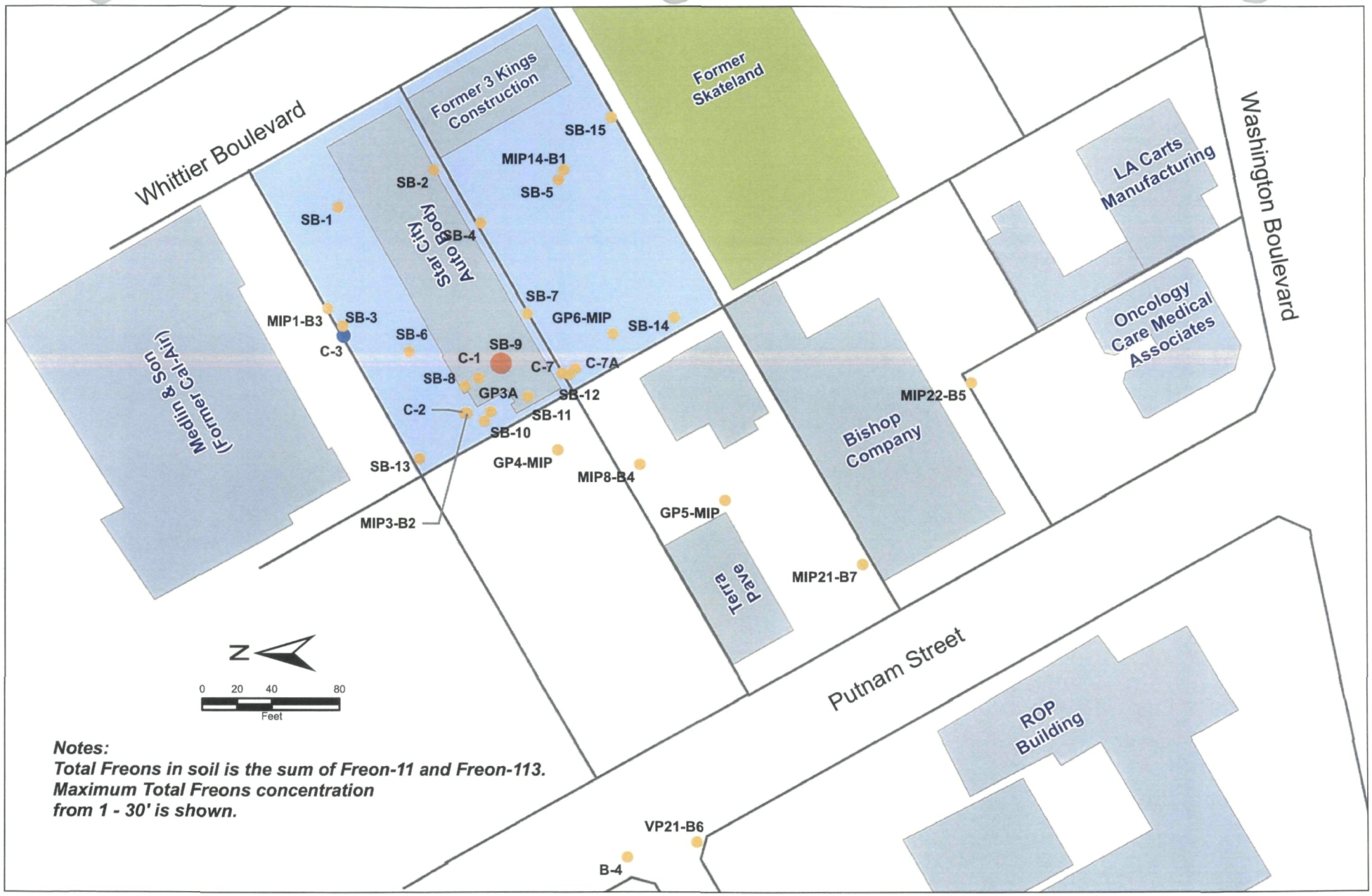
TCE (mg/kg)

- ND - 0.1
- 0.1 - 1
- 1 - 10
- 10 - 100
- 100 - 1,000
- > 1,000

CDM

Omega Chemical

Soil Concentration Distribution (> 30 feet)
Trichloroethene (TCE)
Figure 4-4



Notes:
Total Freons in soil is the sum of Freon-11 and Freon-113.
Maximum Total Freons concentration from 1 - 30' is shown.

Legend

- Property Boundary
- Former Omega Chemical Property
- Existing Building
- Former Building

Total Freons (mg/kg)

- ND - 0.1
- 0.1 - 1
- 1 - 10
- 10 - 100
- 100 - 1,000
- > 1,000

CDM

Omega Chemical
Soil Concentration Distribution (1 - 30 feet)
Total Freons
Figure 4-5

Legend

- Property Boundary
- Former Omega Chemical Property
- Existing Building
- Former Building

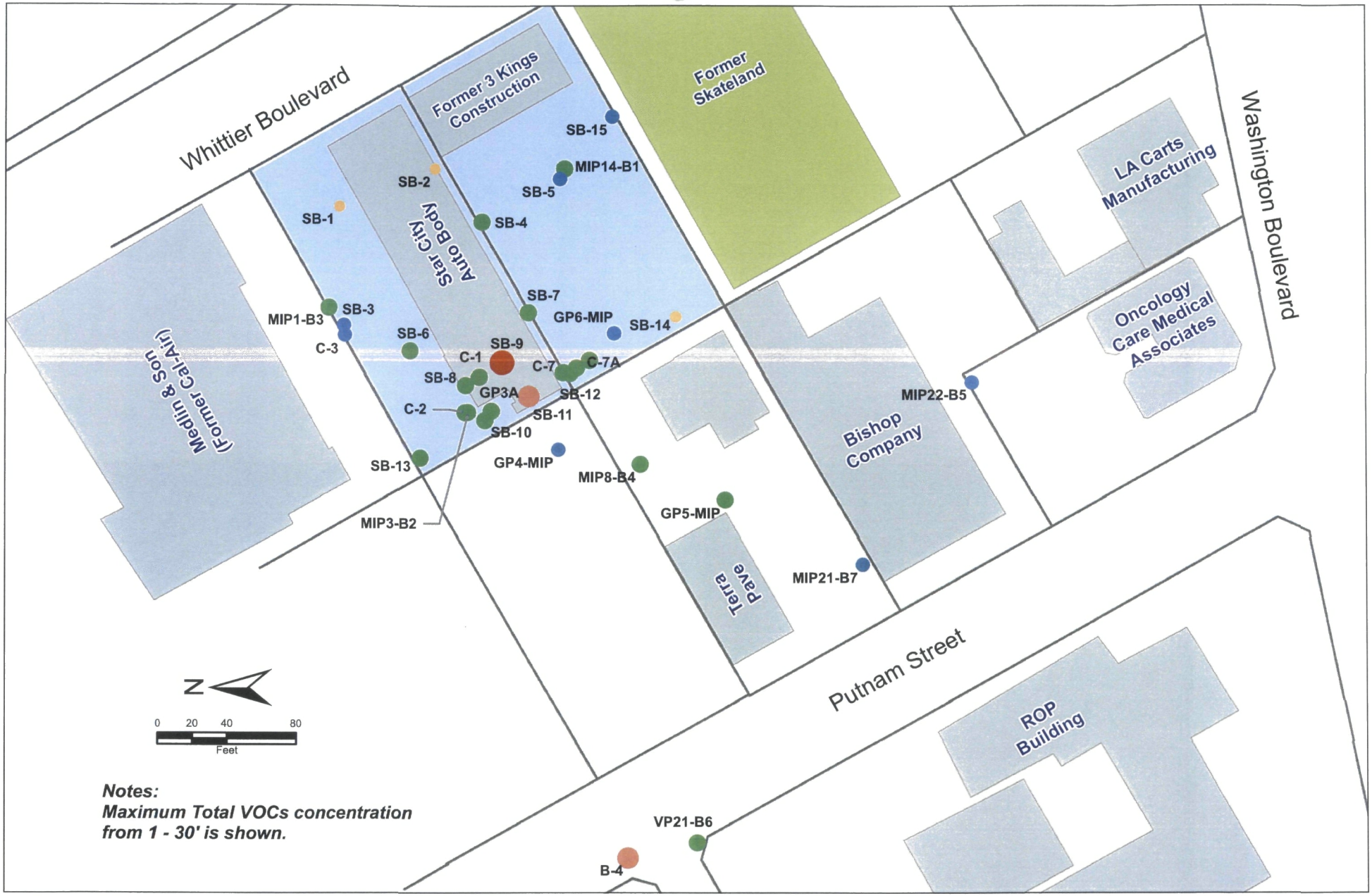
Total Freons (mg/kg)

- ND - 0.1
- 0.1 - 1
- 1 - 10
- 10 - 100
- 100 - 1,000
- > 1,000

CDM

Omega Chemical

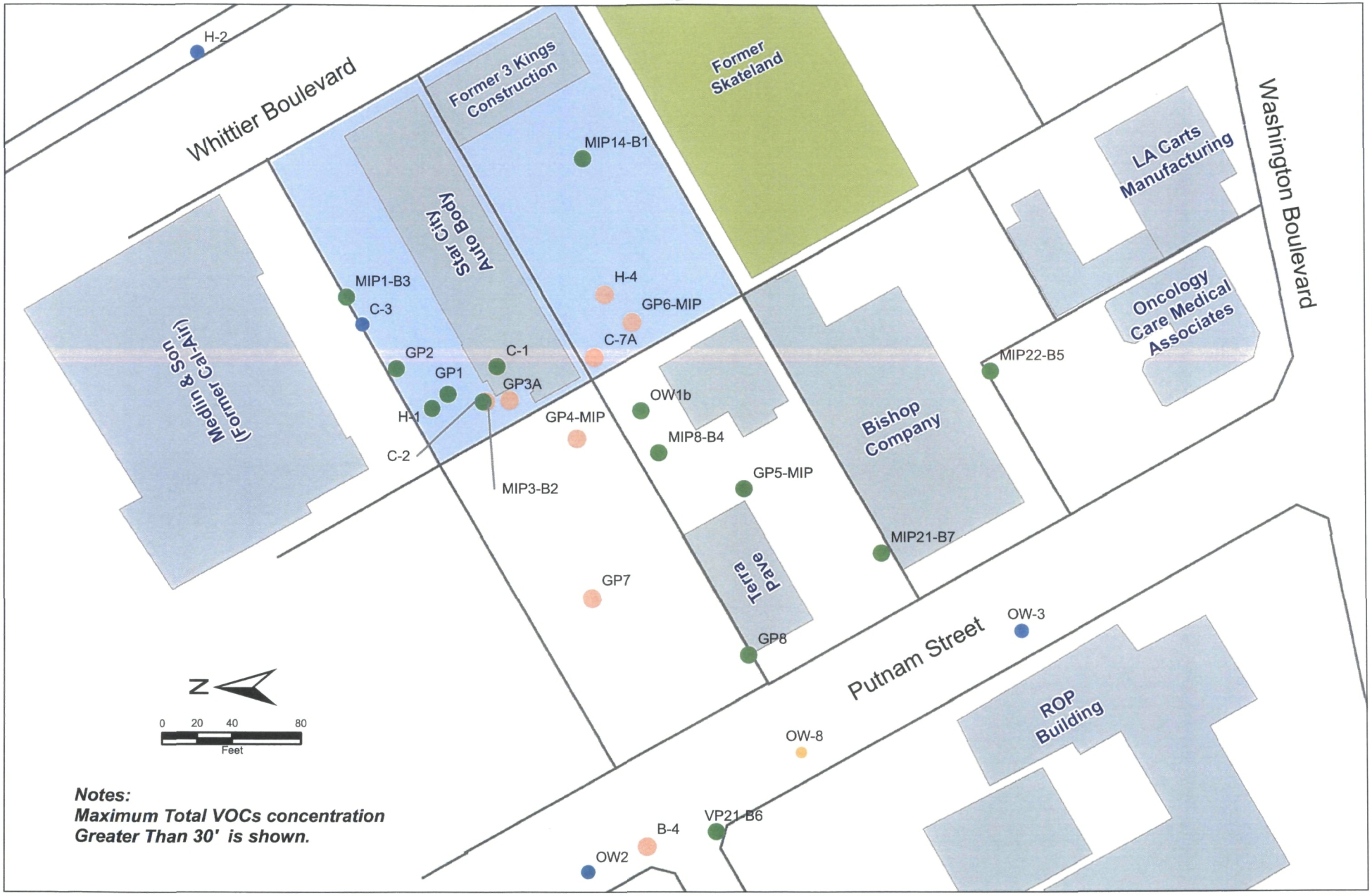
Soil Concentration Distribution (> 30 feet)
Total Freons
Figure 4-6



CDM

Omega Chemical

Soil Concentration Distribution (1 - 30 feet)
Total VOCs
Figure 4-7



Legend

- Property Boundary
- Former Omega Chemical Property
- Existing Building
- Former Building

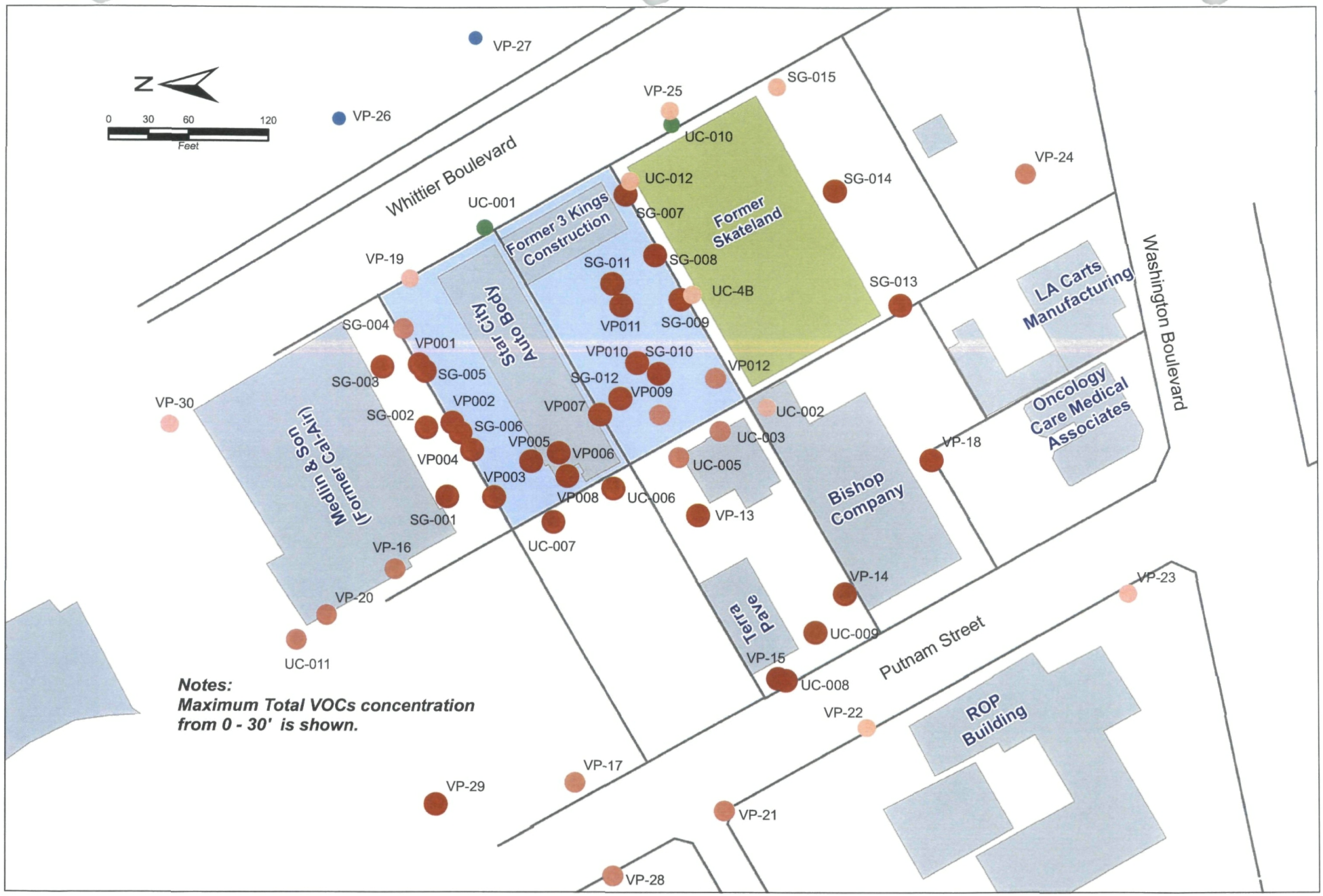
Total VOCs (mg/kg)

- ND - 0.1
- 0.1 - 1
- 1 - 10
- 10 - 100
- 100 - 1,000
- > 1,000

CDM

Omega Chemical

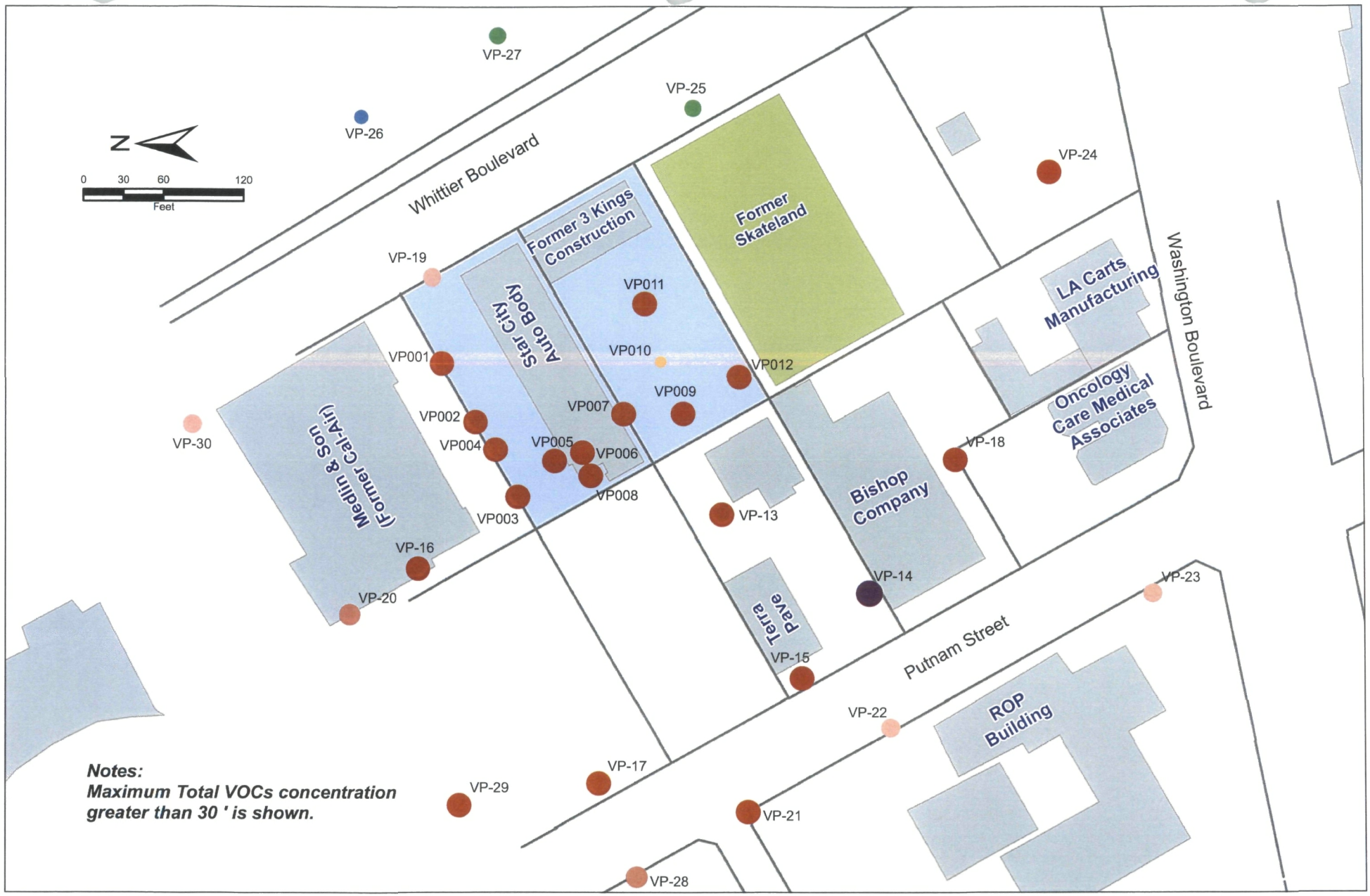
Soil Concentration Distribution (> 30 feet)
Total VOCs
Figure 4-8



CDM

Omega Chemical

Soil Vapor Concentrations (0 - 30 feet)
Total VOCs
Figure 4-9



Legend

- Property Boundary
- Former Omega Chemical Property
- Existing Building
- Former Building

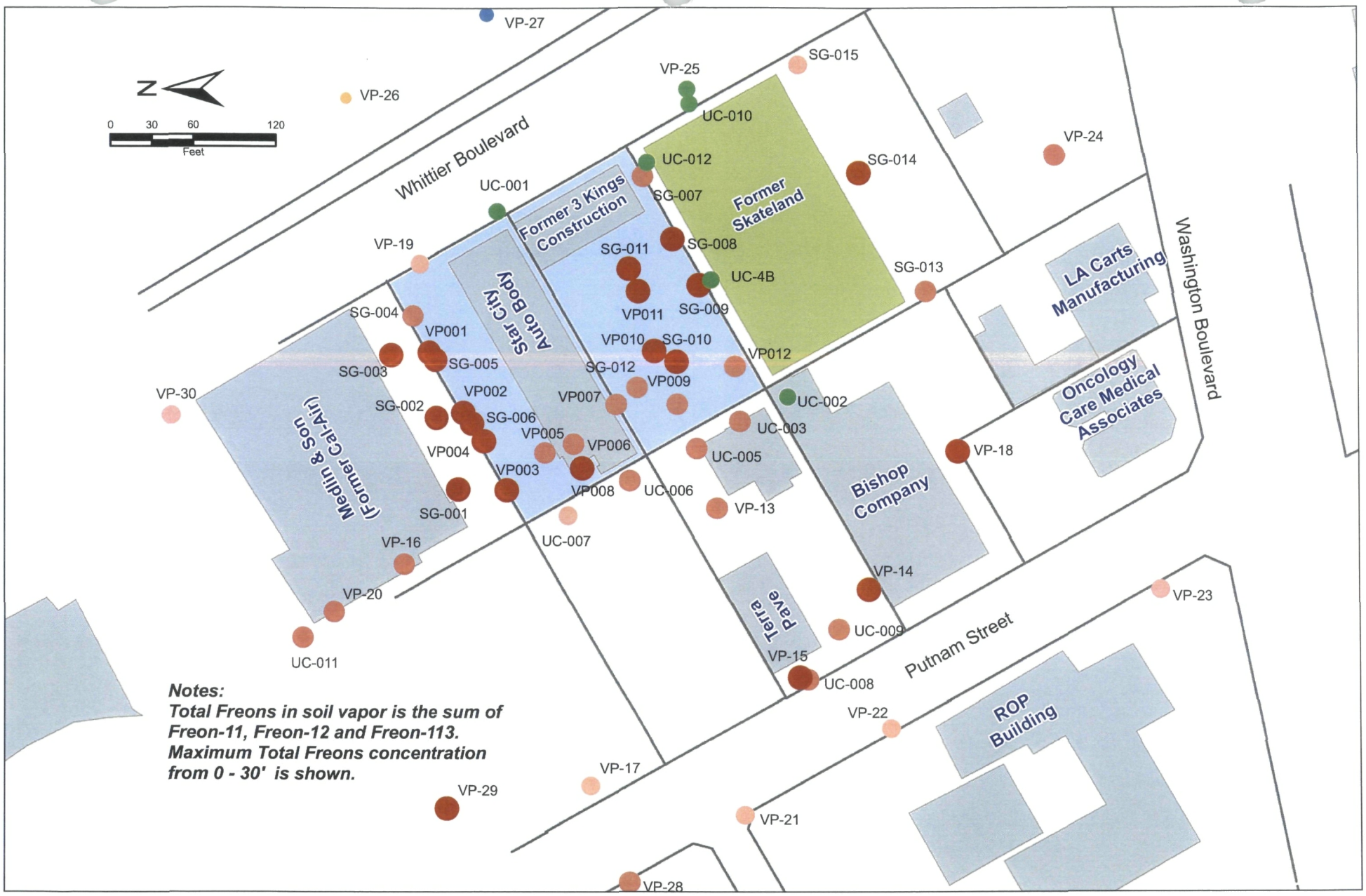
Total VOCs (mg/m^3)

- ND - 0.1
- 0.1 - 1
- 1 - 10
- 10 - 100
- 100 - 1,000
- 1,000 - 10,000
- > 10,000

CDM

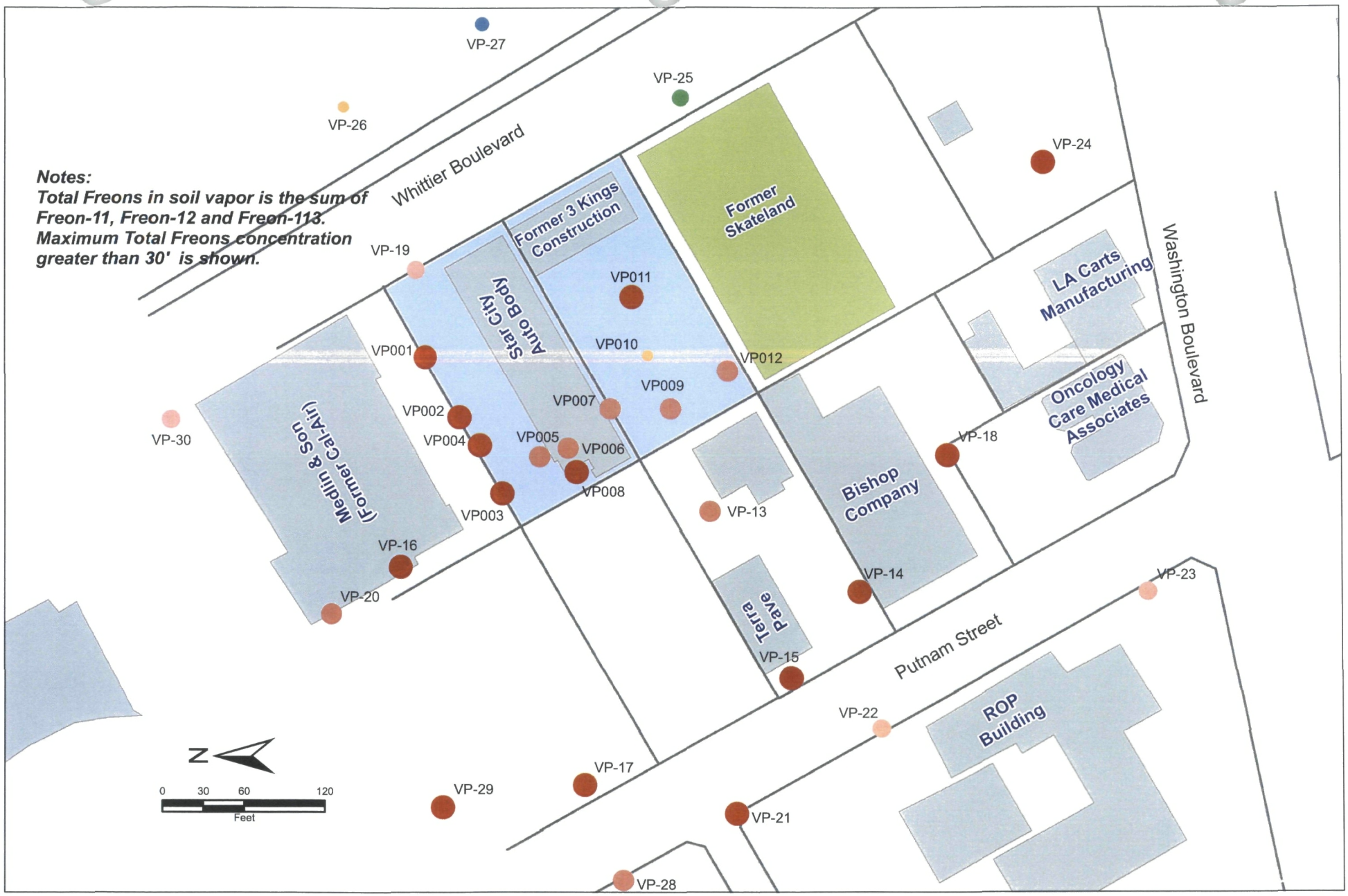
Omega Chemical

Soil Vapor Concentrations (> 30 feet)
Total VOCs
Figure 4-10



CDM

Omega Chemical
Soil Vapor Concentrations (0 - 30 feet)
Total Freons
Figure 4-11



Legend

- Property Boundary
- Former Omega Chemical Property
- Existing Building
- Former Building

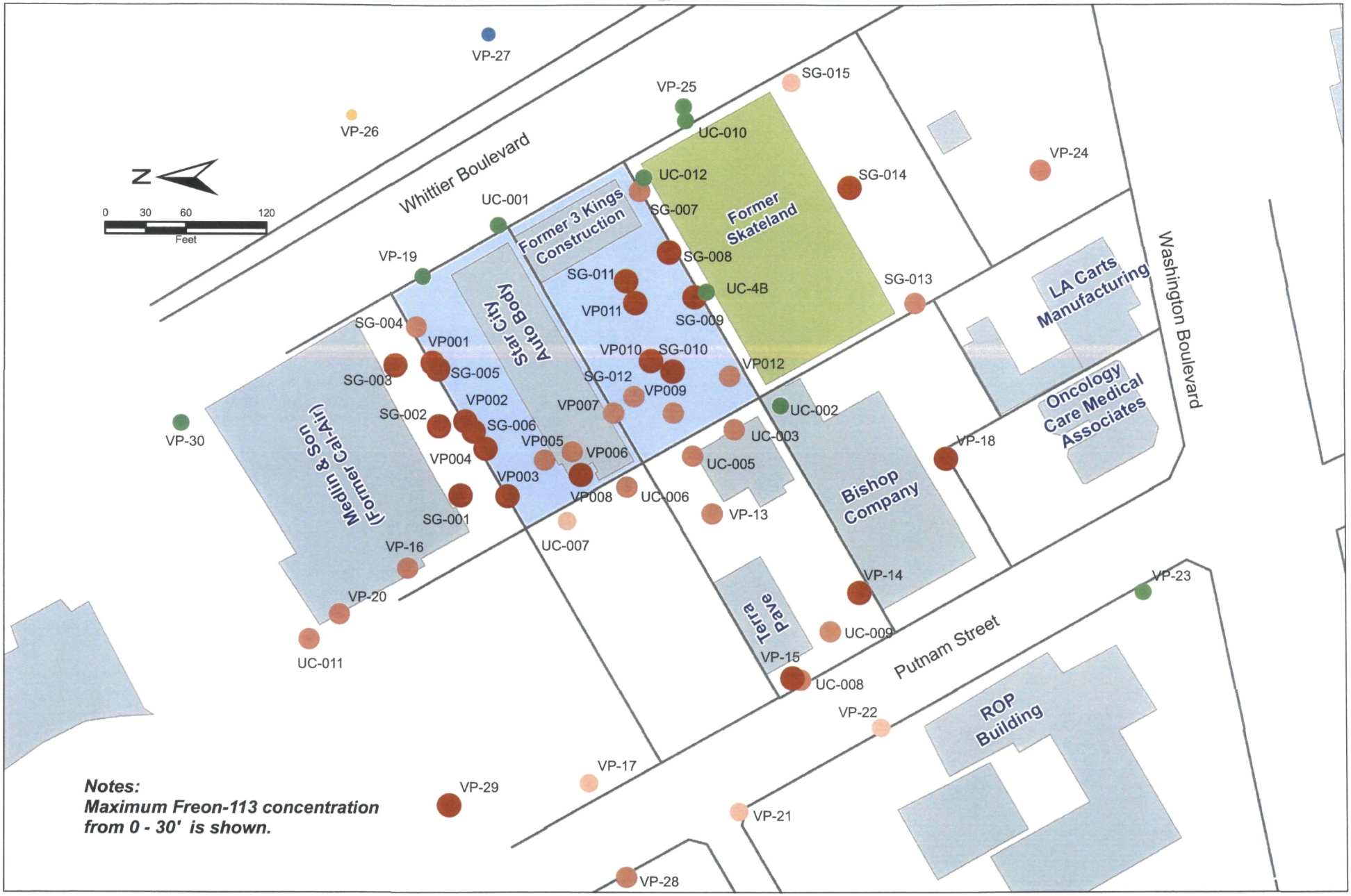
Total Freons (mg/m^3)

- ND - 0.1
- 0.1 - 1
- 1 - 10
- 10 - 100
- 100 - 1,000
- 1,000 - 10,000
- > 10,000

CDM

Omega Chemical

Soil Vapor Concentrations (> 30 feet)
Total Freons
Figure 4-12



Legend

- Property Boundary
- Former Omega Chemical Property
- Existing Building
- Former Building

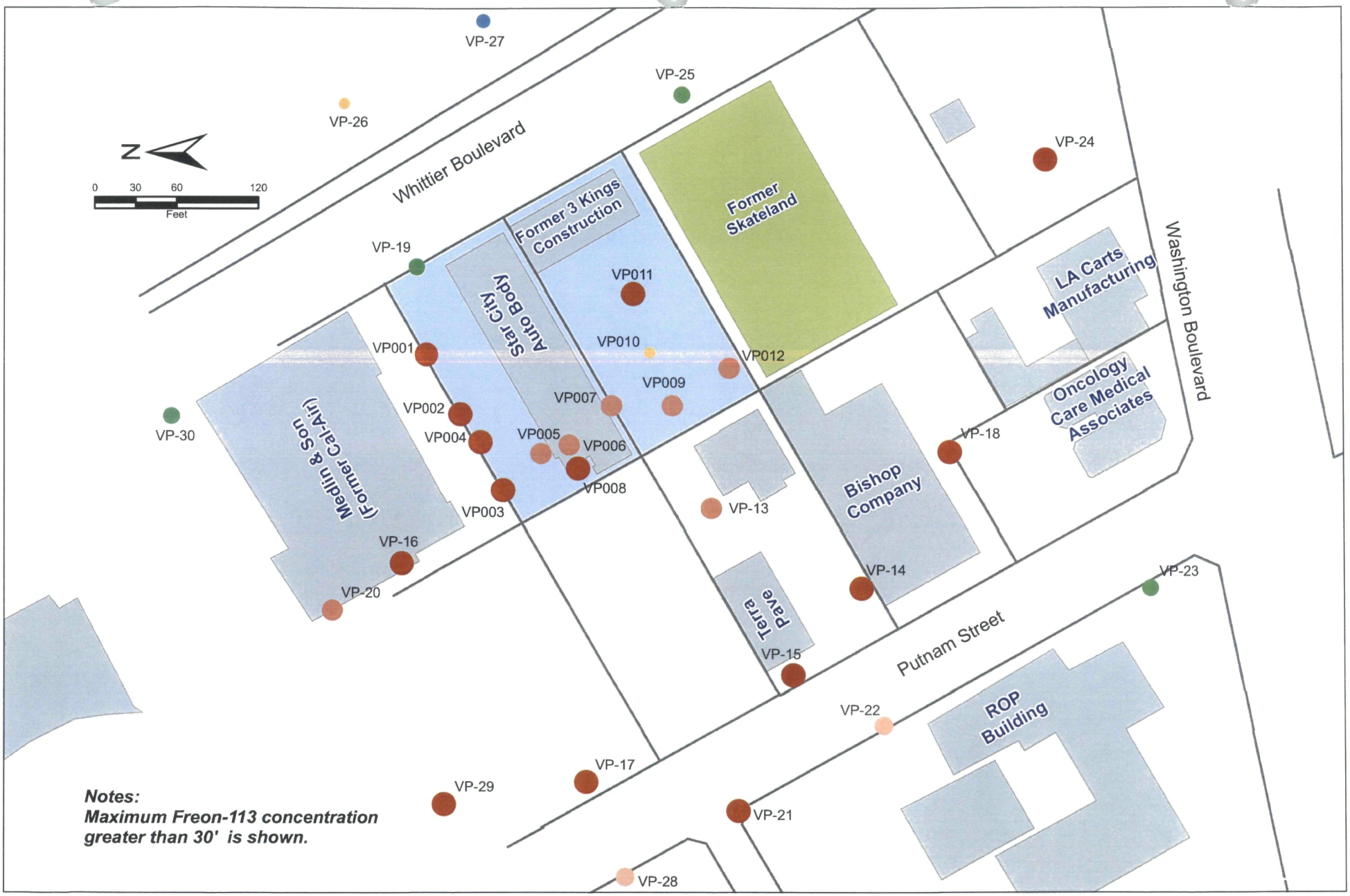
Freons-113 (mg/m³)

- ND - 0.1
- 0.1 - 1
- 1 - 10
- 10 - 100
- 100 - 1,000
- 1,000 - 10,000
- > 10,000

CDM

Omega Chemical

Soil Vapor Concentrations (0 - 30 feet)
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon-113)
Figure 4-13



Legend

- Property Boundary
- Former Omega Chemical Property
- Existing Building
- Former Building

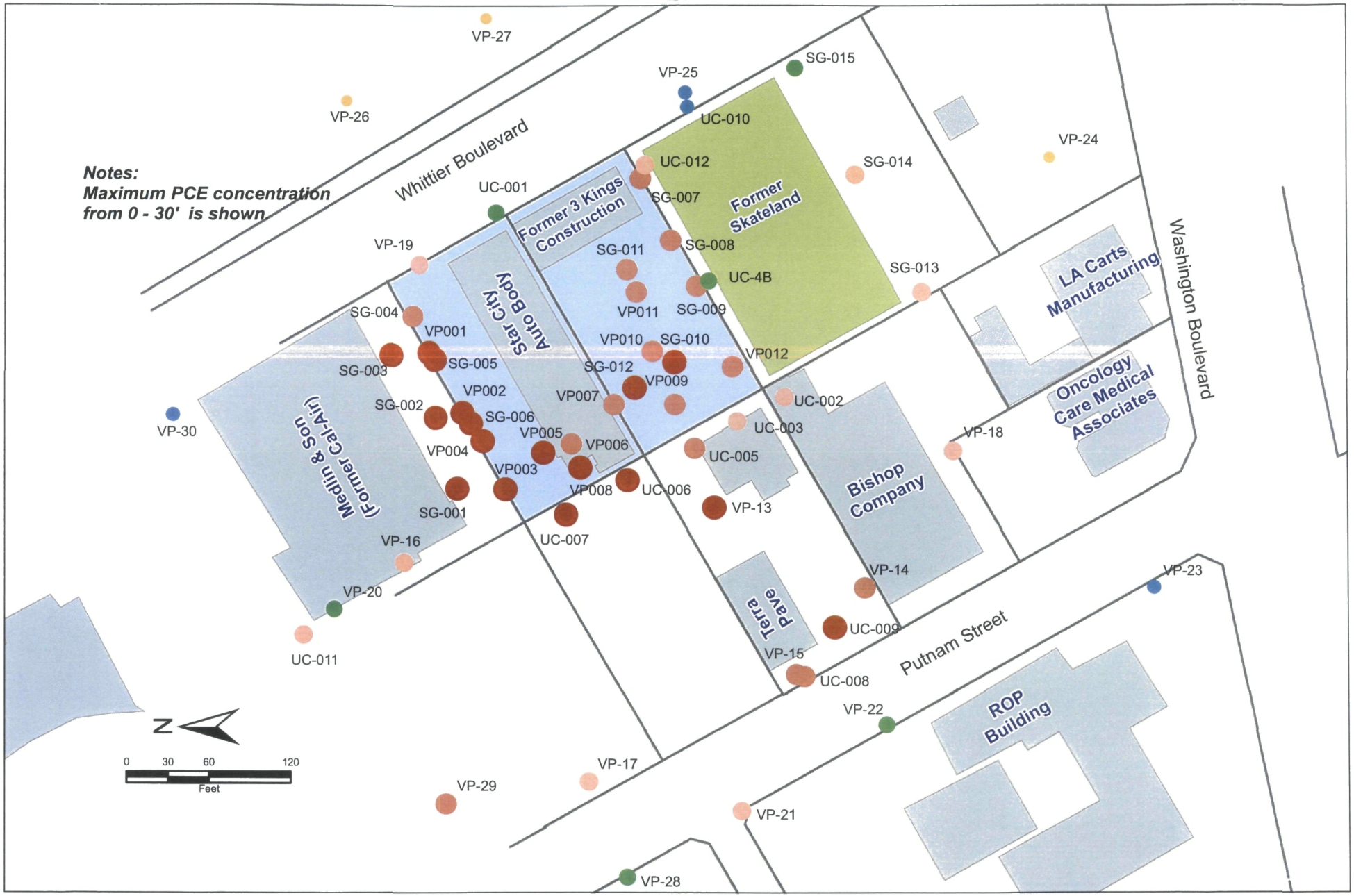
Freon-113 (mg/m³)

- ND - 0.1
- 0.1 - 1
- 1 - 10
- 10 - 100
- 100 - 1,000
- 1,000 - 10,000
- > 10,000

CDM

Omega Chemical

Soil Vapor Concentrations (> 30 feet)
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon-113)
Figure 4-14



Legend

- Property Boundary
- Former Omega Chemical Property
- Existing Building
- Former Building

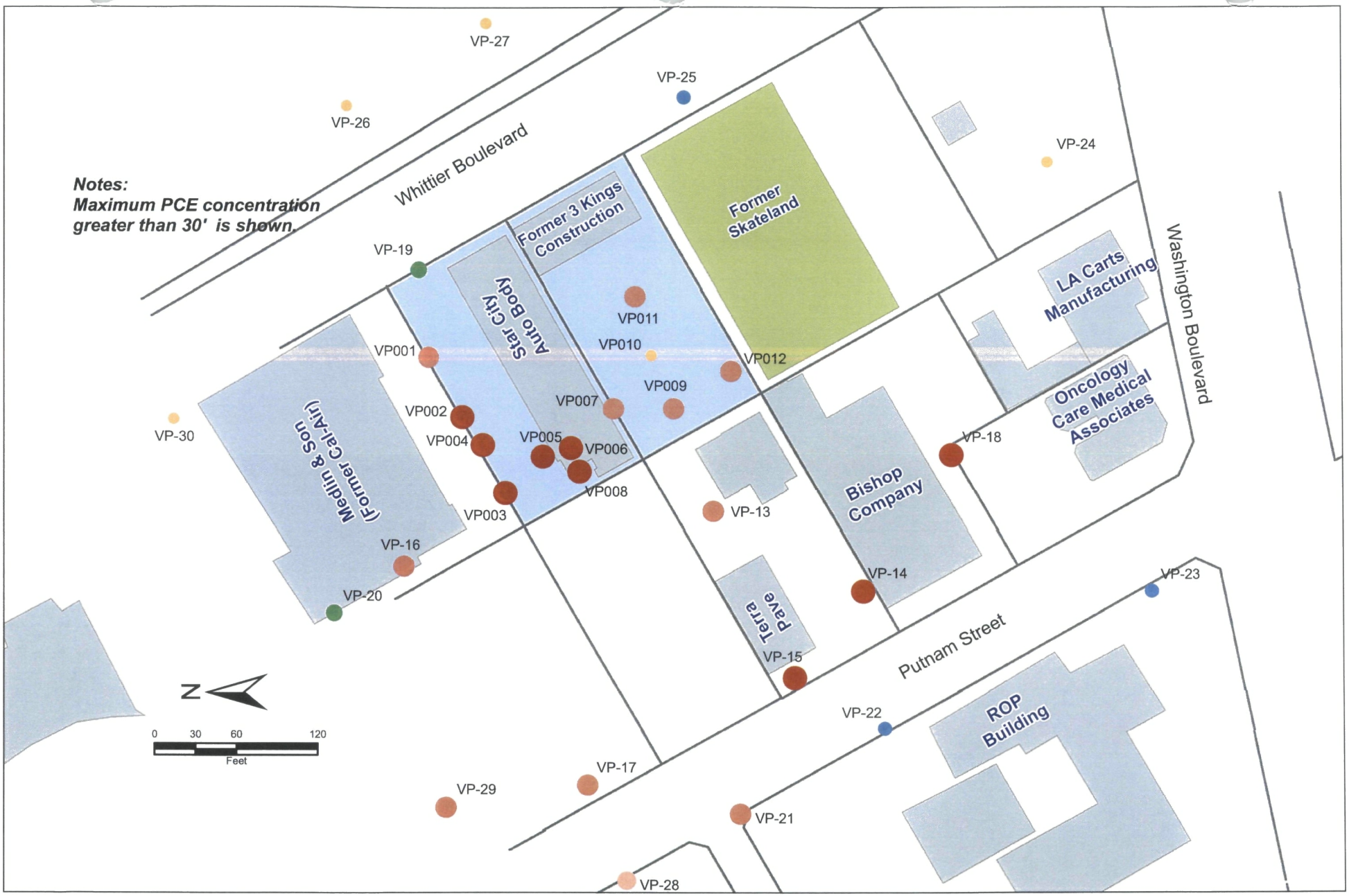
PCE (mg/m³)

- ND - 0.1
- 0.1 - 1
- 1 - 10
- 10 - 100
- 100 - 1,000
- 1,000 - 10,000
- > 10,000

CDM

Omega Chemical

Soil Vapor Concentrations (0 - 30 feet)
Tetrachloroethene (PCE)
Figure 4-15



Legend

- Property Boundary
- Former Omega Chemical Property
- Existing Building
- Former Building

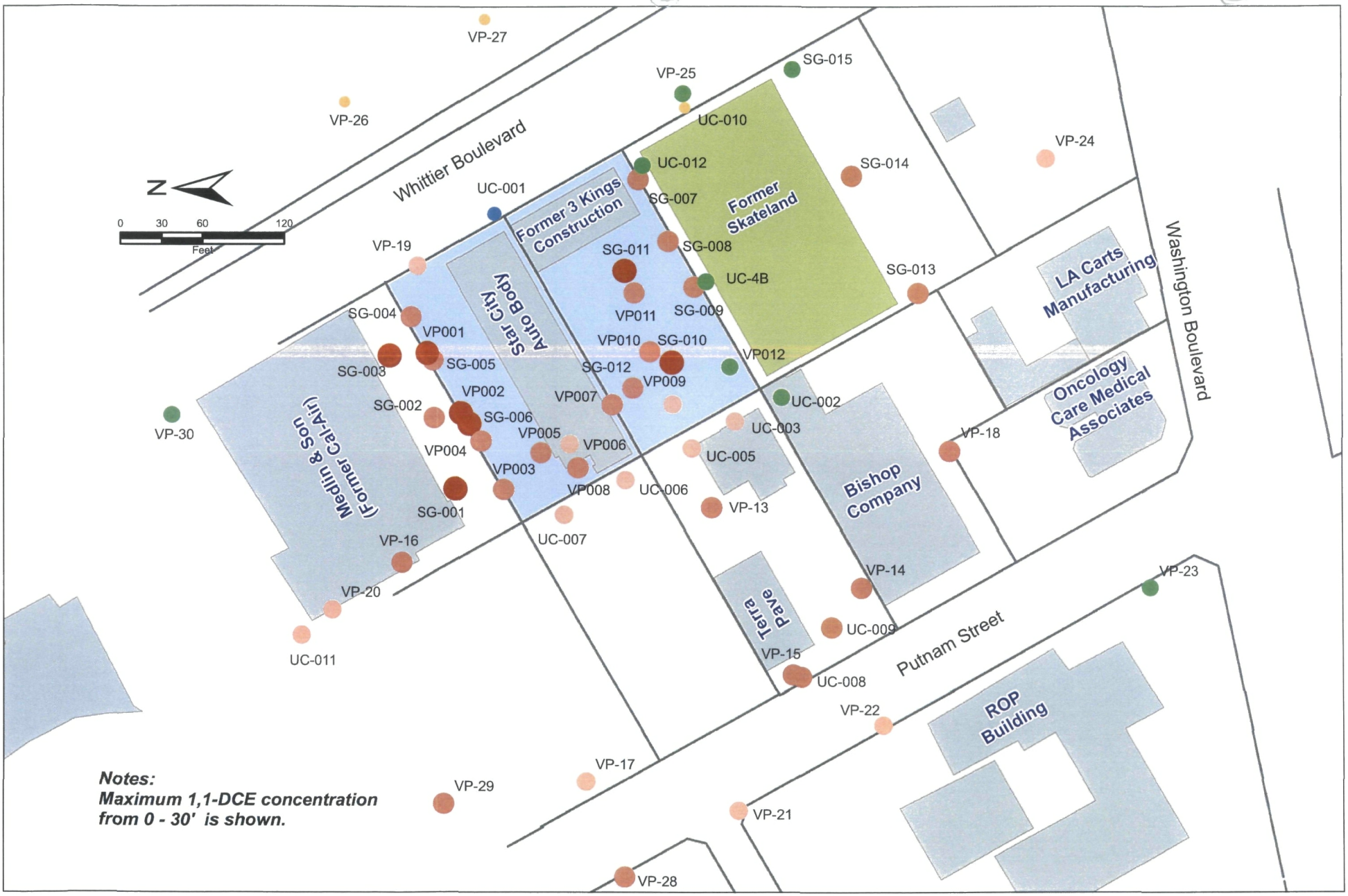
PCE (mg/m³)

- ND - 0.1
- 0.1 - 1
- 1 - 10
- 10 - 100
- 100 - 1,000
- 1,000 - 10,000
- > 10,000

CDM

Omega Chemical

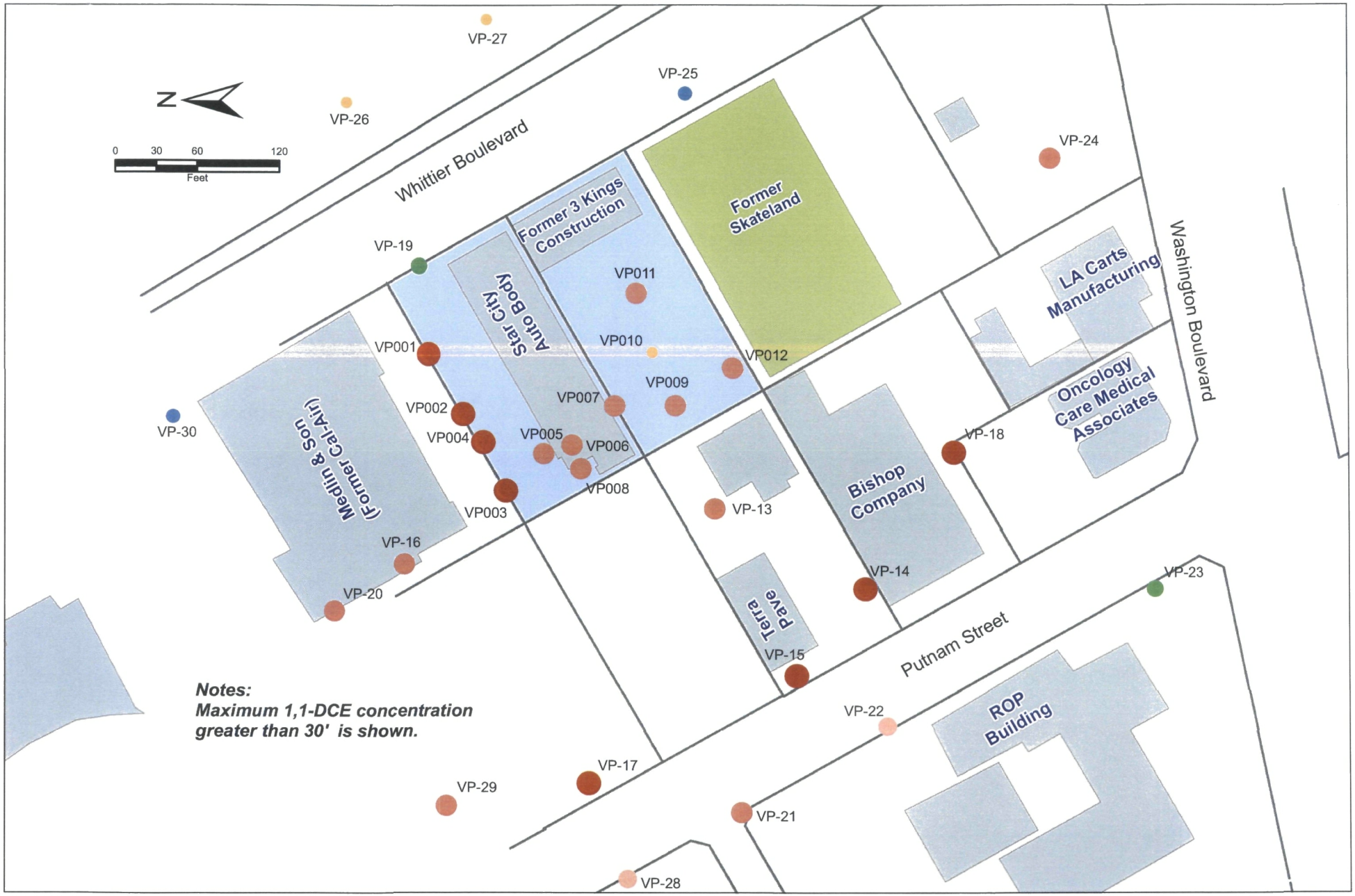
Soil Vapor Concentrations (> 30 feet)
Tetrachloroethene (PCE)
Figure 4-16



CDM

Omega Chemical

Soil Vapor Concentrations (0 - 30 feet)
1,1-Dichloroethene (1,1-DCE)
Figure 4-17



Legend

- Property Boundary
- Former Omega Chemical Property
- Existing Building
- Former Building

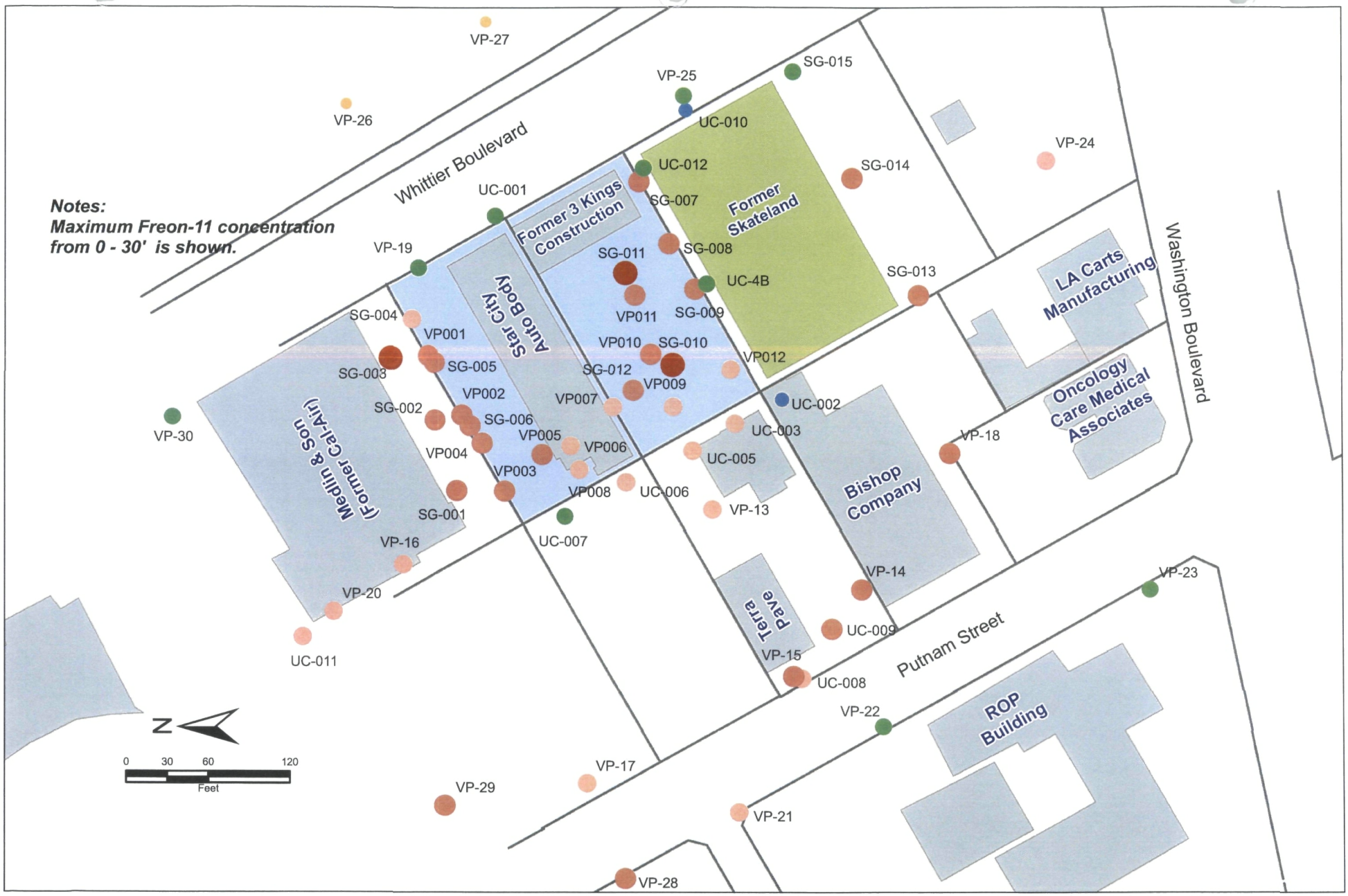
1,1-DCE (mg/m³)

- ND - 0.1
- 0.1 - 1
- 1 - 10
- 10 - 100
- 100 - 1,000
- 1,000 - 10,000
- > 10,000

CDM

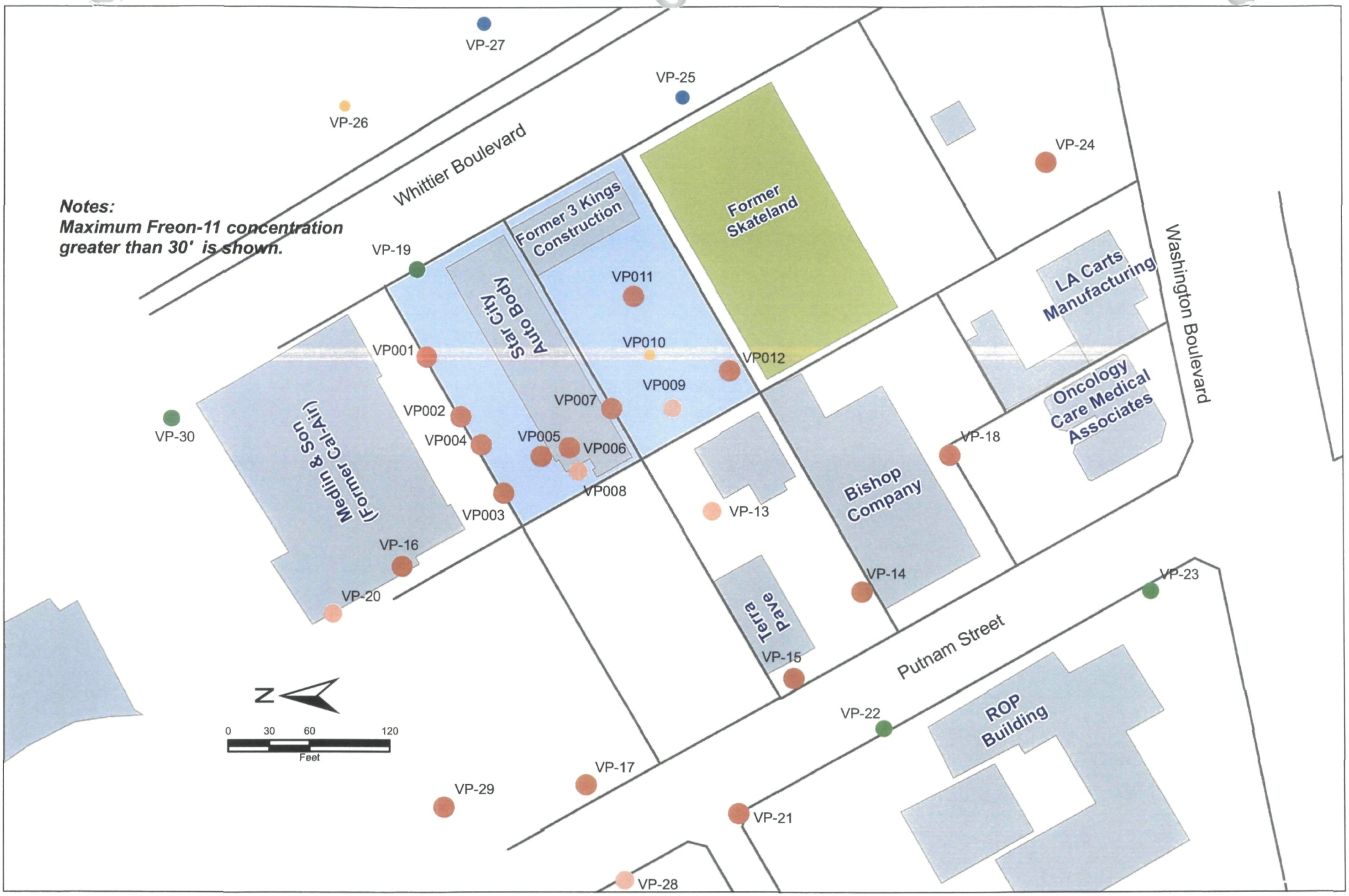
Omega Chemical

Soil Vapor Concentrations (> 30 feet)
1,1-Dichloroethene (1,1-DCE)
Figure 4-18



Omega Chemical

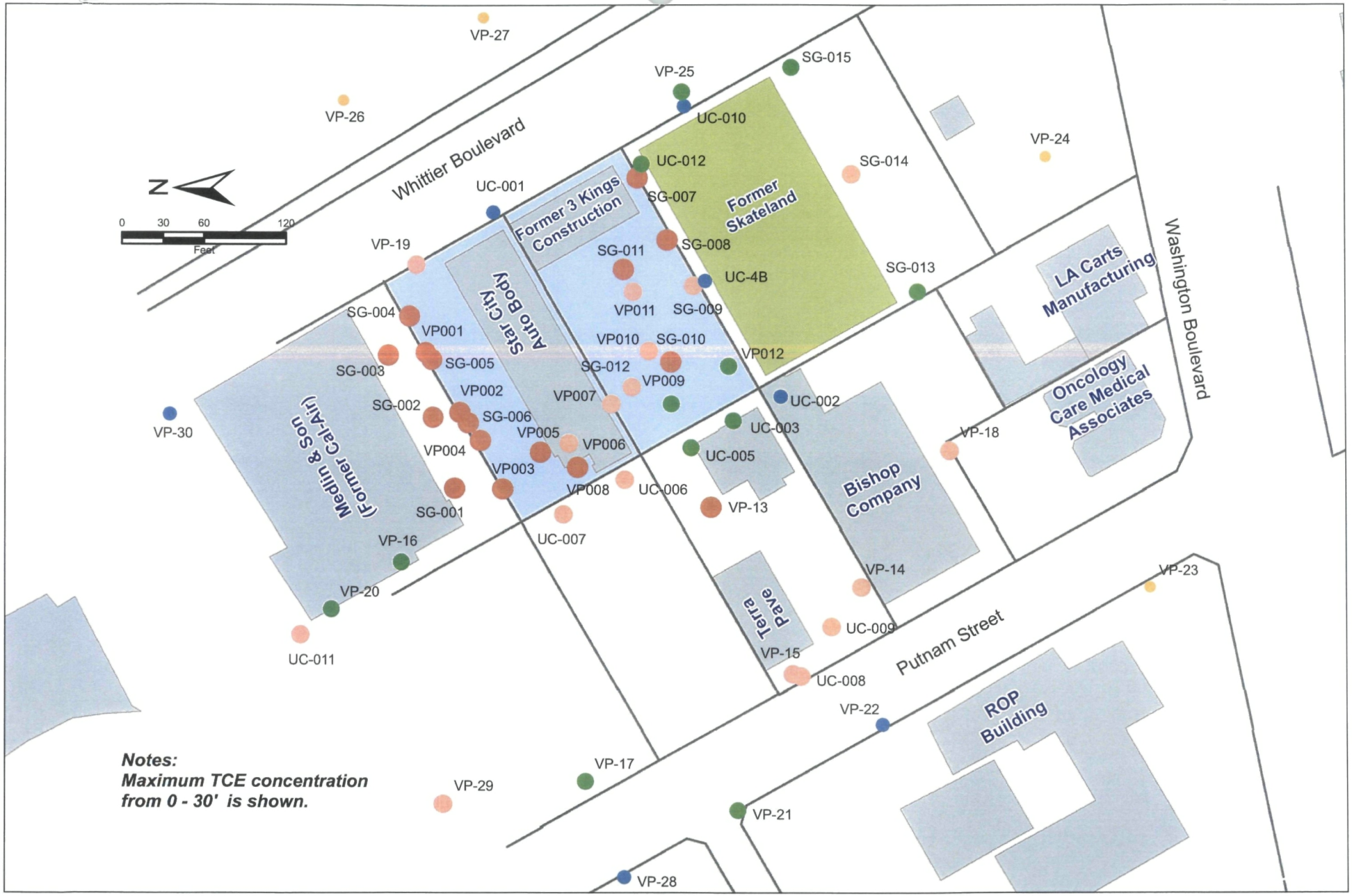
Soil Vapor Concentrations (0 - 30 feet)
Trichlorofluoro-methane (Freon-11)
Figure 4-19



CDM

Omega Chemical

Soil Vapor Concentrations (> 30 feet)
Trichlorofluoro-methane (Freon-11)
Figure 4-20



Legend

- Property Boundary
- Former Omega Chemical Property
- Existing Building
- Former Building

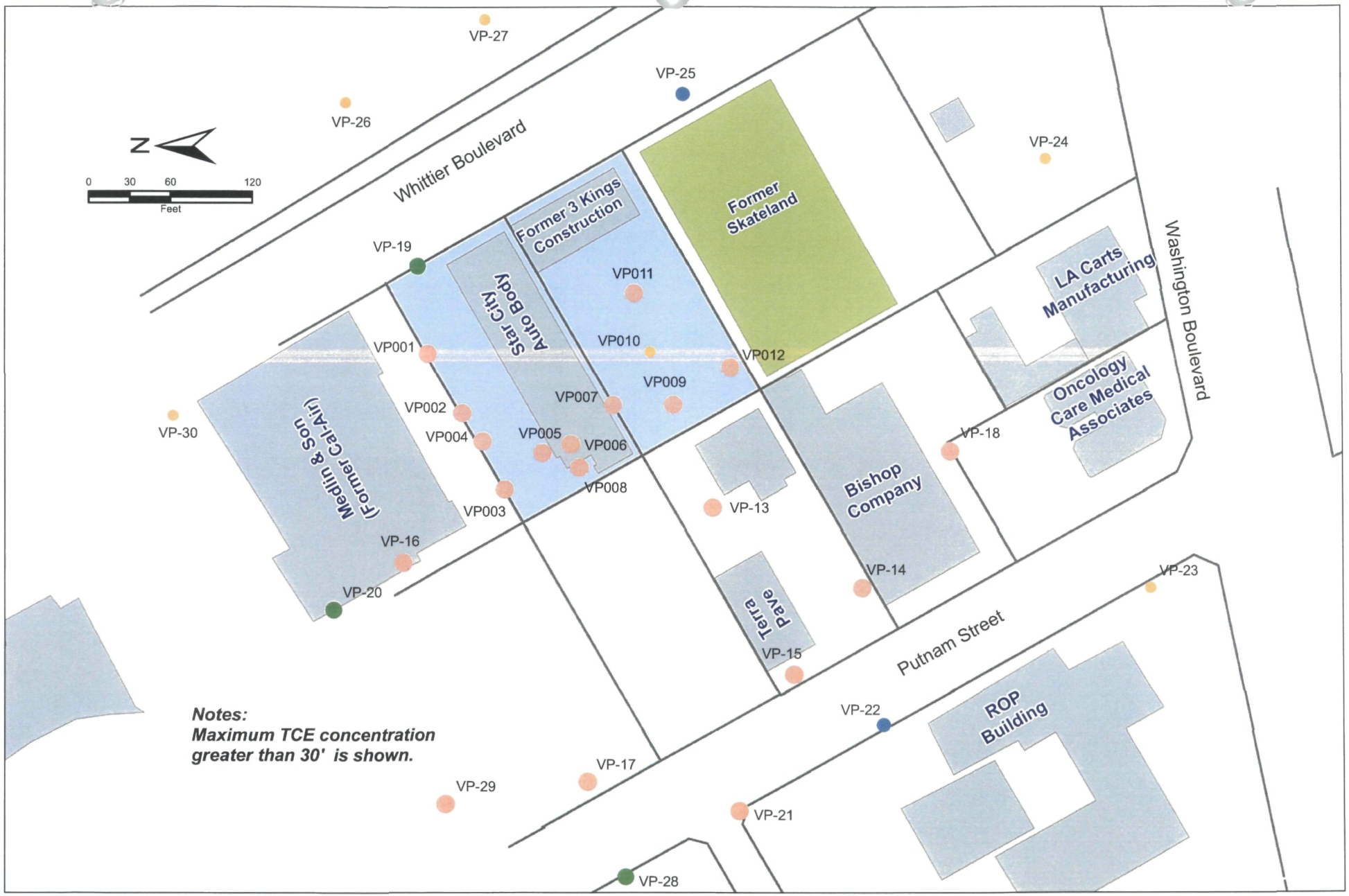
TCE (mg/m^3)

- ND - 0.1
- 0.1 - 1
- 1 - 10
- 10 - 100
- 100 - 1,000
- 1,000 - 10,000
- > 10,000

CDM

Omega Chemical

Soil Vapor Concentrations (0 - 30 feet)
Trichloroethene (TCE)
Figure 4-21



Legend

- Property Boundary
- Former Omega Chemical Property
- Existing Building
- Former Building

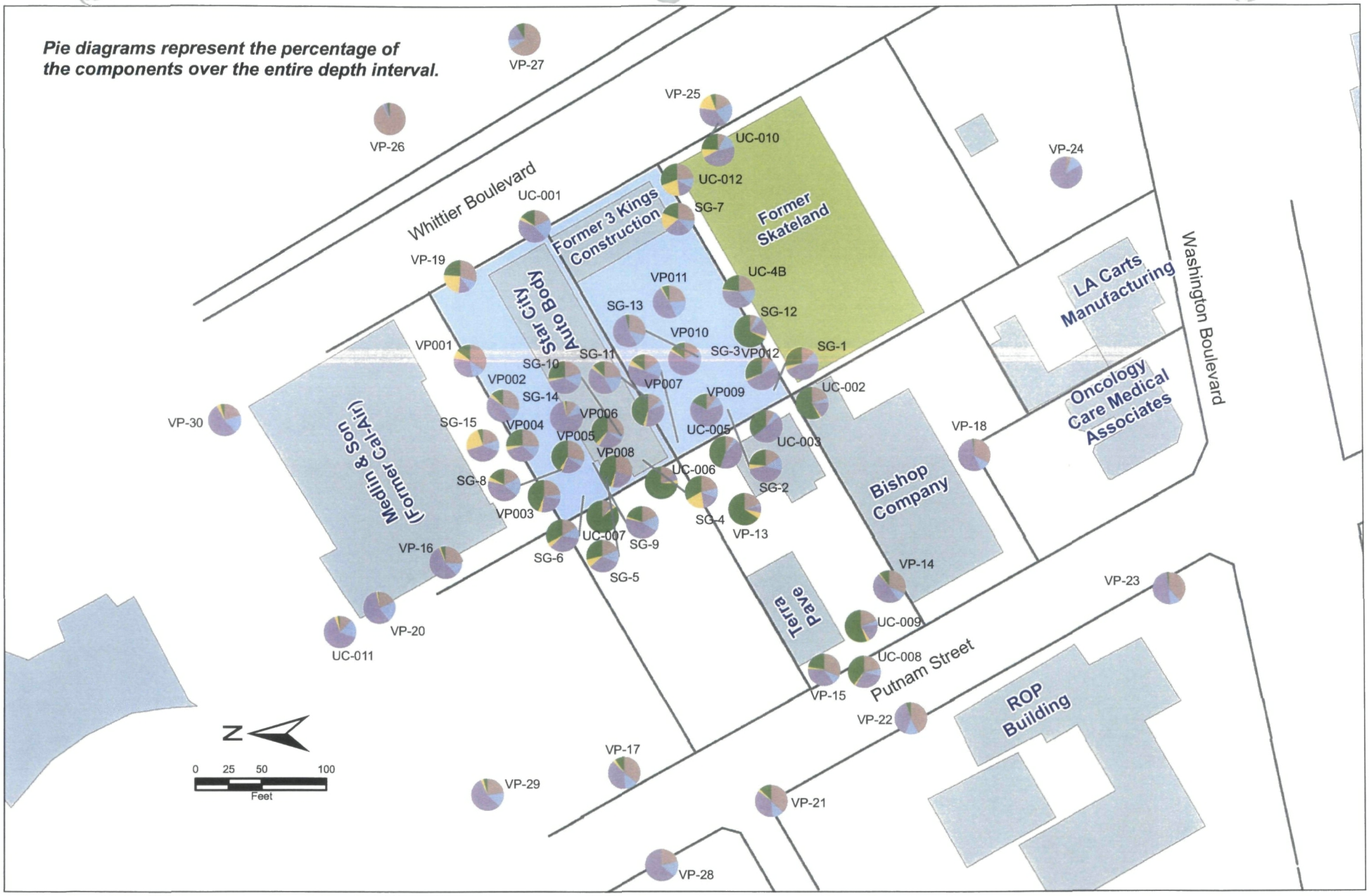
TCE (mg/m3)

- ND - 0.1
- 0.1 - 1
- 1 - 10
- 10 - 100
- 100 - 1,000
- 1,000 - 10,000
- > 10,000

CDM

Omega Chemical

Soil Vapor Concentrations (> 30 feet)
Trichloroethene (TCE)
Figure 4-22



Legend

- Property Boundary
- Former Omega Chemical Property
- Existing Building
- Former Building

PCE, TCE, Freon-113, Freon-11 and Other VOCs

- PCE
- TCE
- Freon-113
- Freon-11
- Other VOCs

CDM

Omega Chemical

Soil Vapor Concentrations PCE, TCE, Freon-11, Freon-113, Other VOCs Ratio (0 - 30 feet)

Figure 4-23

Legend

- Property Boundary
- Former Omega Chemical Property
- Existing Building
- Former Building

PCE, TCE, Freon-113, Freon-11 and Other VOCs

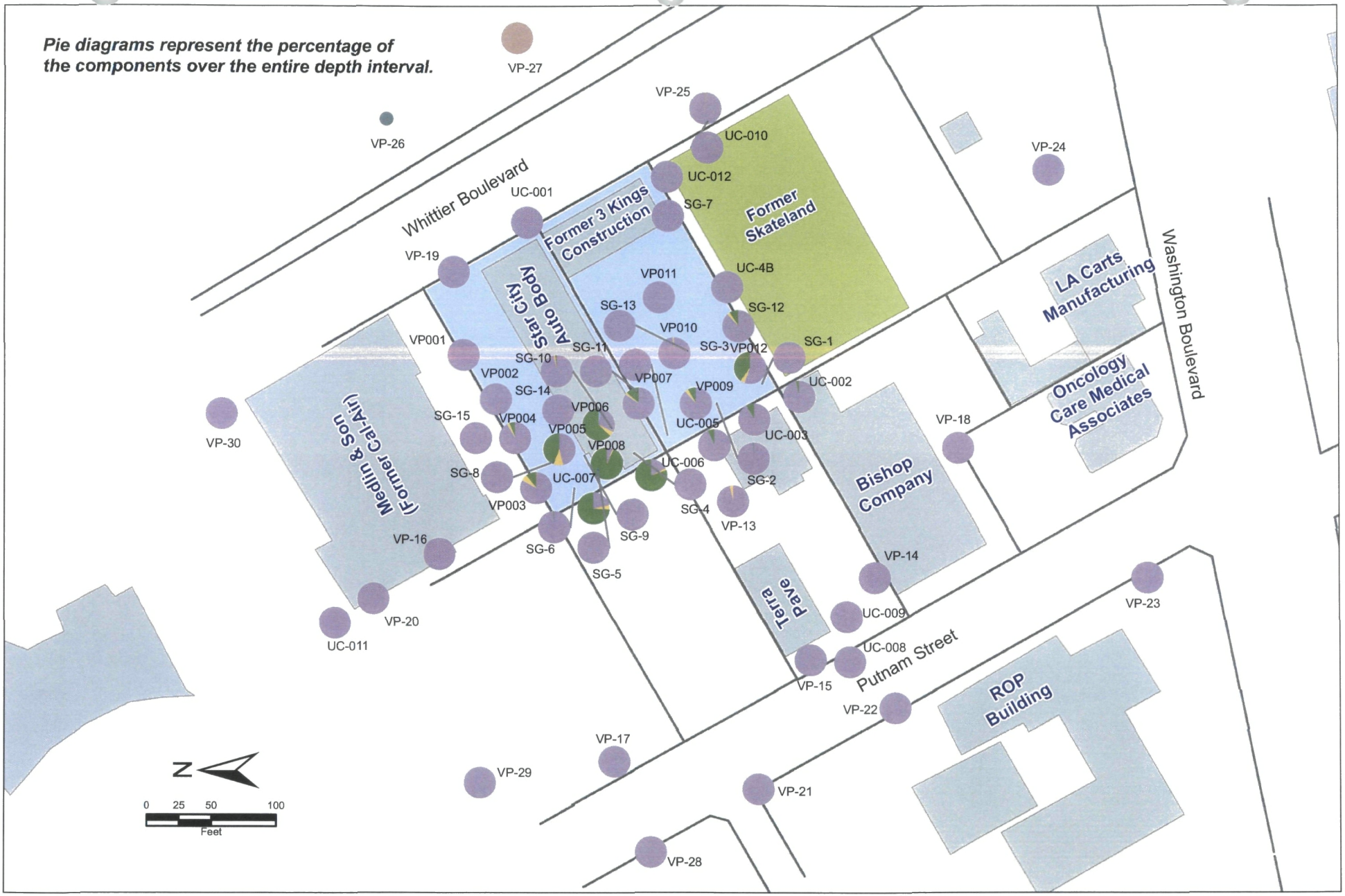
- PCE
- TCE
- Freon-113
- Freon-11
- Other VOCs

CDM

Omega Chemical

Soil Vapor Concentrations PCE, TCE, Freon-11, Freon-113, Other VOCs Ratio (> 30 feet)

Figure 4-24



Legend

- Property Boundary
- Former Omega Chemical Property
- Existing Building
- Former Building

Other VOCs

- 1,1,1-TCA
- 1,1-DCA
- 1,1-DCE
- 1,2-DCA
- Methylene Chloride
- Not Detected

CDM

Omega Chemical
Soil Vapor Concentrations
Other VOCs Ratio (0 - 30 feet)
Figure 4-25

Legend

- Property Boundary
- Former Omega Chemical Property
- Existing Building
- Former Building

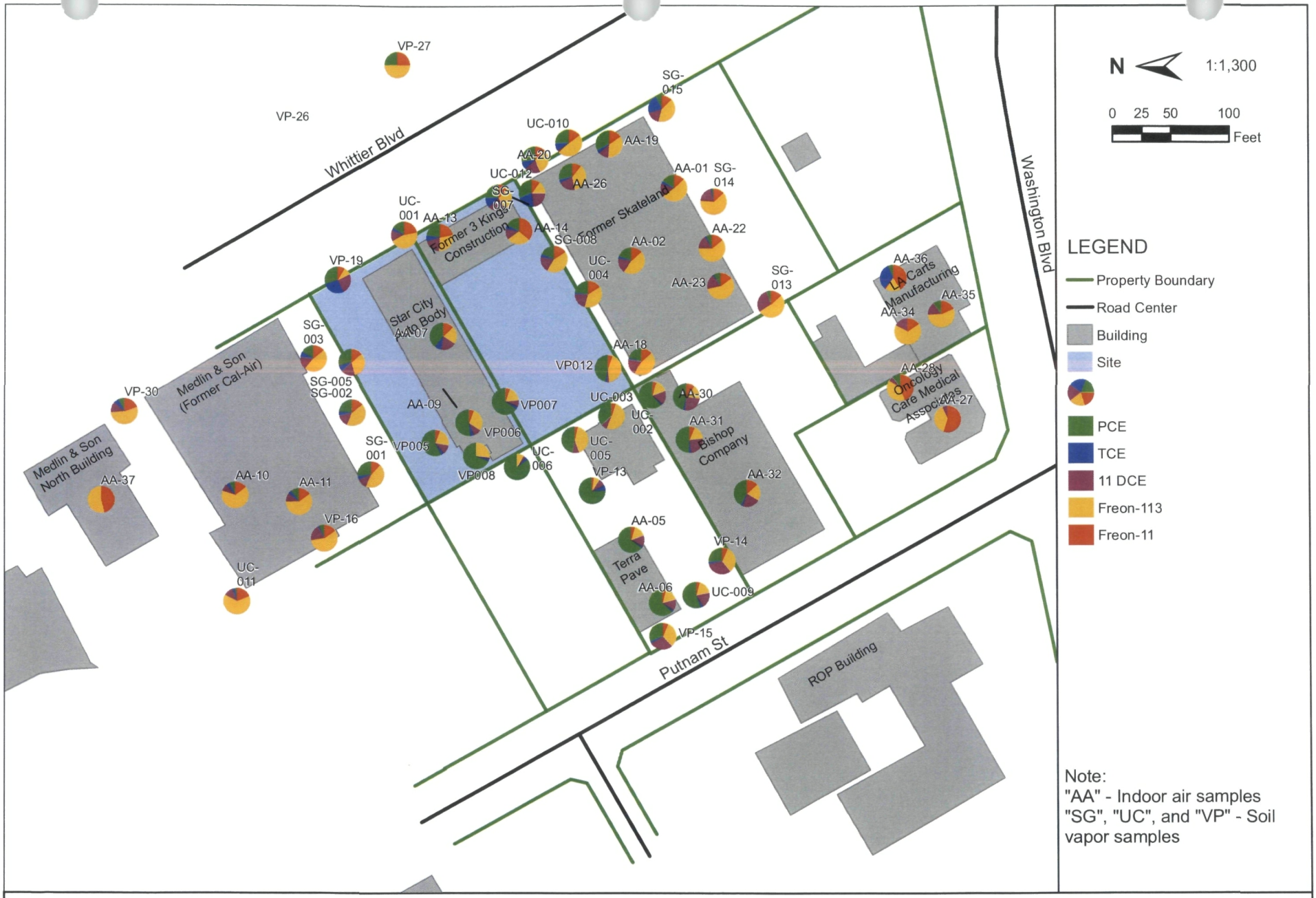
Other VOCs

- 1,1,1-TCA
- 1,2-DCA
- 1,1-DCA
- Methylene Chloride
- 1,1-DCE

CDM

Omega Chemical

Soil Vapor Concentrations
Other VOCs Ratio (> 30 feet)
Figure 4-26



OMEGA CHEMICAL

Shallow Soil Vapor and Indoor Air Pie Charts

CDM

FIGURE 4-27

Figure 4-28 MIP-GP4 PID and Total VOC Soil Concentrations at an Adjacent Boring

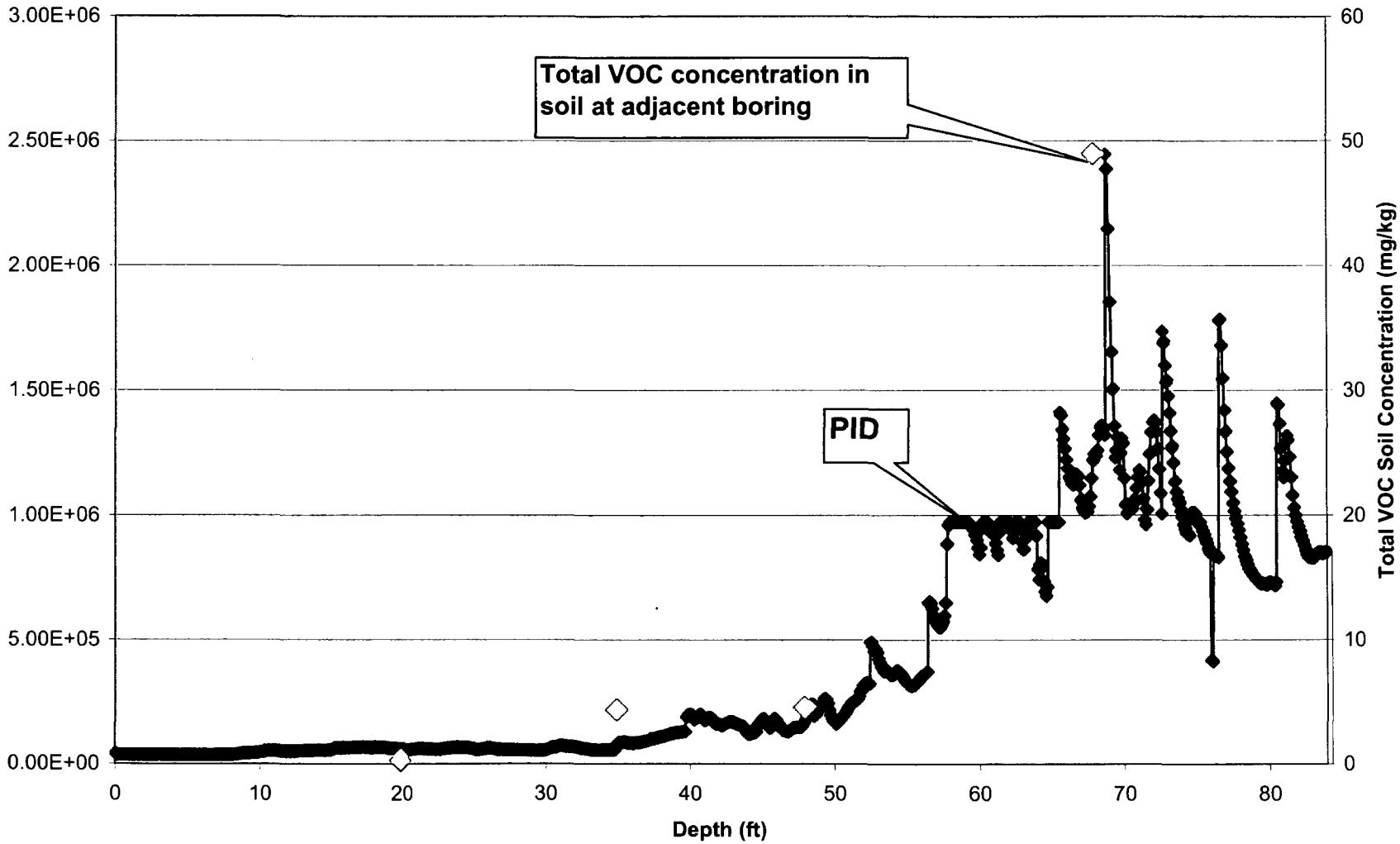


Figure 4-29 MIP-GP6 PID and Total VOCs in Soil from an Adjacent Boring

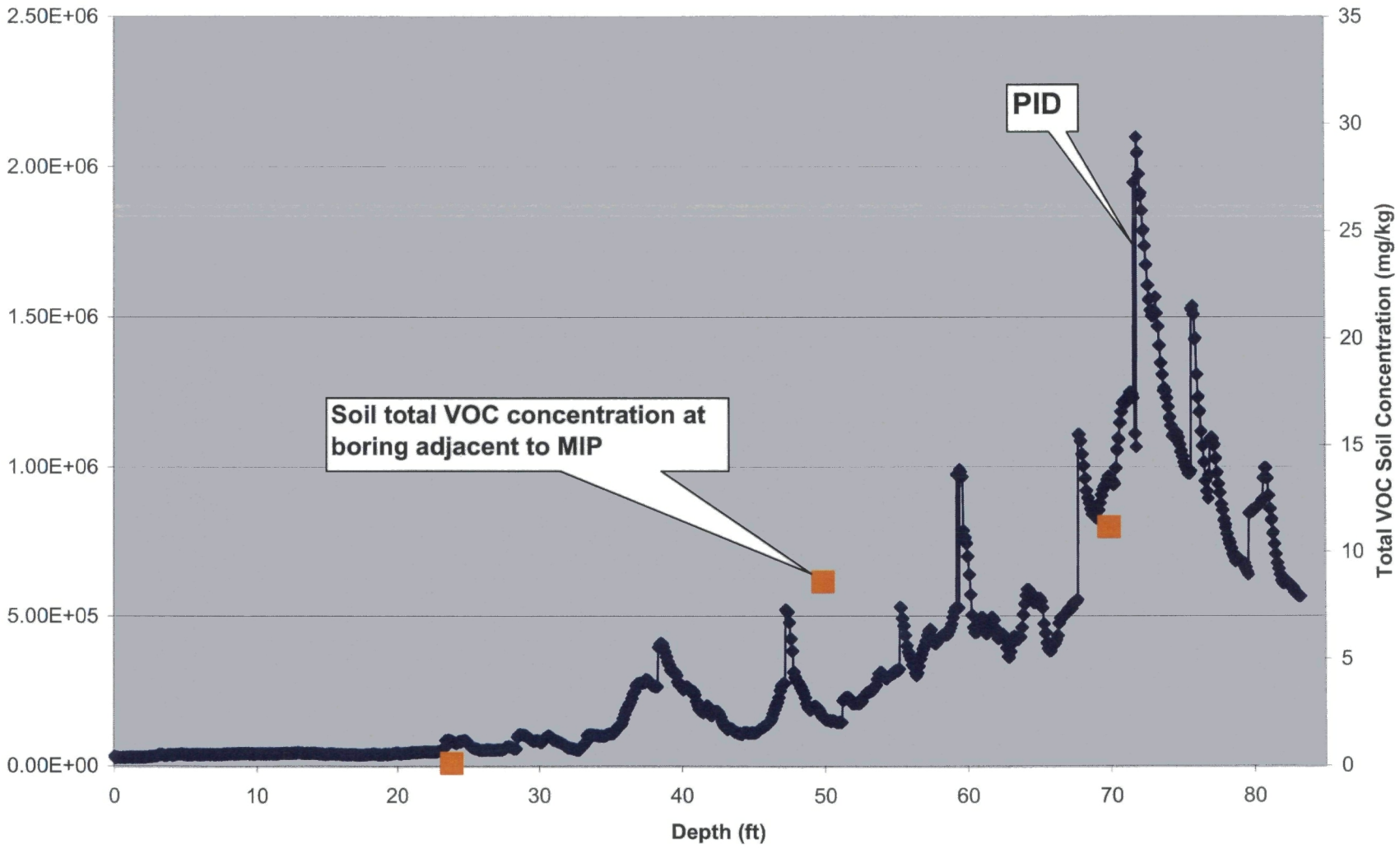


Figure 4-30 MIP-29 ECD and TVOCs in Adjacent Soil Vapor

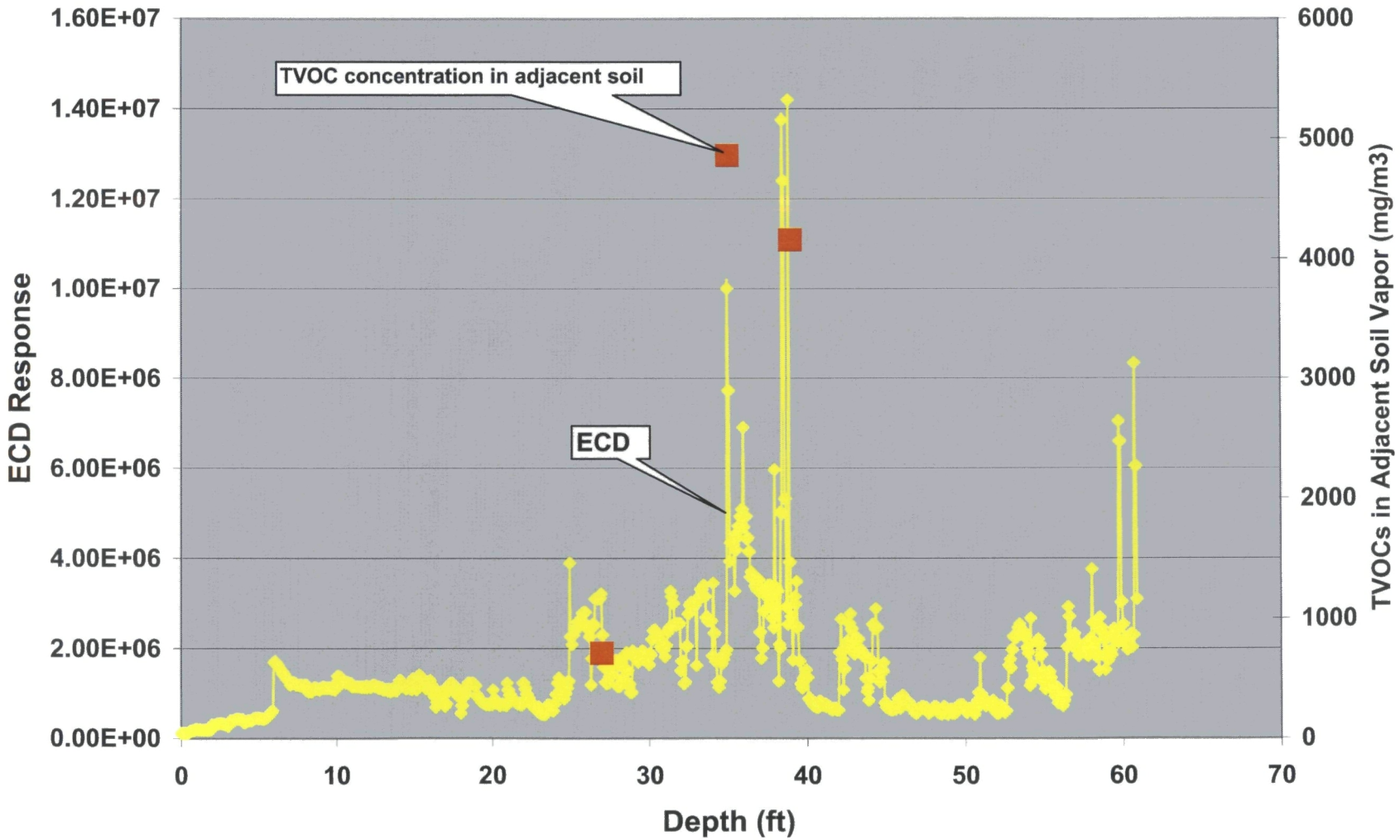


Figure 4-31 MIP-30 ECD and TVOCs in Adjacent Soil Vapor

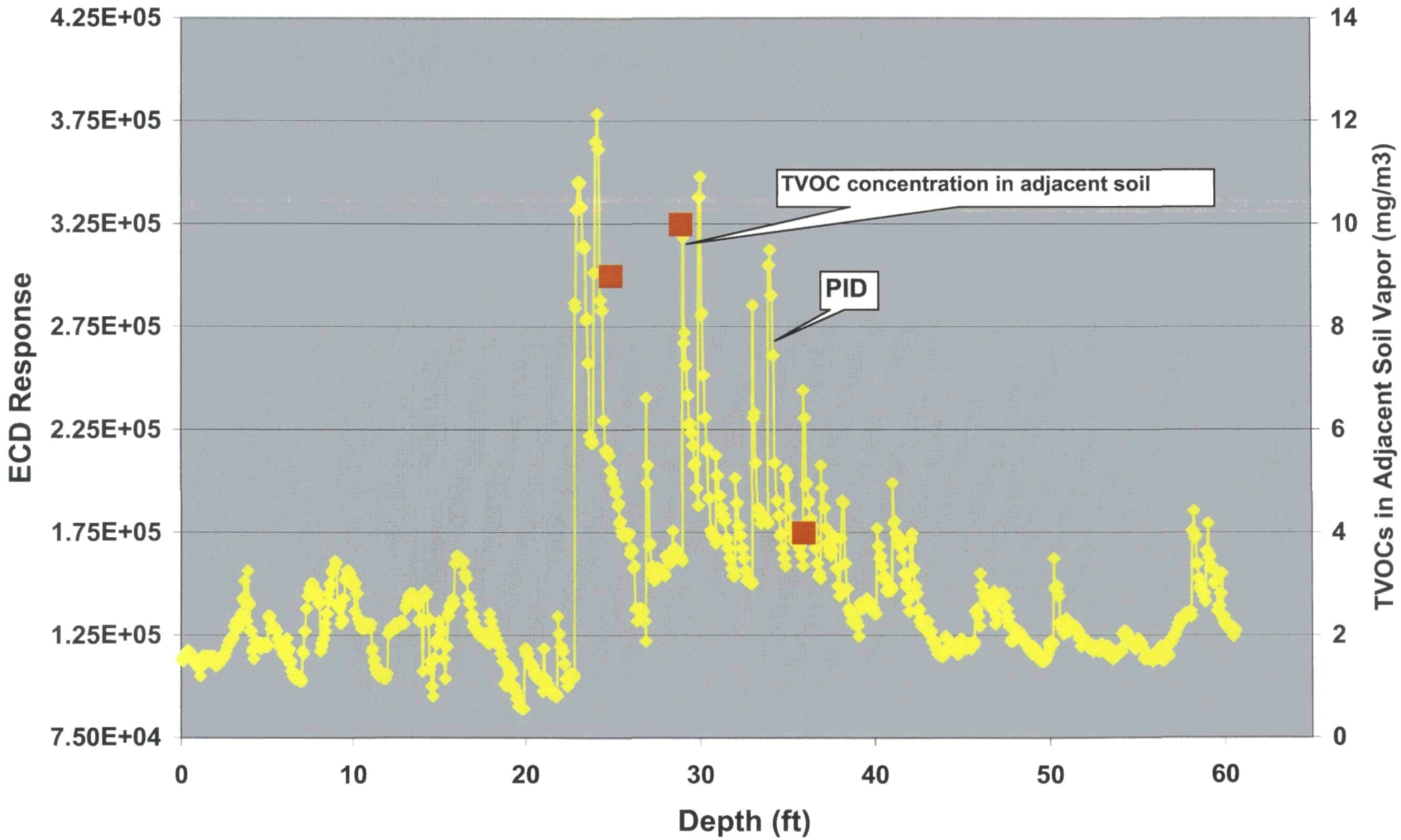


Figure 4-32 MIP-28 ECD and TVOCs in Adjacent Soil Vapor

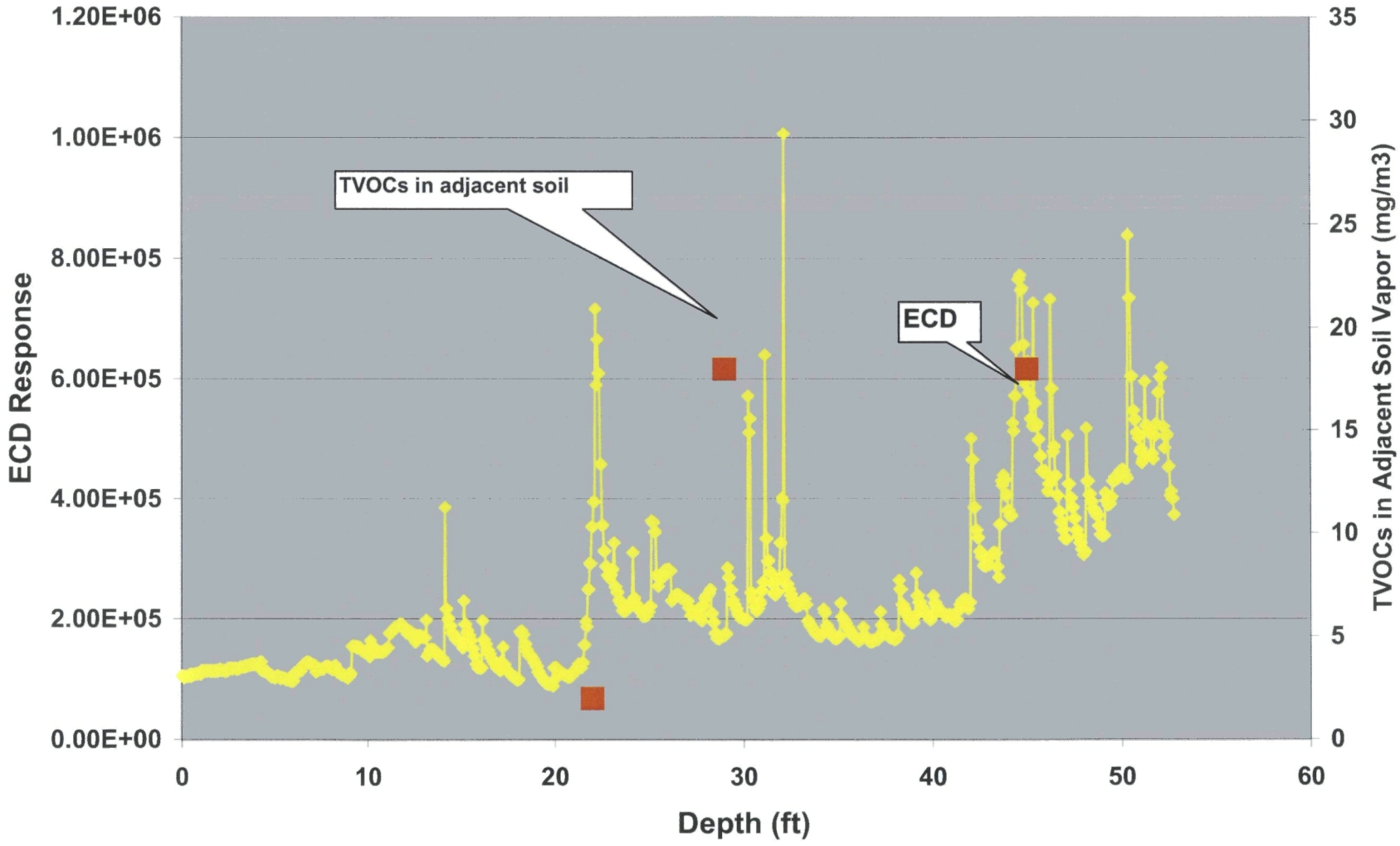


Figure 4-33 MIP-6 ECD and Total VOCs in Soil Vapor at Nearby VP-12

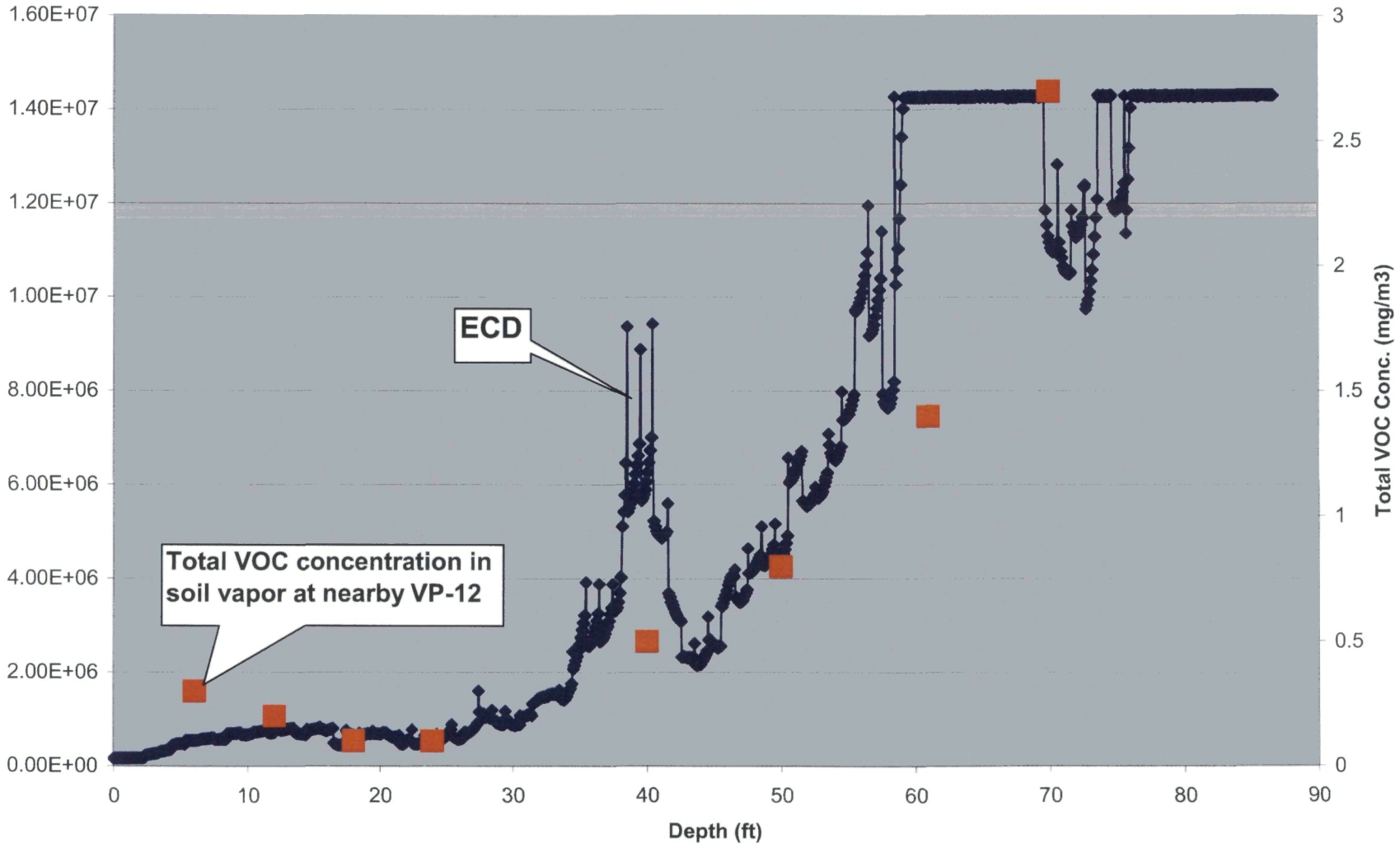


Figure 4-34 MIP-14 PID and TVOCs in Adjacent Soil

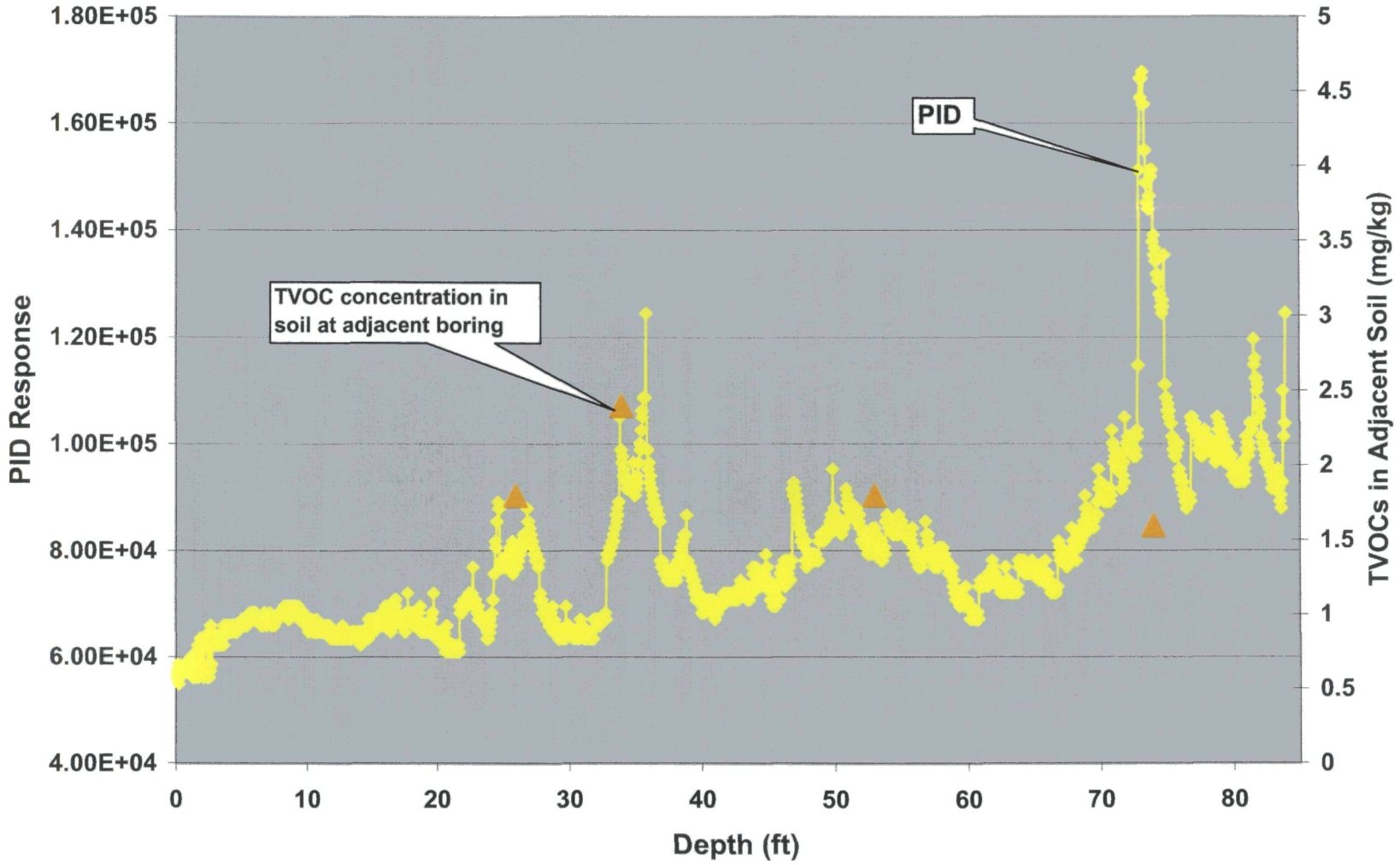


Figure 4-35 MIP-22 PID and TVOCs in Adjacent Soil

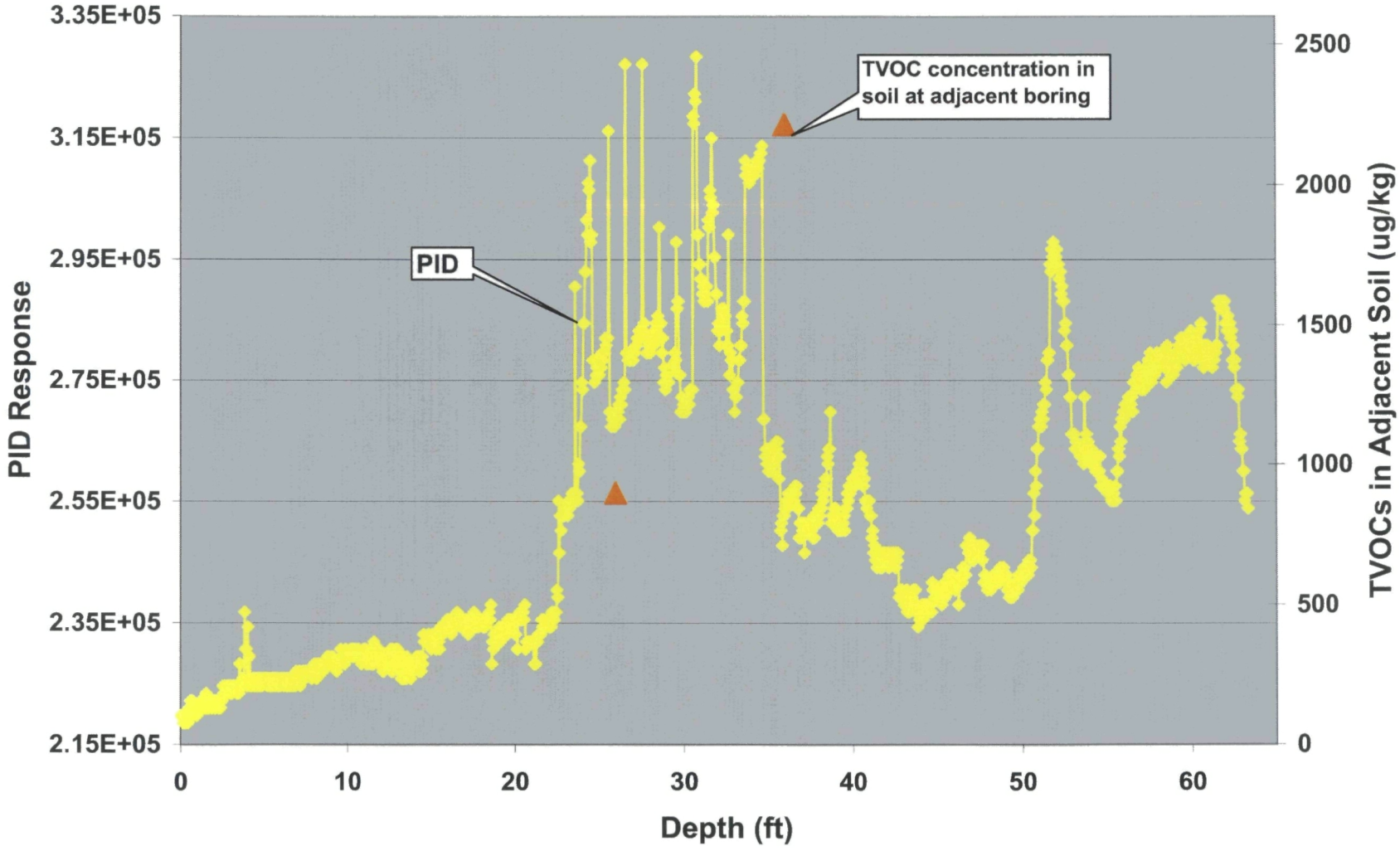


Figure 4-36 MIP-26 PID and TVOCs in Adjacent Soils

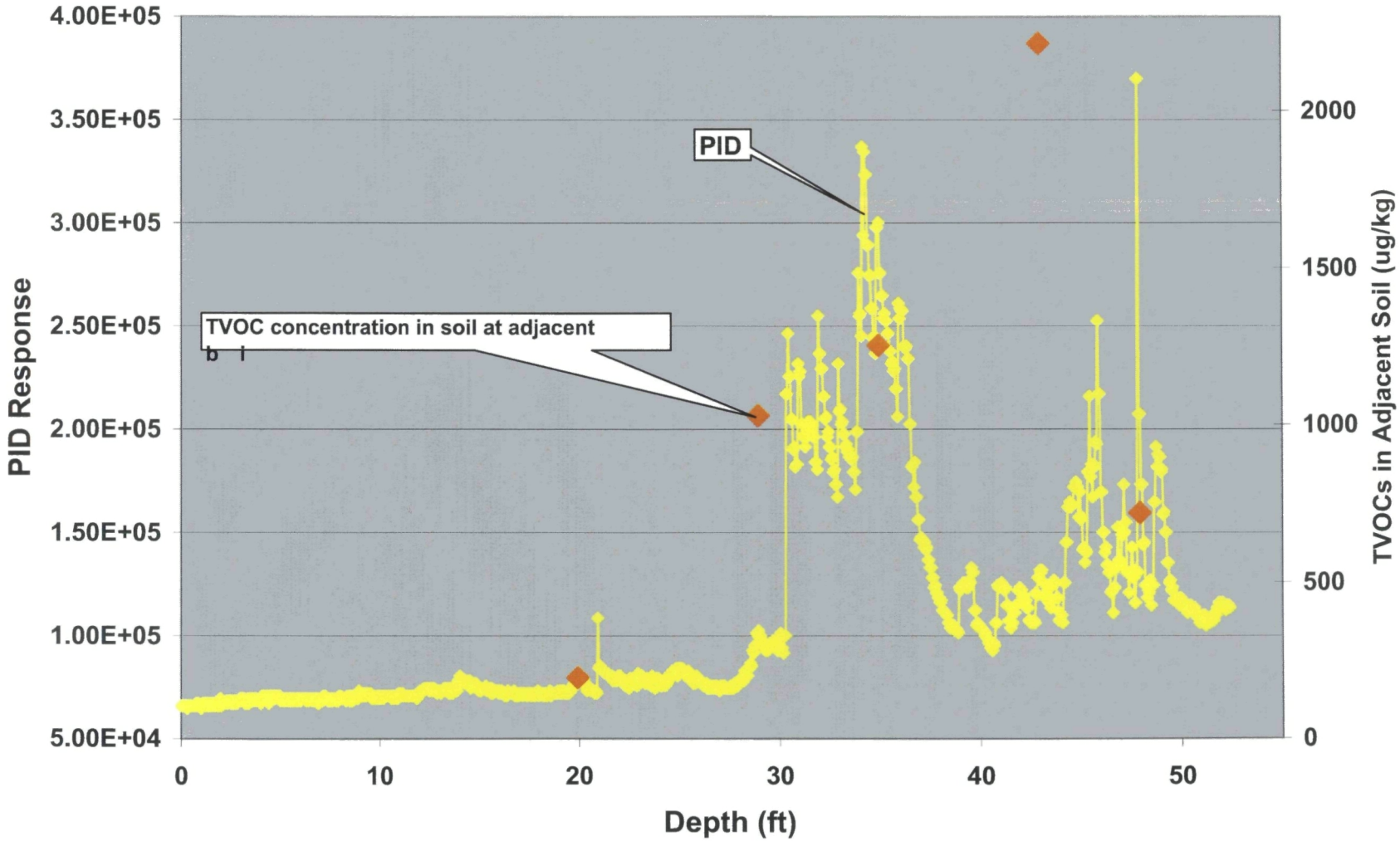


Table 4-1
Omega Chemical Superfund Site
Statistical Summary
Surface Soil Samples

Parameter	Total number of samples	Minimum Reporting Limit	Detections					
			Number	Frequency (%)	Minimum	Maximum	Median	Average
1,1'-BIPHENYL	2	0.34						
1,2,4-TRICHLOROBENZENE	20	0.090						
1,2-DICHLOROBENZENE	20	0.090	2	10	0.083	0.24	0.16	0.16
1,2-DIPHENYLHYDRAZINE	20	0.090						
1,3-DICHLOROBENZENE	20	0.090						
1,4-DICHLOROBENZENE	20	0.090						
1,4-DIOXANE	19	0.030	10	53	0.014	14	0.093	1.7
2,4,5- TRICHLOROPHENOL	22	0.20						
2,4,6-TRICHLOROPHENOL	22	0.20						
2,4-DICHLOROPHENOL	22	0.090						
2,4-DIMETHYLPHENOL	22	0.090						
2,4-DINITROPHENOL	22	0.50						
2,4-DINITROTOLUENE	22	0.090						
2,6-DINITROTOLUENE	22	0.090						
2-CHLORONAPHTHALENE	22	0.090						
2-CHLOROPHENOL	22	0.090						
2-METHY-4,6-DINITROPHENOL	20	0.50						
2-METHYLNAPHTHALENE	22	0.090	1	4.5	0.48	0.48	0.48	0.48
2-METHYLPHENOL	22	0.090						
2-NAPHTHYLAMINE	20	3.0						
2-NITROANILINE	22	0.090						
2-NITROPHENOL	22	0.090						
3,3-DICHLOROBENZIDINE	20	0.20						
3/4 METHYLPHENOL	20	0.090						
3-NITROANILINE	22	0.090						
4,4'-DDD	42	0.0005	2	4.8	0.0016	0.032	0.017	0.017
4,4'-DDE	42	0.0005	6	14	0.0010	0.30	0.0041	0.053
4,4'-DDT	42	0.0005	6	14	0.0030	0.15	0.012	0.047
4-BROMOPHENYL-PHENYL ETHER	20	0.090						
4-CHLORO-3-METHYLPHENOL	22	0.20						
4-CHLOROANILINE	22	0.090						
4-CHLOROPHENYL-PHENYL ETHER	20	0.20						
4-METHYLPHENOL	2	0.34						
4-NITROANILINE	20	0.20						
4-NITROPHENOL	22	0.20						
ACENAPHTHENE (ETHYLENE NAPHTHALENE)	22	0.090						
ACENAPHTHYLENE	22	0.20						
ACETOPHENONE	2	0.34						
ALDRIN (HHDN)	42	0.0005						
ALPHA - CHLORDANE	2	0.0018						
ALPHA-BHC (A-BHC)	42	0.0005						
ALUMINUM	2		2	100	9410	9830	9620	9620
ANILINE (PHENYLAMINE) (AMINOBENZENE)	20	0.20						
ANTHRACENE	20	0.090						
ANTIMONY	22	6.7	8	36	0.60	0.90	0.70	0.75
ARSENIC	22		22	100	3.0	21	5.5	6.1
BARIUM	22		22	100	75	210	160	155
BENZALDEHYDE	2	0.34						
BENZIDINE	20	3.0						
BENZO(A)ANTHRACENE	20	0.090	1	5.0	0.032	0.032	0.032	0.032
BENZO(A)PYRENE	20	0.090						
BENZO(B)FLUORANTHENE	20	0.090						
BENZO(G,H,I)PERYLENE	20	0.090						
BENZO(K)FLUORANTHENE	20	0.090						
BENZOIC ACID	20	0.50						
BENZYL ALCOHOL (PHENYLMETHANOL)	20	0.090						
BERYLLIUM	22		22	100	0.18	0.52	0.48	0.45
BETA-BHC (B-BHC)	42	0.0018						
BIS(2-CHLOROETHOXY)METHANE	22	0.090						
BIS(2-CHLOROETHYL)ETHER	22	0.090						
BIS(2-CHLOROISOPROPYL)ETHER	22	0.090						
BIS(2-ETHYLHEXYL)PHTHALATE	20	0.20	7	35	0.067	51	0.72	8.0
BUTYLBENZYL PHTHALATE	20	0.090	2	10	0.85	1.9	1.38	1.4
CADMIUM	22		22	100	0.25	2.1	1.20	1.2
CALCIUM	2		2	100	6200	7170	6685	6685
CAPROLACTAM	2	0.34						

Table 4-1
Omega Chemical Superfund Site
Statistical Summary
Surface Soil Samples

Parameter	Total number of samples	Minimum Reporting Limit	Detections					
			Number	Frequency (%)	Minimum	Maximum	Median	Average
CHLORDANE	20	0.010						
CHROMIUM	22		22	100	8.3	360	22	45
CHRYSENE	20	0.090	1	5.0	0.038	0.038	0.038	0.038
COBALT	22		22	100	6.3	12	9.0	9.1
COPPER	22		22	100	13	35	26	25
DELTA-BHC (C-BHC)	42	0.0005						
DIBENZO(A,H)ANTHRACENE	20	0.090						
DIBENZOFURAN (DIPHENYLENE OXIDE)	22	0.090						
DIELDRIN	42	0.0005	2	4.8	0.0084	0.050	0.029	0.029
DIETHYL PHTHALATE	20	0.090	1	5.0	0.037	0.037	0.037	0.037
DIMETHYL PHTHALATE	22	0.090						
DI-N-BUTYLPHTHALATE	20	0.090	1	5.0	0.33	0.33	0.33	0.33
DI-N-OCTYL PHTHALATE (DIOCTYL PHTHALATE)	20	0.090						
ENDOSULFAN I	42	0.0005						
ENDOSULFAN II	42	0.0005						
ENDOSULFAN SULFATE	42	0.0005						
ENDRIN	42	0.0005	1	2.4	0.032	0.032	0.032	0.032
ENDRIN ALDEHYDE	42	0.0005						
ENDRINE KETONE	2	0.0034						
FLUORANTHENE (IDRYL)	20	0.090	1	5.0	0.033	0.033	0.033	0.033
FLUORENE (ALPHA-DIPHENYLENEMETHANE)	20	0.090						
GAMMA - CHLORDANE	2	0.0018						
GAMMA-BHC (LINDANE)	42	0.0005						
HEPTACHLOR	42	0.0005						
HEPTACHLOR EPOXIDE	42	0.0005						
HEXACHLOROBENZENE (PERCHLOROBENZENE)	20	0.090						
HEXACHLOROBUTADIENE	22	0.090						
HEXACHLOROCYCLOPENTADIENE	22	0.090						
HEXACHLOROETHANE (PERCHLOROETHANE)	22	0.090						
INDENO(1,2,3-C,D)PYRENE	20	0.090						
IRON	2		2	100	22100	23100	22600	22600
ISOPHORONE	22	0.090						
LEAD	22		22	100	5.0	100	24	32
MAGNESIUM	2		2	100	5190	5590	5390	5390
MANGANESE	2		2	100	285	353	319	319
MERCURY	22	0.11	20	91	0.029	0.85	0.068	0.18
METHOXYCHLOR	22	0.0005						
MOLYBDENUM	20	5.0						
NAPHTHALENE	22	0.090	1	4.5	1.2	1.2	1.20	1.2
NICKEL	22		22	100	9.2	31	22	21
NITROBENZENE (OIL OF MIRBANE)	22	0.090						
N-NITROSODIMETHYLAMINE	20	0.090						
N-NITROSODI-N-PROPYLAMINE	22	0.090						
N-NITROSODIPHENYLAMINE	20	0.090						
PCB-1016 (AROCLOR 1016)	22	0.010						
PCB-1221 (AROCLOR 1221)	22	0.010						
PCB-1232 (AROCLOR 1232)	22	0.010						
PCB-1242 (AROCLOR 1242)	22	0.010						
PCB-1248 (AROCLOR 1248)	22	0.010						
PCB-1254 (AROCLOR 1254)	22	0.010	1	4.5	0.50	0.50	0.50	0.50
PCB-1260 (AROCLOR 1260)	22	0.010						
PENTACHLOROPHENOL (PCP)	20	0.20						
PHENANTHRENE	20	0.090	1	5.0	0.030	0.030	0.030	0.030
PHENOL	22	0.090						
POLYCHLORINATED BI PHENYLS, TOTAL	20	0.010	1	5.0	0.50	0.50	0.50	0.50
POTASSIUM	2		2	100	4330	4520	4425	4425
PYRENE	20	0.090	2	10	0.018	0.044	0.031	0.031
SELENIUM	22	1.0						
SILVER	22	1.0	3	14	0.55	1.2	0.59	0.78
SODIUM	2		2	100	290	316	303	303
THALLIUM	22	2.8	14	64	0.90	2.0	1.40	1.5
TOXAPHENE	22	0.10						
VANADIUM	22		22	100	20	52	44	41
ZINC	22		22	100	34	160	68	75

Notes and assumptions:
All results are reported in milligrams per kilogram (mg/Kg)

Table 4-1
Omega Chemical Superfund Site
Statistical Summary
Surface Soil Samples

Parameter	Total number of samples	Minimum Reporting Limit	Detections					
			Number	Frequency (%)	Minimum	Maximum	Median	Average

Number, frequency, minimum, maximum, median and averages are based on detected results only; non-detect values were not used in analysis
If cell is blank, the parameter was analyzed but not detected at a concentration above the reporting limit indicated
Duplicate sample results were excluded from analysis

Table 4-2
Omega Chemical Superfund Site
Statistical Summary
All Subsurface Soils >1 Foot Depth

Parameter	Total number of samples	Minimum Reporting Limit	Detections					
			Number	Frequency (%)	Minimum	Maximum	Median	Average
1,1,1,2-TETRACHLOROETHANE	83	0.00078	3	3.6	0.0012	0.0050	0.0026	0.0029
1,1,1-TRICHLOROETHANE	151	0.00078	58	38	0.00097	1200	0.027	38
1,1,2,2-TETRACHLOROETHANE	151	0.0012						
1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE	151	0.0013	29	19	0.0059	590	0.033	35
1,1,2-TRICHLOROETHANE	151	0.00078	23	15	0.0015	0.14	0.0076	0.021
1,1-DICHLOROETHANE	151	0.00086	38	25	0.0011	0.030	0.0072	0.010
1,1-DICHLOROETHENE	151	0.00084	58	38	0.0019	60	0.048	1.2
1,1-DICHLOROPROPENE	87	0.0012						
1,2,3-TRICHLOROBENZENE	83	0.0016						
1,2,3-TRICHLOROPROPANE	87	0.0012						
1,2,4-TRICHLOROBENZENE	101	0.0016						
1,2,4-TRIMETHYLBENZENE	83	0.0016						
1,2-DIBROMO-3-CHLOROPROPANE	87	0.0039	1	1.1	0.016	0.016	0.016	0.016
1,2-DIBROMOETHANE	87	0.00078						
1,2-DICHLOROBENZENE	169	0.00078	3	1.8	0.00088	0.0022	0.0009	0.0013
1,2-DICHLOROETHANE	151	0.00078	40	26	0.0018	5.0	0.044	0.28
1,2-DICHLOROPROPANE	151	0.00078						
1,2-DIPHENYLHYDRAZINE	18	0.20						
1,3,5-TRIMETHYLBENZENE	83	0.0016						
1,3-DICHLOROBENZENE	169	0.00078						
1,3-DICHLOROPROPANE	87	0.00078						
1,4-DICHLOROBENZENE	169	0.00078	1	0.59	0.0016	0.0016	0.0016	0.0016
1,4-DIOXANE	67	0.025	19	28	0.018	41	0.45	4.6
2,2-DICHLOROPROPANE	83	0.0016						
2,4,5- TRICHLOROPHENOL	18	0.20						
2,4,6-TRICHLOROPHENOL	18	0.20						
2,4-DICHLOROPHENOL	18	0.20						
2,4-DIMETHYLPHENOL	18	0.20						
2,4-DINITROPHENOL	18	0.40						
2,4-DINITROTOLUENE	18	0.20						
2,6-DINITROTOLUENE	18	0.20						
2-BUTANONE	120	0.0060						
2-CHLOROETHYL VINYL ETHER	64	0.0050						
2-CHLORONAPHTHALENE	18	0.20						
2-CHLOROPHENOL	18	0.20						
2-CHLOROTOLUENE	83	0.00078						
2-HEXANONE	120	0.0060						
2-METHY-4,6-DINITROPHENOL	18	0.20						
2-METHYLNAPHTHALENE	18	0.20	1	5.6	0.54	0.54	0.54	0.54
2-METHYLPHENOL	18	0.20						
2-NITROANILINE	18	0.20						
2-NITROPHENOL	18	0.20						
3,3-DICHLOROBENZIDINE	18	0.40						
3-NITROANILINE	18	0.20						
4,4'-DDD	18	0.00070	1	5.6	0.0015	0.0015	0.0015	0.0015
4-BROMOPHENYL-PHENYL ETHER	18	0.20						
4-CHLORO-3-METHYLPHENOL	18	0.20						
4-CHLOROANILINE	18	0.20						
4-CHLOROPHENYL-PHENYL ETHER	18	0.20						
4-CHLOROTOLUENE	83	0.00078						
4-METHYL-2-PENTANONE	56	0.0039						
4-METHYLPHENOL	18	0.40						
4-NITROANILINE	18	0.20						
4-NITROPHENOL	18	0.20						
ACENAPHTHENE (ETHYLENE NAPHTHALENE)	18	0.20						
ACENAPHTHYLENE	18	0.20						
ACETONE	151	0.0060	3	2.0	0.012	0.95	0.021	0.33
ACROLEIN	64	0.30						
ACRYLONITRILE	64	0.30						
ALDRIN (HHDN)	18	0.00070						
ALPHA-BHC (A-BHC)	18	0.00040						
ANILINE (PHENYLAMINE) (AMINOBENZENE)	18	0.20						
ANTHRACENE	18	0.20						
ANTIMONY	18	10	2	11	13	18	16	16
ARSENIC	18		18	100	0.81	9.0	3.3	3.6
BARIUM	18		18	100	28	230	150	136
BENZENE	151	0.00078	18	12	0.0011	0.0078	0.0022	0.0029

Table 4-2
Omega Chemical Superfund Site
Statistical Summary
All Subsurface Soils >1 Foot Depth

Parameter	Total number of samples	Minimum Reporting Limit	Detections					
			Number	Frequency (%)	Minimum	Maximum	Median	Average
BENZIDINE	18	4.0						
BENZO(A)ANTHRACENE	18	0.20	1	5.6	2.4	2.4	2.4	2.4
BENZO(A)PYRENE	18	0.20	1	5.6	1.6	1.6	1.6	1.6
BENZO(B)FLUORANTHENE	18	0.20	1	5.6	0.91	0.91	0.91	0.91
BENZO(G,H,I)PERYLENE	18	0.20	1	5.6	0.49	0.49	0.49	0.49
BENZO(K)FLUORANTHENE	18	0.20						
BENZOIC ACID	18	2.0						
BENZYL ALCOHOL (PHENYLMETHANOL)	18	0.40	2	11	5.2	22	14	14
BERYLLIUM	18		18	100	0.29	0.75	0.55	0.51
BETA-BHC (B-BHC)	18	0.00070						
BIS(2-CHLOROETHOXY)METHANE	18	0.20						
BIS(2-CHLOROETHYL)ETHER	18	0.20						
BIS(2-CHLOROISOPROPYL)ETHER	18	0.20						
BIS(2-ETHYLHEXYL)PHTHALATE	18	0.40	5	28	3.2	4.3	3.5	3.6
BROMOBENZENE	83	0.00078						
BROMOCHLOROMETHANE	83	0.0016						
BROMODICHLOROMETHANE	151	0.00078						
BROMOFORM	151	0.0012	2	1.3	0.013	0.025	0.019	0.019
BROMOMETHANE	151	0.0012						
BUTYLBENZYL PHTHALATE	18	0.20						
CADMIUM	18	0.50						
CARBON DISULFIDE	100	0.0012						
CARBON TETRACHLORIDE	151	0.00078						
CHLORDANE	18	0.020						
CHLOROBENZENE	151	0.00078	1	0.66	0.0015	0.0015	0.0015	0.0015
CHLORODIBROMOMETHANE	51	0.0016						
CHLOROETHANE	151	0.0012						
CHLOROFORM	151	0.00086	56	37	0.0014	3.0	0.018	0.15
CHLOROMETHANE	151	0.0012						
CHROMIUM	18		18	100	5.6	210	19	31
CHRYSENE	18	0.20	1	5.6	6.0	6.0	6.0	6.0
CIS-1,2-DICHLOROETHENE	151	0.00078	14	9.3	0.00096	0.036	0.0077	0.0092
CIS-1,3-DICHLOROPROPENE	151	0.00078						
COBALT	18	4.0	17	94	4.7	16	8.8	8.6
COPPER	18		18	100	17	150	33	45
DELTA-BHC (C-BHC)	18	0.00070						
DIBENZO(A,H)ANTHRACENE	18	0.20						
DIBENZOFURAN (DIPHENYLENE OXIDE)	18	0.20						
DIBROMOCHLOROMETHANE	100	0.0012						
DIBROMOMETHANE	83	0.00078						
DICHLORODIFLUOROMETHANE	87	0.0012						
DIELDRIN	18	0.00070						
DIETHYL PHTHALATE	18	0.20						
DI-ISOPROPYL ETHER (DIPE)	34	0.00078						
DIMETHYL PHTHALATE	18	0.20						
DI-N-BUTYLPHTHALATE	18	0.20						
DI-N-OCTYL PHTHALATE (DIOCTYL PHTHALATE)	18	0.20	1	5.6	0.24	0.24	0.24	0.24
ENDOSULFAN I	18	0.00070						
ENDOSULFAN II	18	0.00070						
ENDOSULFAN SULFATE	18	0.0040						
ENDRIN	18	0.00070						
ENDRIN ALDEHYDE	18	0.00070						
ETHANOL	32	0.39						
ETHYL TERT-BUTYL ETHER (ETBE)	38	0.00078						
ETHYLBENZENE	151	0.00078						
FLUORANTHENE (IDRYL)	18	0.20	1	5.6	0.66	0.66	0.66	0.66
FLUORENE (ALPHA-DIPHENYLENEMETHANE)	18	0.20						
GAMMA-BHC (LINDANE)	18	0.00040						
HEPTACHLOR	18	0.00040						
HEPTACHLOR EPOXIDE	18	0.00070						
HEXACHLOROBENZENE (PERCHLOROBENZENE)	18	0.20						
HEXACHLOROBUTADIENE	69	0.0039						
HEXACHLOROCYCLOPENTADIENE	18	0.20						
HEXACHLOROETHANE (PERCHLOROETHANE)	18	0.20						
INDENO(1,2,3-C,D)PYRENE	18	0.20						
ISOPHORONE	18	0.20	3	17	0.54	9.9	6.5	5.6
ISOPROPYLBENZENE	83	0.00078						

Table 4-2
Omega Chemical Superfund Site
Statistical Summary
All Subsurface Soils >1 Foot Depth

Parameter	Total number of samples	Minimum Reporting Limit	Detections					
			Number	Frequency (%)	Minimum	Maximum	Median	Average
LEAD	18	5.0	17	94	8.5	890	20	78
M,P-XYLENES	87	0.0012						
MERCURY	18	0.10	1	5.6	0.54	0.54	0.54	0.54
METHOXYCHLOR	18	0.0010						
METHYL ISOBUTYL KETONE	64	0.030						
METHYL TERT-BUTYL ETHER	67	0.0012						
METHYLENE CHLORIDE	151	0.0016	17	11	0.0065	100	0.22	11
MOLYBDENUM	18	1.0	16	89	1.5	4.2	3.3	3.1
NAPHTHALENE	101	0.0039						
N-BUTYLBENZENE	83	0.00078						
NICKEL	18		18	100	4.9	55	25	24
NITROBENZENE (OIL OF MIRBANE)	18	0.20						
N-NITROSODIMETHYLAMINE	18	0.20						
N-NITROSODI-N-PROPYLAMINE	18	0.20						
N-NITROSODIPHENYLAMINE	18	0.20						
N-PROPYLBENZENE	83	0.00078						
O-XYLENE	87	0.00078	1	1.1	0.0016	0.0016	0.0016	0.0016
P,P'-DDE	18	0.00070	2	11	0.0012	0.0054	0.0033	0.0033
P,P'-DDT	18	0.00070	4	22	0.0017	0.013	0.0035	0.0054
PCB-1016 (AROCLOR 1016)	18	0.030						
PCB-1221 (AROCLOR 1221)	18	0.030						
PCB-1232 (AROCLOR 1232)	18	0.030						
PCB-1242 (AROCLOR 1242)	18	0.030						
PCB-1248 (AROCLOR 1248)	18	0.030						
PCB-1254 (AROCLOR 1254)	18	0.030	2	11	0.052	0.21	0.13	0.13
PCB-1260 (AROCLOR 1260)	18	0.030						
PENTACHLOROPHENOL (PCP)	18	0.20						
PHENANTHRENE	18	0.20	1	5.6	5.0	5.0	5.0	5.0
PHENOL	18	0.20						
P-ISOPROPYLTOLUENE	83	0.00078						
PYRENE	18	0.20	1	5.6	3.1	3.1	3.1	3.1
PYRIDINE	18	0.40						
SEC-BUTYLBENZENE	83	0.00078						
SELENIUM	18	0.40						
SILVER	18	1.0						
STYRENE	151	0.00078						
TERT-AMYL METHYL ETHER (TAME)	38	0.00078						
TERT-BUTYL ALCOHOL	35	0.016						
TERT-BUTYLBENZENE	83	0.00078						
TETRACHLOROETHENE	151	0.00094	148	98	0.0020	1300	1.7	26
TETRAHYDROFURAN	1		1	100	0.22	0.22	0.22	0.22
THALLIUM	18	7.0						
TOLUENE	151	0.00078	8	5.3	0.0013	62	0.0029	9.5
TOTAL ORGANIC CARBON	57	500	53	93	510	6000	1600	1729
TOTAL XYLENES	84	0.0031	3	3.6	0.10	4.0	2.0	2.0
TOXAPHENE	18	0.040						
TRANS-1,2-DICHLOROETHENE	151	0.00078	20	13	0.00091	0.060	0.0049	0.0097
TRANS-1,3-DICHLOROPROPENE	151	0.0012	1	0.66	0.024	0.024	0.024	0.024
TRICHLOROETHENE	151	0.0020	77	51	0.0022	140	0.042	3.2
TRICHLOROFLUOROMETHANE (FREON 11)	151	0.0016	24	16	0.0031	220	0.021	16
VANADIUM	18		18	100	21	71	47	47
VINYL ACETATE	96	0.0050	1	1.0	0.050	0.050	0.050	0.050
VINYL CHLORIDE	151	0.00078						
ZINC	18		18	100	34	350	69	86

Notes and assumptions:

All results are reported in milligrams per kilogram (mg/Kg)

Number, frequency, minimum, maximum, median and averages are based on detected results only; non-detect values were not used in analysis

If cell is blank, the parameter was analyzed but not detected

Duplicate sample results were excluded from analysis

Table 4-3
Omega Chemical Superfund Site
Statistical Summary
Subsurface Soil Samples 1 – 30 feet

Parameter	Total number of samples	Minimum Reporting Limit	Detections					
			Number	Frequency (%)	Minimum	Maximum	Median	Average
1,1,1,2-TETRACHLOROETHANE	16	0.00083						
1,1,1-TRICHLOROETHANE	60	0.00083	19	32	0.00097	1200	0.064	115
1,1,2,2-TETRACHLOROETHANE	60	0.0016						
1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE	60	0.0050	10	17	0.0072	590	0.032	101
1,1,2-TRICHLOROETHANE	60	0.00083	6	10	0.0034	0.011	0.0056	0.0062
1,1-DICHLOROETHANE	60	0.00086	6	10	0.0036	0.013	0.0063	0.0075
1,1-DICHLOROETHENE	60	0.0042	16	27	0.0019	60	0.031	3.8
1,1-DICHLOROPROPENE	16	0.0016						
1,2,3-TRICHLOROBENZENE	16	0.0017						
1,2,3-TRICHLOROPROPANE	16	0.0017						
1,2,4-TRICHLOROBENZENE	34	0.0017						
1,2,4-TRIMETHYLBENZENE	16	0.0016						
1,2-DIBROMO-3-CHLOROPROPANE	16	0.0040						
1,2-DIBROMOETHANE	16	0.00083						
1,2-DICHLOROBENZENE	78	0.00083	1	1.3	0.00088	0.00088	0.00088	0.00088
1,2-DICHLOROETHANE	60	0.00083	6	10	0.0032	0.16	0.028	0.063
1,2-DICHLOROPROPANE	60	0.00083						
1,2-DIPHENYLHYDRAZINE	18	0.20						
1,3,5-TRIMETHYLBENZENE	16	0.0016						
1,3-DICHLOROBENZENE	78	0.00083						
1,3-DICHLOROPROPANE	16	0.00083						
1,4-DICHLOROBENZENE	78	0.00083	1	1.3	0.0016	0.0016	0.0016	0.0016
1,4-DIOXANE	16	0.025	8	50	0.035	41	1.6	10
2,2-DICHLOROPROPANE	16	0.0016						
2,4,5- TRICHLOROPHENOL	18	0.20						
2,4,6-TRICHLOROPHENOL	18	0.20						
2,4-DICHLOROPHENOL	18	0.20						
2,4-DIMETHYLPHENOL	18	0.20						
2,4-DINITROPHENOL	18	0.40						
2,4-DINITROTOLUENE	18	0.20						
2,6-DINITROTOLUENE	18	0.20						
2-BUTANONE	58	0.0081						
2-CHLOROETHYL VINYL ETHER	44	0.0050						
2-CHLORONAPHTHALENE	18	0.20						
2-CHLOROPHENOL	18	0.20						
2-CHLOROTOLUENE	16	0.00083						
2-HEXANONE	58	0.0081						
2-METHY-4,6-DINITROPHENOL	18	0.20						
2-METHYLNAPHTHALENE	18	0.20	1	5.6	0.54	0.54	0.54	0.54
2-METHYLPHENOL	18	0.20						
2-NITROANILINE	18	0.20						
2-NITROPHENOL	18	0.20						
3,3-DICHLOROBENZIDINE	18	0.40						
3-NITROANILINE	18	0.20						
4,4'-DDD	18	0.00070	1	5.6	0.0015	0.0015	0.0015	0.0015
4-BROMOPHENYL-PHENYL ETHER	18	0.20						
4-CHLORO-3-METHYLPHENOL	18	0.20						
4-CHLOROANILINE	18	0.20						
4-CHLOROPHENYL-PHENYL ETHER	18	0.20						
4-CHLOROTOLUENE	16	0.00083						
4-METHYL-2-PENTANONE	14	0.0040						
4-METHYLPHENOL	18	0.40						
4-NITROANILINE	18	0.20						
4-NITROPHENOL	18	0.20						
ACENAPHTHENE (ETHYLENE NAPHTHALENE)	18	0.20						
ACENAPHTHYLENE	18	0.20						
ACETONE	60	0.0081						
ACROLEIN	44	0.30						
ACRYLONITRILE	44	0.30						
ALDRIN (HHDN)	18	0.00070						
ALPHA-BHC (A-BHC)	18	0.00040						
ANILINE (PHENYLAMINE) (AMINOBENZENE)	18	0.20						
ANTHRACENE	18	0.20						
ANTIMONY	18	10	2	11	13	18	16	16
ARSENIC	18		18	100	0.81	9.0	3.3	3.6
BARIUM	18		18	100	28	230	150	136

Table 4-3
Omega Chemical Superfund Site
Statistical Summary
Subsurface Soil Samples 1 – 30 feet

Parameter	Total number of samples	Minimum Reporting Limit	Detections					
			Number	Frequency (%)	Minimum	Maximum	Median	Average
BENZENE	60	0.00083	1	1.7	0.0019	0.0019	0.0019	0.0019
BENZIDINE	18	4.0						
BENZO(A)ANTHRACENE	18	0.20	1	5.6	2.4	2.4	2.4	2.4
BENZO(A)PYRENE	18	0.20	1	5.6	1.6	1.6	1.6	1.6
BENZO(B)FLUORANTHENE	18	0.20	1	5.6	0.91	0.91	0.91	0.91
BENZO(G,H,I)PERYLENE	18	0.20	1	5.6	0.49	0.49	0.49	0.49
BENZO(K)FLUORANTHENE	18	0.20						
BENZOIC ACID	18	2.0						
BENZYL ALCOHOL (PHENYLMETHANOL)	18	0.40	2	11	5.2	22	14	14
BERYLLIUM	18		18	100	0.29	0.75	0.55	0.51
BETA-BHC (B-BHC)	18	0.00070						
BIS(2-CHLOROETHOXY)METHANE	18	0.20						
BIS(2-CHLOROETHYL)ETHER	18	0.20						
BIS(2-CHLOROISOPROPYL)ETHER	18	0.20						
BIS(2-ETHYLHEXYL)PHTHALATE	18	0.40	5	28	3.2	4.3	3.5	3.6
BROMOBENZENE	16	0.00083						
BROMOCHLOROMETHANE	16	0.0017						
BROMODICHLOROMETHANE	60	0.00083						
BROMOFORM	60	0.0040	1	1.7	0.013	0.013	0.013	0.013
BROMOMETHANE	60	0.0040						
BUTYLBENZYL PHTHALATE	18	0.20						
CADMIUM	18	0.50						
CARBON DISULFIDE	55	0.0083						
CARBON TETRACHLORIDE	60	0.00083						
CHLORDANE	18	0.020						
CHLOROBENZENE	60	0.00083						
CHLORODIBROMOMETHANE	5	0.0016						
CHLOROETHANE	60	0.0017						
CHLOROFORM	60	0.00086	10	17	0.0014	0.013	0.0052	0.0056
CHLOROMETHANE	60	0.0040						
CHROMIUM	18		18	100	5.6	210	19	31
CHRYSENE	18	0.20	1	5.6	6.0	6.0	6.0	6.0
CIS-1,2-DICHLOROETHENE	60	0.00083	2	3.3	0.00096	0.0018	0.0014	0.0014
CIS-1,3-DICHLOROPROPENE	60	0.00083						
COBALT	18	4.0	17	94	4.7	16	8.8	8.6
COPPER	18		18	100	17	150	33	45
DELTA-BHC (C-BHC)	18	0.00070						
DIBENZO(A,H)ANTHRACENE	18	0.20						
DIBENZOFURAN (DIPHENYLENE OXIDE)	18	0.20						
DIBROMOCHLOROMETHANE	55	0.0017						
DIBROMOMETHANE	16	0.00083						
DICHLORODIFLUOROMETHANE	16	0.0017						
DIELDRIN	18	0.00070						
DIETHYL PHTHALATE	18	0.20						
DI-ISOPROPYL ETHER (DIPE)	11	0.00083						
DIMETHYL PHTHALATE	18	0.20						
DI-N-BUTYLPHTHALATE	18	0.20						
DI-N-OCTYL PHTHALATE (DIOCTYL PHTHALATE)	18	0.20	1	5.6	0.24	0.24	0.24	0.24
ENDOSULFAN I	18	0.00070						
ENDOSULFAN II	18	0.00070						
ENDOSULFAN SULFATE	18	0.0040						
ENDRIN	18	0.00070						
ENDRIN ALDEHYDE	18	0.00070						
ETHANOL	11	0.42						
ETHYL TERT-BUTYL ETHER (ETBE)	11	0.00083						
ETHYLBENZENE	60	0.00083						
FLUORANTHENE (IDRYL)	18	0.20	1	5.6	0.66	0.66	0.66	0.66
FLUORENE (ALPHA-DIPHENYLENEMETHANE)	18	0.20						
GAMMA-BHC (LINDANE)	18	0.00040						
HEPTACHLOR	18	0.00040						
HEPTACHLOR EPOXIDE	18	0.00070						
HEXACHLOROBENZENE (PERCHLOROBENZENE)	18	0.20						
HEXACHLOROBUTADIENE	23	0.0040						
HEXACHLOROCYCLOPENTADIENE	18	0.20						
HEXACHLOROETHANE (PERCHLOROETHANE)	18	0.20						
INDENO(1,2,3-C,D)PYRENE	18	0.20						

Table 4-3
Omega Chemical Superfund Site
Statistical Summary
Subsurface Soil Samples 1 – 30 feet

Parameter	Total number of samples	Minimum Reporting Limit	Detections					
			Number	Frequency (%)	Minimum	Maximum	Median	Average
ISOPHORONE	18	0.20	3	17	0.54	9.9	6.5	5.6
ISOPROPYLBENZENE	16	0.00083						
LEAD	18	5.0	17	94	8.5	890	20	78
M,P-XYLENES	16	0.0016						
MERCURY	18	0.10	1	5.6	0.54	0.54	0.54	0.54
METHOXYCHLOR	18	0.0010						
METHYL ISOBUTYL KETONE	44	0.030						
METHYL TERT-BUTYL ETHER	16	0.0017						
METHYLENE CHLORIDE	60	0.0050	2	3.3	59	100	80	80
MOLYBDENUM	18	1.0	16	89	1.5	4.2	3.3	3.1
NAPHTHALENE	34	0.0040						
N-BUTYLBENZENE	16	0.00083						
NICKEL	18		18	100	4.9	55	25	24
NITROBENZENE (OIL OF MIRBANE)	18	0.20						
N-NITROSODIMETHYLAMINE	18	0.20						
N-NITROSODI-N-PROPYLAMINE	18	0.20						
N-NITROSODIPHENYLAMINE	18	0.20						
N-PROPYLBENZENE	16	0.00083						
O-XYLENE	16	0.00083						
P,P'-DDE	18	0.00070	2	11	0.0012	0.0054	0.0033	0.0033
P,P'-DDT	18	0.00070	4	22	0.0017	0.013	0.0035	0.0054
PCB-1016 (AROCLOR 1016)	18	0.030						
PCB-1221 (AROCLOR 1221)	18	0.030						
PCB-1232 (AROCLOR 1232)	18	0.030						
PCB-1242 (AROCLOR 1242)	18	0.030						
PCB-1248 (AROCLOR 1248)	18	0.030						
PCB-1254 (AROCLOR 1254)	18	0.030	2	11	0.052	0.21	0.13	0.13
PCB-1260 (AROCLOR 1260)	18	0.030						
PENTACHLOROPHENOL (PCP)	18	0.20						
PHENANTHRENE	18	0.20	1	5.6	5.0	5.0	5.0	5.0
PHENOL	18	0.20						
P-ISOPROPYLTOLUENE	16	0.00083						
PYRENE	18	0.20	1	5.6	3.1	3.1	3.1	3.1
PYRIDINE	18	0.40						
SEC-BUTYLBENZENE	16	0.00083						
SELENIUM	18	0.40						
SILVER	18	1.0						
STYRENE	60	0.00083						
TERT-AMYL METHYL ETHER (TAME)	11	0.00083						
TERT-BUTYL ALCOHOL	12	0.017						
TERT-BUTYLBENZENE	16	0.00083						
TETRACHLOROETHENE	60	0.0050	59	98	0.0091	1300	1.1	57
THALLIUM	18	7.0						
TOLUENE	60	0.00083	1	1.7	62	62	62	62
TOTAL ORGANIC CARBON	18		18	100	670	6000	2050	2293
TOTAL XYLENES	47	0.0032	1	2.1	0.10	0.10	0.10	0.10
TOXAPHENE	18	0.040						
TRANS-1,2-DICHLOROETHENE	60	0.00084	2	3.3	0.0048	0.012	0.0084	0.0084
TRANS-1,3-DICHLOROPROPENE	60	0.0016	1	1.7	0.024	0.024	0.024	0.024
TRICHLOROETHENE	60	0.0050	21	35	0.0032	140	0.022	11
TRICHLOROFLUOROMETHANE (FREON 11)	60	0.0040	6	10	0.018	220	0.042	63
VANADIUM	18		18	100	21	71	47	47
VINYL ACETATE	55	0.0083	1	1.8	0.050	0.050	0.050	0.050
VINYL CHLORIDE	60	0.00083						
ZINC	18		18	100	34	350	69	86

Notes and assumptions:

All results are reported in milligrams per kilogram (mg/Kg)

Number, frequency, minimum, maximum, median and averages are based on detected results only; non-detect values were not used in analysis

If cell is blank, the parameter was analyzed but not detected

Duplicate sample results were excluded from analysis

Table 4-4
Omega Chemical Superfund Site
Statistical Summary
Subsurface Soil Samples >30 feet

Parameter	Total number of samples	Minimum Reporting Limit	Detections					
			Number	Frequency (%)	Minimum	Maximum	Median	Average
1,1,1,2-TETRACHLOROETHANE	67	0.00078	3	4.5	0.0012	0.0050	0.0026	0.0029
1,1,1-TRICHLOROETHANE	91	0.00078	39	43	0.0012	3.1	0.013	0.21
1,1,2,2-TETRACHLOROETHANE	91	0.0012						
1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE	91	0.0013	19	21	0.0059	1.0	0.033	0.090
1,1,2-TRICHLOROETHANE	91	0.00078	17	19	0.0015	0.14	0.0081	0.026
1,1-DICHLOROETHANE	91	0.00094	32	35	0.0011	0.030	0.0072	0.010
1,1-DICHLOROETHENE	91	0.00084	42	46	0.0060	1.3	0.076	0.16
1,1-DICHLOROPROPENE	71	0.0012						
1,2,3-TRICHLOROBENZENE	67	0.0016						
1,2,3-TRICHLOROPROPANE	71	0.0012						
1,2,4-TRICHLOROBENZENE	67	0.0016						
1,2,4-TRIMETHYLBENZENE	67	0.0016						
1,2-DIBROMO-3-CHLOROPROPANE	71	0.0039	1	1.4	0.016	0.016	0.016	0.016
1,2-DIBROMOETHANE	71	0.00078						
1,2-DICHLOROBENZENE	91	0.00078	2	2.2	0.00093	0.0022	0.0016	0.0016
1,2-DICHLOROETHANE	91	0.00078	34	37	0.0018	5.0	0.051	0.31
1,2-DICHLOROPROPANE	91	0.00078						
1,3,5-TRIMETHYLBENZENE	67	0.0016						
1,3-DICHLOROBENZENE	91	0.00078						
1,3-DICHLOROPROPANE	71	0.00078						
1,4-DICHLOROBENZENE	91	0.00078						
1,4-DIOXANE	51	0.0250	11	22	0.018	1.5	0.14	0.38
2,2-DICHLOROPROPANE	67	0.0016						
2-BUTANONE	62	0.0060						
2-CHLOROETHYL VINYL ETHER	20	0.0050						
2-CHLOROTOLUENE	67	0.00078						
2-HEXANONE	62	0.0060						
4-CHLOROTOLUENE	67	0.00078						
4-METHYL-2-PENTANONE	42	0.0039						
ACETONE	91	0.0060	3	3.3	0.012	0.95	0.021	0.33
ACROLEIN	20	0.30						
ACRYLONITRILE	20	0.30						
BENZENE	91	0.00078	17	19	0.0011	0.0078	0.0023	0.0029
BROMOBENZENE	67	0.00078						
BROMOCHLOROMETHANE	67	0.0016						
BROMODICHLOROMETHANE	91	0.00078						
BROMOFORM	91	0.0012	1	1.1	0.025	0.025	0.025	0.025
BROMOMETHANE	91	0.0012						
CARBON DISULFIDE	45	0.0012						
CARBON TETRACHLORIDE	91	0.00078						
CHLOROBENZENE	91	0.00078	1	1.1	0.0015	0.0015	0.0015	0.0015
CHLORODIBROMOMETHANE	46	0.0016						
CHLOROETHANE	91	0.0012						
CHLOROFORM	91	0.00095	46	51	0.0014	3.0	0.030	0.18
CHLOROMETHANE	91	0.0012						
CIS-1,2-DICHLOROETHENE	91	0.00078	12	13	0.0012	0.036	0.0092	0.011
CIS-1,3-DICHLOROPROPENE	91	0.00078						
DIBROMOCHLOROMETHANE	45	0.0012						
DIBROMOMETHANE	67	0.00078						
DICHLORODIFLUOROMETHANE	71	0.0012						
DI-ISOPROPYL ETHER (DIPE)	23	0.00078						
ETHANOL	21	0.39						
ETHYL TERT-BUTYL ETHER (ETBE)	27	0.00078						
ETHYLBENZENE	91	0.00078						
HEXACHLOROBUTADIENE	46	0.0039						
ISOPROPYLBENZENE	67	0.00078						
M,P-XYLENES	71	0.0012						
METHYL ISOBUTYL KETONE	20	0.0300						
METHYL TERT-BUTYL ETHER	51	0.0012						
METHYLENE CHLORIDE	91	0.0016	15	16	0.0065	15	0.059	1.9
Moisture/Tnfr	2		2	100	16	18	17	17
NAPHTHALENE	67	0.0039						
N-BUTYLBENZENE	67	0.00078						
N-PROPYLBENZENE	67	0.00078						
O-XYLENE	71	0.00078	1	1.4	0.0016	0.0016	0.0016	0.0016
P-ISOPROPYLTOLUENE	67	0.00078						
SEC-BUTYLBENZENE	67	0.00078						

Table 4-4
Omega Chemical Superfund Site
Statistical Summary
Subsurface Soil Samples >30 feet

Parameter	Total number of samples	Minimum Reporting Limit	Detections					
			Number	Frequency (%)	Minimum	Maximum	Median	Average
STYRENE	91	0.00078						
TERT-AMYL METHYL ETHER (TAME)	27	0.00078						
TERT-BUTYL ALCOHOL	23	0.0160						
TERT-BUTYLBENZENE	67	0.00078						
TETRACHLOROETHENE	91	0.00094	89	98	0.0020	56	2	5.3
TETRAHYDROFURAN	1		1	100	0.22	0.22	0.22	0.22
TOLUENE	91	0.00078	7	7.7	0.0013	14	0.0028	2.0
TOTAL ORGANIC CARBON	39	500	35	90	510	2700	1400	1439
TOTAL XYLENES	37	0.0031	2	5.4	2.0	4.0	3	3.0
TRANS-1,2-DICHLOROETHENE	91	0.00078	18	20	0.00091	0.060	0.0040	0.0099
TRANS-1,3-DICHLOROPROPENE	91	0.0012						
TRICHLOROETHENE	91	0.0020	56	62	0.0022	4.2	0.068	0.18
TRICHLOROFLUOROMETHANE (FREON 11)	91	0.0016	18	20	0.0031	0.038	0.017	0.019
VINYL ACETATE	41	0.0050						
VINYL CHLORIDE	91	0.00078						

Notes and assumptions:
All results are reported in milligrams per kilogram (mg/Kg)
Number, frequency, minimum, maximum, median and averages are based on detected results only; non-detect values were not used in analysis
If cell is blank, the parameter was analyzed but not detected
Duplicate sample results were excluded from analysis

Table 4-5
Omega Chemical Superfund Site
Statistical Summary
Soil Gas Samples – All Depths

Parameter	Total number of samples	Minimum Reporting Limit	Detections					
			Number	Frequency (%)	Minimum	Maximum	Median	Average
1,1,1,2-TETRACHLOROETHANE	87	0.0054						
1,1,1-TRICHLOROETHANE	238	0.0043	113	47.5	0.140	2500	14	133
1,1,2,2-TETRACHLOROETHANE	238	0.0055						
1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE	238	0.0077	233	97.9	0.0084	4300	420	822
1,1,2-TRICHLOROETHANE	238	0.0043	9	3.8	0.330	1.4	1.1	0.99
1,1-DICHLOROETHANE	238	0.0032	118	49.6	0.024	110	5.6	12
1,1-DICHLOROETHENE	238	0.004	228	95.8	0.0048	3400	226	460
1,1-DICHLOROTETRAFLUOROETHANE	11	0.0056						
1,2,4-TRICHLOROBENZENE	238	0.0059						
1,2,4-TRIMETHYLBENZENE	238	0.0039	18	7.6	0.0082	0.033	0.014	0.016
1,2-DIBROMOETHANE	238	0.005						
1,2-DICHLORO-1,1,2,2-TETRAFLUOROETHANE	227	0.0071						
1,2-DICHLORO-1,1,2-TRIFLUOROETHANE	6		6	100	9.4	94	59	56
1,2-DICHLOROBENZENE	238	0.0047						
1,2-DICHLOROETHANE	238	0.0032	39	16.4	0.032	140	3.6	9.3
1,2-DICHLOROPROPANE	238	0.0032						
1,3,5-TRIMETHYLBENZENE	238	0.0038	2	0.8	0.010	0.13	0.070	0.070
1,3-BUTADIENE	134	0.0022	24	17.9	0.0029	0.32	0.029	0.049
1,3-DICHLOROBENZENE	238	0.0047						
1,4-DICHLOROBENZENE	237	0.0047						
1,4-DIOXANE	134	0.014	1	0.7	0.023	0.023	0.023	0.023
2,2,4-TRIMETHYLPENTANE	134	0.0047	31	23.1	0.0049	14	0.047	1.2
2-BUTANONE	227	0.0042	36	15.9	0.0044	0.41	0.058	0.078
2-HEXANONE	227	0.0066	1	0.4	2.7	2.7	2.7	2.7
2-PROPANOL	134	0.0099	13	9.7	0.013	37	14	17
3-CHLOROPROPENE	134	0.013						
4-ETHYLTOLUENE	227	0.0038	14	6.2	0.0065	0.042	0.011	0.014
4-METHYL-2-PENTANONE	227	0.0041	3	1.3	0.0042	0.015	0.010	0.0097
ACETALDEHYDE	3							
ACETONE	228	0.067	127	55.7	0.015	38	1.5	4.2
BENZENE	238	0.0025	80	33.6	0.0029	8.0	0.15	0.84
BENZYL CHLORIDE	93	0.0083						
BROMODICHLOROMETHANE	227	0.0052	4	1.8	0.0093	0.024	0.020	0.018
BROMOFORM	227	0.0081	1	0.4	0.013	0.013	0.013	0.013
BROMOMETHANE	238	0.003						
CARBON DISULFIDE	227	0.0024	91	40.1	0.0031	44	4.0	6.2
CARBON TETRACHLORIDE	238	0.0049	6	2.5	0.130	0.33	0.21	0.21
CHLOROBENZENE	238	0.0036						
CHLOROETHANE	238	0.0021						
CHLOROFORM	238	0.0038	137	57.6	0.0057	288	5.9	21
CHLOROMETHANE	238	0.0017	2	0.8	0.0016	0.0018	0.0017	0.0017
CIS-1,2-DICHLOROETHENE	238	0.0032	51	21.4	0.053	38	1.1	5.6
CIS-1,3-DICHLOROPROPENE	238	0.0035						
CYCLOHEXANE	134	0.0035	21	15.7	0.0042	17	0.024	1.9
DIBROMOCHLOROMETHANE	227	0.0066	2	0.9	0.0093	0.014	0.012	0.012
DICHLORODIFLUOROMETHANE	238	0.0039	41	17.2	0.0072	15	0.64	2.3
ETHANOL	134	0.011	17	12.7	0.012	0.28	0.021	0.044
ETHYLBENZENE	238	0.0034	17	7.1	0.0055	0.030	0.012	0.014
HEPTANE	134	0.0041	27	20.1	0.0049	11	0.032	0.84
HEXACHLOROBUTADIENE	238	0.0085						
HEXANE (N-HEXANE)	134	0.005	39	29.1	0.0039	37	0.087	2.4
ISOPROPYLBENZENE	134	0.005						
M,P-XYLENES	232	0.0069	40	17.2	0.010	0.70	0.035	0.083
M-CHLOROTOLUENE	134	0.0052						
METHYL TERT-BUTYL ETHER	221	0.0036	3	1.4	0.019	0.042	0.021	0.027
METHYLENE CHLORIDE	238	0.0028	48	20.2	0.0048	62	1.4	6.3
O-XYLENE	232	0.0034	29	12.5	0.0045	3.5	0.015	0.32
PENTANE	1							
PROPYLBENZENE	134	0.005						
STYRENE	238	0.0034						
TETRACHLOROETHENE	238	0.0054	226	95.0	0.011	41348	210	902
TETRAHYDROFURAN	134	0.003	3	2.2	0.0030	3.8	0.0042	1.3
TOLUENE	238	0.007	98	41.2	0.0048	15	0.15	0.77
TOTAL XYLENES	6	7.378						
TRANS-1,2-DICHLOROETHENE	227	0.0031	90	39.6	0.035	79	4.6	11
TRANS-1,3-DICHLOROPROPENE	238	0.0036						
TRICHLOROETHENE	238	0.0042	216	90.8	0.035	610	38	76
TRICHLOROFLUOROMETHANE (FREON 11)	238	0.0057	231	97.1	0.0057	1517	84	213
VINYL ACETATE	117	0.0056						

Table 4-5
Omega Chemical Superfund Site
Statistical Summary
Soil Gas Samples – All Depths

Parameter	Total number of samples	Minimum Reporting Limit	Detections					
			Number	Frequency (%)	Minimum	Maximum	Median	Average
VINYL CHLORIDE	238	0.002	5	2.1	0.033	0.36	0.079	0.14

Notes and assumptions:

All results are reported in milligrams per cubic meter (mg/m3)

Number, minimum, maximum and averages are based on detected results only; non-detect values were not used in analysis

Number, frequency, minimum, maximum, median and averages are based on detected results only; non-detect values were not used in analysis

Only data collected beginning in 1999 (CDM and EPA) are included; duplicate sample results were excluded from analysis

Table 4-6
Omega Chemical Superfund Site
Statistical Summary
Soil Gas Samples – <30 feet

Parameter	Total number of samples	Minimum Reporting Limit	Detections					
			Number	Frequency (%)	Minimum	Maximum	Median	Average
1,1,1,2-TETRACHLOROETHANE	48	0.043						
1,1,1-TRICHLOROETHANE	153	0.0044	67	43.8	0.14	2500	10	129
1,1,2,2-TETRACHLOROETHANE	153	0.0055						
1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE	153	0.0077	151	98.7	0.013	3400	340	724
1,1,2-TRICHLOROETHANE	153	0.0044	9	5.9	0.33	1.4	1.1	1.0
1,1-DICHLOROETHANE	153	0.0032	71	46.4	0.024	110	3.8	11
1,1-DICHLOROETHENE	153	0.004	149	97.4	0.082	2337	170	355
1,1-DICHLOROTETRAFLUOROETHANE	11	0.0056						
1,2,4-TRICHLOROBENZENE	153	0.0059						
1,2,4-TRIMETHYLBENZENE	153	0.0039	9	5.9	0.0090	0.033	0.013	0.015
1,2-DIBROMOETHANE	153	0.0061						
1,2-DICHLORO-1,1,2,2-TETRAFLUOROETHANE	142	0.0071						
1,2-DICHLORO-1,1,2-TRIFLUOROETHANE	6		6	100.00	9.4	94	59	56
1,2-DICHLOROBENZENE	153	0.0048						
1,2-DICHLOROETHANE	153	0.0032	24	15.7	0.032	10	2.0	3.6
1,2-DICHLOROPROPANE	153	0.0032						
1,3,5-TRIMETHYLBENZENE	153	0.0039						
1,3-BUTADIENE	91	0.0022	10	11.0	0.0029	0.14	0.028	0.037
1,3-DICHLOROBENZENE	153	0.0048						
1,4-DICHLOROBENZENE	152	0.0048						
1,4-DIOXANE	91	0.014						
2,2,4-TRIMETHYLPENTANE	91	0.0047	17	18.7	0.0049	1.5	0.036	0.18
2-BUTANONE	142	0.0042	19	13.4	0.0044	0.18	0.061	0.067
2-HEXANONE	142	0.016						
2-PROPANOL	91	0.0099	3	3.3	13	37	19	23
3-CHLOROPROPENE	91	0.013						
4-ETHYLTOLUENE	142	0.005	7	4.9	0.0074	0.042	0.012	0.017
4-METHYL-2-PENTANONE	142	0.0041	1	0.70	0.015	0.015	0.015	0.015
ACETALDEHYDE								
ACETONE	143	0.067	72	50.3	0.015	21	0.62	2.7
BENZENE	153	0.0032	43	28.1	0.0029	3.8	0.090	0.49
BENZYL CHLORIDE	51	0.067						
BROMODICHLOROMETHANE	142	0.0068	4	2.8	0.0093	0.024	0.020	0.018
BROMOFORM	142	0.01	1	0.70	0.013	0.013	0.013	0.013
BROMOMETHANE	153	0.0031						
CARBON DISULFIDE	142	0.0031	45	31.7	0.0031	26	3.4	4.5
CARBON TETRACHLORIDE	153	0.005	4	2.6	0.13	0.23	0.18	0.18
CHLOROBENZENE	153	0.0037						
CHLOROETHANE	153	0.0021						
CHLOROFORM	153	0.0039	82	53.6	0.0074	100	4.4	7.7
CHLOROMETHANE	153	0.0017						
CIS-1,2-DICHLOROETHENE	153	0.0032	39	25.5	0.053	38	1.5	6.9
CIS-1,3-DICHLOROPROPENE	153	0.0036						
CYCLOHEXANE	91	0.0036	8	8.8	0.0042	0.95	0.015	0.13
DIBROMOCHLOROMETHANE	142	0.0086	2	1.4	0.0093	0.014	0.0117	0.012
DICHLORODIFLUOROMETHANE	153	0.004	30	19.6	0.012	9.4	0.50	1.2
ETHANOL	91	0.011	8	8.8	0.013	0.28	0.020	0.064
ETHYLBENZENE	153	0.0035	10	6.5	0.0055	0.030	0.012	0.014
HEPTANE	91	0.0041	10	11.0	0.0049	0.12	0.018	0.044
HEXACHLOROBUTADIENE	153	0.0085						
HEXANE (N-HEXANE)	91	0.005	19	20.9	0.0039	4.7	0.031	0.42
ISOPROPYLBENZENE	91	0.005						
M,P-XYLENES	150	0.0074	23	15.3	0.010	0.61	0.031	0.072
M-CHLOROTOLUENE	91	0.0052						
METHYL TERT-BUTYL ETHER	139	0.0036	2	1.4	0.019	0.021	0.020	0.020
METHYLENE CHLORIDE	153	0.0028	13	8.5	0.0082	23	0.30	2.2
O-XYLENE	150	0.0035	15	10.0	0.0047	3.5	0.014	0.39
PENTANE								
PROPYLBENZENE	91	0.005						
STYRENE	153	0.0034						
TETRACHLOROETHENE	153	0.0068	150	98.0	0.012	3400	180	479
TETRAHYDROFURAN	91	0.003	3	3.3	0.0030	3.8	0.0042	1.3
TOLUENE	153	0.007	57	37.3	0.0075	15	0.15	0.82
TOTAL XYLENES	3	7.378						
TRANS-1,2-DICHLOROETHENE	142	0.004	54	38.0	0.035	25	4.1	6.6
TRANS-1,3-DICHLOROPROPENE	153	0.0036						
TRICHLOROETHENE	153	0.0054	144	94.1	0.056	470	37	71
TRICHLOROFLUOROMETHANE (FREON 11)	153	0.0059	152	99.3	0.0057	1517	78	214
VINYL ACETATE	75	0.046						
VINYL CHLORIDE	153	0.002	2	1.3	0.033	0.079	0.056	0.056

Notes and assumptions:

All results are reported in milligrams per cubic meter (mg/m3)

Number, frequency, minimum, maximum, median and averages are based on detected results only; non-detect values were not used in analysis

If cell is blank, the parameter was analyzed but not detected at a concentration above the reporting limit indicated

Only data collected beginning in 1999 (CDM and EPA) are included; duplicate sample results were excluded from analysis

Table 4-7
Omega Chemical Superfund Site
Statistical Summary
Soil Gas Samples – >30 feet

Parameter	Total number of samples	Minimum Reporting Limit	Detections					
			Number	Frequency (%)	Minimum	Maximum	Median	Average
1,1,1,2-TETRACHLOROETHANE	39	0.0054						
1,1,1-TRICHLOROETHANE	85	0.0043	46	54	0.93	1600	27	139
1,1,2,2-TETRACHLOROETHANE	85	0.0069						
1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE	85	0.0077	82	96	0.0084	4300	645	1003
1,1,2-TRICHLOROETHANE	85	0.0043						
1,1-DICHLOROETHANE	85	0.0032	47	55	0.025	77	8.9	14
1,1-DICHLOROETHENE	85	0.004	79	93	0.0048	3400	380	658
1,2,4-TRICHLOROBENZENE	85	0.012						
1,2,4-TRIMETHYLBENZENE	85	0.005	9	11	0.0082	0.030	0.014	0.017
1,2-DIBROMOETHANE	85	0.005						
1,2-DICHLORO-1,1,2,2-TETRAFLUOROETHANE	85	0.0071						
1,2-DICHLORO-1,1,2-TRIFLUOROETHANE	4							
1,2-DICHLOROBENZENE	85	0.0047						
1,2-DICHLOROETHANE	85	0.0032	15	18	0.22	140	11	18
1,2-DICHLOROPROPANE	85	0.0032						
1,3,5-TRIMETHYLBENZENE	85	0.0038	2	2.4	0.010	0.13	0.070	0.070
1,3-BUTADIENE	43	0.0046	14	33	0.0092	0.32	0.030	0.057
1,3-DICHLOROBENZENE	85	0.0047						
1,4-DICHLOROBENZENE	85	0.0047						
1,4-DIOXANE	43	0.014	1	2.3	0.023	0.023	0.023	0.023
2,2,4-TRIMETHYLPENTANE	43	0.0047	14	33	0.0096	14	0.29	2.4
2-BUTANONE	85	0.0047	17	20	0.0050	0.41	0.041	0.090
2-HEXANONE	85	0.0066	1	1.2	2.7	2.7	2.7	2.7
2-PROPANOL	43	0.0099	10	23	0.013	29	14	16
3-CHLOROPROPENE	43	0.013						
4-ETHYLTOLUENE	85	0.0038	7	8.2	0.0065	0.024	0.0091	0.012
4-METHYL-2-PENTANONE	85	0.0041	2	2.4	0.0042	0.010	0.0071	0.0071
ACETALDEHYDE	3							
ACETONE	85	0.076	55	65	0.024	38	3.3	6.2
BENZENE	85	0.0025	37	44	0.012	8.0	0.16	1.2
BENZYL CHLORIDE	42	0.0083						
BROMODICHLOROMETHANE	85	0.0052						
BROMOFORM	85	0.0081						
BROMOMETHANE	85	0.003						
CARBON DISULFIDE	85	0.0024	46	54	0.0057	44	4.7	7.8
CARBON TETRACHLORIDE	85	0.0049	2	2.4	0.19	0.33	0.26	0.26
CHLOROBENZENE	85	0.0036						
CHLOROETHANE	85	0.0021						
CHLOROFORM	85	0.0038	55	65	0.0057	288	14	41
CHLOROMETHANE	85	0.0083	2	2.4	0.0016	0.0018	0.0017	0.0017
CIS-1,2-DICHLOROETHENE	85	0.0032	12	14	0.065	6.0	0.89	1.4
CIS-1,3-DICHLOROPROPENE	85	0.0035						
CYCLOHEXANE	43	0.0035	13	30	0.010	17	0.035	3.0
DIBROMOCHLOROMETHANE	85	0.0066						
DICHLORODIFLUOROMETHANE	85	0.0039	11	13	0.0072	15	1.1	5.3
ETHANOL	43	0.023	9	21	0.012	0.039	0.028	0.026
ETHYLBENZENE	85	0.0034	7	8.2	0.0066	0.020	0.011	0.013
HEPTANE	43	0.023	17	40	0.0092	11	0.079	1.3
HEXACHLOROBUTADIENE	85	0.017						
HEXANE (N-HEXANE)	43	0.042	20	47	0.020	37	0.109	4.3
ISOPROPYLBENZENE	43	0.005						
M,P-XYLENES	82	0.0069	17	21	0.013	0.70	0.039	0.097
M-CHLOROTOLUENE	43	0.0052						
METHYL TERT-BUTYL ETHER	82	0.0036	1	1.2	0.042	0.042	0.042	0.042
METHYLENE CHLORIDE	85	0.0035	35	41	0.0048	62	2.7	7.9
O-XYLENE	82	0.0034	14	17	0.0045	2.9	0.017	0.26
PENTANE	1							
PROPYLBENZENE	43	0.005						
STYRENE	85	0.0043						
TETRACHLOROETHENE	85	0.0054	76	89	0.011	41348	230	1735
TETRAHYDROFURAN	43	0.003						
TOLUENE	85	0.2	41	48	0.0048	7.2	0.19	0.70
TOTAL XYLENES	3	78.13						
TRANS-1,2-DICHLOROETHENE	85	0.0031	36	42	0.32	79	5.6	18
TRANS-1,3-DICHLOROPROPENE	85	0.0046						
TRICHLOROETHENE	85	0.0042	72	85	0.035	610	45	85
TRICHLOROFLUOROMETHANE (FREON 11)	85	0.0057	79	93	0.0080	840	100	210
VINYL ACETATE	42	0.0056						
VINYL CHLORIDE	85	0.002	3	3.5	0.079	0.36	0.16	0.20

Table 4-7
Omega Chemical Superfund Site
Statistical Summary
Soil Gas Samples – >30 feet

Parameter	Total number of samples	Minimum Reporting Limit	Detections					
			Number	Frequency (%)	Minimum	Maximum	Median	Average

Notes and assumptions:

All results are reported in milligrams per cubic meter (mg/m3)

Number, minimum, maximum and averages are based on detected results only; non-detect values were not used in analysis

Number, frequency, minimum, maximum, median and averages are based on detected results only; non-detect values were not used in analysis

Only data collected beginning in 1999 (CDM and EPA) are included; duplicate sample results were excluded from analysis

Table 4-8
Omega Chemical Superfund Site
Statistical Summary
Ambient Air Samples

Parameter	Total number of samples	Minimum Reporting Limit	Detections					
			Number	Frequency (%)	Minimum	Maximum	Median	Average
1,1,1-TRICHLOROETHANE	11	0.19	1	9.1	1.1	1.1	1.1	1.1
1,1,2,2-TETRACHLOROETHANE	11	0.23	1	9.1	0.40	0.40	0.4	0.40
1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE	11	1.4	10	91	0.73	2.6	1.5	1.4
1,1,2-TRICHLOROETHANE	11	0.19						
1,1-DICHLOROETHANE	11	0.14						
1,1-DICHLOROETHENE	11	0.069	8	73	0.13	0.89	0.5	0.45
1,2-DICHLOROBENZENE	11	0.2	2	18	0.30	1.8	1.1	1.1
1,2-DICHLOROETHANE	11	0.14						
1,4-DICHLOROBENZENE	11	0.2	2	18	0.22	0.40	0.3	0.31
ACETONE	11		11	100	14	4000	34.0	392
BENZENE	11	1.5	10	91	0.82	1.7	1.0	1.1
CARBON TETRACHLORIDE	11	1.2	10	91	0.50	0.72	0.6	0.59
CHLOROBENZENE	11	0.16						
CHLOROFORM	11	0.17						
CIS-1,2-DICHLOROETHENE	11	0.14						
DICHLORODIFLUOROMETHANE	11		11	100	1.8	3.5	2.7	2.7
ETHYLBENZENE	11		11	100	0.45	1.4	0.8	0.81
M,P-XYLENES	11		11	100	1.3	5.0	2.2	2.6
METHYL TERT-BUTYL ETHER	11	0.62						
METHYLENE CHLORIDE	11	1.2	3	27	1.5	2.1	1.8	1.8
O-XYLENE	11		11	100	0.45	1.9	0.9	1.0
TETRACHLOROETHENE	11	1.3	10	91	0.32	1.7	0.9	1.0
TOLUENE	11		11	100	3.7	16	5.5	6.4
TRANS-1,2-DICHLOROETHENE	11	0.68						
TRANS-1,3-DICHLOROPROPENE	11	0.16						
TRICHLOROETHENE	11	0.18	7	64	0.22	1.1	0.4	0.44
TRICHLOROFLUOROMETHANE (FREON 11)	11		11	100	1.6	2.1	1.8	1.8
VINYL CHLORIDE	11	0.044						

Notes and assumptions:

All results are reported in parts per micrograms per cubic meter (ug/m3)

Number, frequency, minimum, maximum, median and averages are based on detected results only; non-detect values were not used in analysis

If cell is blank, the parameter was analyzed but not detected at a concentration above the reporting limit indicated

Data collected beginning in 2004 (CDM and EPA) are included; duplicate sample results were excluded from analysis

Table 4-9
Omega Chemical Superfund Site
Statistical Summary
Indoor Air Samples

Parameter	Total number of samples	Minimum Reporting Limit	Detections					
			Number	Frequency (%)	Minimum	Maximum	Median	Average
1,1,1-TRICHLOROETHANE	53	0.15	19	36	0.19	1.2	0.26	0.40
1,1,2,2-TETRACHLOROETHANE	53	0.18						
1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE	53	26	52	98	0.70	1300	36	217
1,1,2-TRICHLOROETHANE	53	0.15	1	1.9	2.9	2.9	2.9	2.9
1,1-DICHLOROETHANE	53	0.11						
1,1-DICHLOROETHENE	53	0.47	51	96	0.06	550	22	85
1,1-DICHLOROTETRAFLUOROETHANE	6	6.99						
1,2,4-TRICHLOROBENZENE	6	7.42	1	17	32	32	32	32
1,2,4-TRIMETHYLBENZENE	6	7.37	2	33	6.4	10	8.3	8.3
1,2-DIBROMOETHANE	6	7.68						
1,2-DICHLOROBENZENE	53	0.16	1	1.9	1.2	1.2	1.2	1.2
1,2-DICHLOROETHANE	53	0.11	1	1.9	0.32	0.32	0.32	0.32
1,2-DICHLOROPROPANE	6	4.05						
1,3,5-TRIMETHYLBENZENE	6	4.91						
1,3-DICHLOROBENZENE	6	6.01						
1,4-DICHLOROBENZENE	53	0.19	17	32	0.16	1.8	0.32	0.49
ACETONE	48		48	100	9.3	6000	43	430
BENZENE	53	1.1	42	79	0.75	27	2.2	3.3
BROMOMETHANE	6	3.88						
CARBON TETRACHLORIDE	53	0.7	34	64	0.50	1.3	0.62	0.63
CHLOROBENZENE	53	0.12	2	3.8	1.2	1.2	1.2	1.2
CHLOROETHANE	6	2.64						
CHLOROFORM	53	0.16	24	45	0.14	0.66	0.25	0.29
CHLOROMETHANE	6	2.06						
CIS-1,2-DICHLOROETHENE	53	0.11						
CIS-1,3-DICHLOROPROPENE	6	4.54						
DICHLORODIFLUOROMETHANE	53	3.6	45	85	1.2	11	3.0	3.4
ETHYLBENZENE	53	1	45	85	0.47	48	1.5	4.7
HEXACHLOROBUTADIENE	6	10.7	1	17	64	64	64	64
M,P-XYLENES	53	2.1	47	89	1.3	270	5.2	20
METHYL TERT-BUTYL ETHER	47	0.48	1	2.1	0.67	0.67	0.67	0.67
METHYLENE CHLORIDE	53	1.1	29	55	1.2	260	2.2	14
O-XYLENE	53	1	47	89	0.36	78	1.8	6.4
PENTANE	1		1	100	21	21	21	21
STYRENE	6	4.26						
TETRACHLOROETHENE	53	0.43	48	91	0.24	1100	44	115
TOLUENE	53		53	100	2.8	2400	12	93
TRANS-1,2-DICHLOROETHENE	47	0.53						
TRANS-1,3-DICHLOROPROPENE	53	0.12						
TRICHLOROETHENE	53	0.34	44	83	0.25	270	9.2	18
TRICHLOROFLUOROMETHANE (FREON 11)	53	4.1	51	96	1.5	350	13	62
VINYL CHLORIDE	53	0.034						

Notes and assumptions:

All results are reported in parts per micrograms per cubic meter (ug/m3)

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Section 5

Section 5
Site Conceptual Model

This Section presents the Site Conceptual Model with respect to sources of contamination, the nature and extent of contamination, contaminant fate and transport, and the potential exposure and receptor pathways.

5.1 Sources of Contamination

The contaminants, which primarily consist of VOCs, present in the subsurface at the former Omega Chemical property may have been released via a combination of the following mechanisms:

- Leaking above and/or underground storage tanks and associated piping; historical information suggests that such potential sources are most likely on the northern and northwestern portion of the former Omega Chemical property (see Figure 2-1 which illustrates the locations of historical tanks and the loading dock area)

- Transport of on-site surface spillage (e.g., from above ground tanks, drum storage areas, poor housekeeping practices, etc.) over pavement to unpaved areas with subsequent infiltration; these types of releases may have occurred anywhere on the former Omega Chemical property and may also have been transported via surface runoff onto directly adjacent properties (i.e., Terra Pave).

- Leaking drums, particularly those which were located in the northern and northwestern portion of the former Omega Chemical property

Additionally, the potential also existed for the former presence of a direct conduit (i.e., monitoring well BMW1, installed in 1988 which has never been found), to have transmitted contaminants from the ground surface straight to groundwater. Well BMW1 was installed using 4-inch diameter PVC casing and 0.02-inch slotted PVC screen placed in the interval from 90 to 100 feet bgs (Report on Site Assessment Investigations at Omega Recovery Facility, ENSR Consulting and Engineering, October 1988). In addition, as previously discussed, a 500-gallon UST removed from the loading dock area in 1987 is also considered a source area.

Once in the ground, the contaminants likely infiltrated into the vadose zone, dispersing laterally at permeability contrasts until the 30-foot unit was encountered. Based on lithologic information collected for this RI, the 30-foot unit appears to include a greater percentage of fine grained materials when compared to overlying and underlying sediments. As a result, it likely retarded the vertical migration of contaminants, which in turn led to accumulation and further spreading of contamination laterally across the top of this unit. The elevation of the top of this permeability contrast slopes toward the southwest (Figure 2-7), which likely led to

preferential lateral transport in this direction. Released liquids also penetrated the 30-foot unit and continued to infiltrate to the water table.

This Site Conceptual Model is primarily supported by the MIP results that were collected across the Site. Three MIP borings show evidence of high relative concentrations of volatiles from near surface to the 30-foot unit. These include MIP 3, which is located west of the Star City Auto Building, MIP-14, located in the parking lot south of Star City, and MIP 17, located between the Star City and Medlin buildings. Other MIP borings at the Site show the presence of significantly elevated VOC concentrations above the 30 foot unit, including MIP-1, MIP-8, MIP-11, MIP-22, and MIP-24. Each of these locations shows the presence of elevated VOC concentrations principally in sandier units; however, some residual VOC associated with finer grain units is also apparent. The VOC distribution at MIP-1 is likely related to apparent surface releases near MIP-17. Elevated detector responses at MIP-8 and MIP-11 represent migration of contaminants released near MIP-3. The migration path appears to be relatively narrow, since no signature of this migration is apparent at borings MIP-2, MIP-9 and MIP-10. The migration pathway leading to the presence of significantly elevated VOCs above the 30 foot clay unit at MIP-22 and MIP-24 is not known, but could potentially be associated with releases from the MIP-14 area. Soil sampling results generally show higher levels of VOCs in soil vapor in the areas where chemicals were stored, or may have been spilled on the former Omega Chemical property. The exception is the shallow elevated VOC concentrations at boring B-4; at this location, elevated VOC concentrations are located as shallow as five feet, and extend to the water table, suggesting that an additional source area may be present near this boring along Putnam Street; surface runoff of a spill at the former Omega property may be the source of this contamination.

The total VOC map (Figure 4-7), which presents the sum of all detected VOCs in soil vapor from ground surface to a depth of 30 feet, is also indicative of the locations where releases occurred. This map shows the highest soil vapor concentrations are located between the Star City Auto and Medlin buildings, west of the Star City Auto building and in the parking lot south of the Star City Auto building. These locations of elevated shallow soil vapor VOC concentrations are consistent with information from the MIP exploration borings with respect to probable sources of release. PCE, TCE, and Freon contour maps provided in this section may also indicate possible source areas.

5.2 Nature and Extent of Contamination

This section summarizes the understanding of the nature and extent of contamination at the Site, and compares detected concentrations to the EPA Region 9 PRGs for soil and media. Additionally, soil vapor data (see section 5.2.2) will be compared to CHHSLs. Because PRGs are generic, and not site-specific in nature, HBRGs were developed in the HHRA to assist in decisions regarding remedial actions for soil and soil vapor. In the interim, the PRGs (both industrial and residential) are used as a means to define the lateral extent of contamination.

5.2.1 Soil

PCE was detected above its residential and industrial/commercial PRGs in soils at the Site. PCE is the compound that is the most widespread, thus, it is used to define the area that has been impacted by releases at and emanating from the former Omega Chemical property. Figures 5-1 and 5-2 present the locations where soil samples had exceedances of the PRGs for PCE at depths less than 30 feet and greater than 30 feet, respectively.

As indicated on Figure 5-1, there were exceedances for residential and industrial/ commercial PRGs for PCE at the majority of the sample locations on the former Omega Chemical property. There were also PCE PRG exceedences at several other locations in the vicinity of the former Omega Chemical property, i.e., Terra Pave and adjacent areas. Location B-4, sampled in 1996, is anomalous and may represent an additional source area, since elevated concentrations are present at shallow depths. The extent of soil contamination in the area of B-4 has not been directly defined; however, soil vapor samples are available in this area that will be discussed in the next section.

Figures 5-3 and 5-4 present the locations where soil samples had exceedances of the residential and industrial/commercial PRGs for TCE at depths less than 30 feet and greater than 30 feet, respectively. Figures 5-5 and 5-6 illustrate total Freons (sum of Freon 113 and Freon 11) in soils at depths less than 30 feet and greater than 30 feet, respectively. PRGs do not exist for Freons.

5.2.2 Soil Vapor and Indoor Air

As previously shown on Table 4-5, a total of 44 VOCs were detected at least once in the soil vapor samples. PCE is the most widespread compound at the Site, thus, it is used to define the extent of contamination at the Site. Other compounds are present at high concentrations and are widely distributed, but not to the extent of PCE.

Shallow Vadose Zone. The total VOC dot plot for shallow soil vapor samples (Figure 4-9) indicates that the areas with highest VOC concentrations in the vadose zone above the 30-foot unit are primarily located at the former Omega Chemical property. In general, VOC concentrations above the clay unit decrease to the south and southwest of this location. Soil vapor VOCs to the east, along Whittier Blvd., were relatively very low in shallow soil vapor samples.

Figures 5-7 and 5-8 show the extent of PCE and TCE compared with their respective CHHSLs. Because CHHSLs represent screening levels at the 10^{-6} risk threshold, these two figures also display the 10^{-4} risk levels (CHHSL x 100) to account for USEPA's defined risk range. Additional 10 x CHHSL and 1000 x CHHSL contours are also provided on the figure.

The preliminary results from the SVE pilot test in the 3 Kings parking lot indicate that the VOC mass removal rates are higher from wells screened from 26 to 36 feet bgs compared to wells screened from 12 to 22 feet bgs. This supports the conclusion that

there are higher VOC concentrations in soils in the vicinity of the 30-foot unit compared to shallower soils. This conclusion is also supported by the MIP results in the vicinity of the SVE pilot test (MIP-14 and 5) which show higher detector responses in the deeper portions of the 0 to 30 foot interval.

Deeper Vadose Zone. Below the 30-foot unit, vadose zone soil vapor VOC concentrations are also high between the Star City and Medlin buildings, and are also high near the Terra Pave building (VP-14 and VP-15) and the Bishop building (VP-18). Moderate total VOC concentrations were present in >30 foot soil vapor samples collected from a location southeast of Skateland (VP-24) and to the southwest of the Medlin building (VP-29, VP-21 and VP-17). As for the shallow vadose zone results, soil vapor VOCs to the east, along Whittier Blvd., were relatively very low in >30 foot samples.

Utility Corridor Samples. Figure 4-27 presents pie charts showing the concentration ratios of VOCs in existing soil gas samples and from utility corridors. This figure shows there is similarity among fingerprints from samples collected from utility corridors and adjacent soil gas fingerprints (for example, compare the pie charts for UC-5 and UC-3 to SG-10, and compare UC-4B to SG-9).

In addition, a qualitative analysis of these charts indicates the following general observations:

- Shallow (< 24 feet) samples collected from the southwest portion of the former Omega Chemical property (soil gas and utility corridor gas samples) had a significantly greater percentage of PCE and a lesser percentage of Freon.
- The VOC fingerprints of utility corridor gas samples were reflective of those of nearby soil gas samples.
- The four highest TVOC concentrations (UC-6, -7, -8, and -9) were adjacent to the Terra Pave property in the main sewer line along the southwest fence line of the former Omega Chemical property and in a water line along the south side of the Terra Pave building.

The TVOC concentrations in samples collected from utility corridors adjacent to Skateland are roughly two orders of magnitude lower than those in samples at SG-13 and SG-14 at 12 feet. This suggests either significant attenuation between the deeper soils and the shallow (< 12 feet) utility corridors or is indicative of venting. The alley that contains this utility corridor was excavated and the sewer pipe was replaced in early 2004; additionally, this alley is one of the few locations within the Whittier Blvd./Putnam St. block that has an unpaved surface. The TVOC concentrations in samples collected from the utility corridor between the Omega and Terra Pave properties are inconsistent when compared to the adjoining soil gas results. The two samples to the north of this corridor (UC-6 and -7) have nearly identical PCE and TVOC concentrations as the corresponding soil gas results (SG 10 and -12). However,

the two southerly samples (UC-3 and -5) had significantly lower PCE concentrations, and significantly higher ratios of Freon.

Indoor air VOC concentrations in samples collected within Skateland were compared to the VOC results for soil gas samples collected next to Skateland and utility corridors next to Skateland. This comparison showed that the indoor air fingerprint at Skateland was very similar to that of the sample collected from the sewer tie-in line at Skateland (UC-2), but considerably different from the fingerprint for samples collected from this line as it passes northeast to enter the building at the bathroom area (northeast corner of the building) and from the nearby soil gas results. PCE was present in Skateland indoor air at a higher percentage (>60 percent) compared to the other utility corridor samples and soil gas samples SG-7 through SG-9 and SG-13 through SG-15 (ranges from 2percent to 30 percent). Conversely, Freon 11 and 113 were present in Skateland indoor air at a lower percentage (<30 percent) compared to the other utility corridor samples and soil gas samples SG-7 through SG-9 and SG-13 through SG-15 (ranges from 45 percent to 90 percent). However, this could be due to an internal Skateland source of PCE such as skate cleaning fluid or wood floor cleaning and care products. According to a chemical use survey completed May 28, 2004 by CDM, PCE was present in a finish used on the wood skating rink floor in April 2004, approximately four weeks prior to the initial indoor air sampling event. In general, the utility corridor and other soil vapor sample results do not suggest that utility corridors play a significant role in the distribution of VOCs in the vadose zone.

VOC contamination near the base of the vadose zone is in dynamic equilibrium among the various phases (i.e., aqueous, soil, and soil vapor). VOCs in the capillary fringe and in groundwater are the probable sources of deep soil vapor contamination.

5.2.3 Groundwater

Groundwater beneath the Site is contaminated with, in general, the same compounds detected in soils and soil vapor at the former Omega Chemical property. Specifically, PCE is, by far, the most prevalent contaminant in groundwater and occurs in the highest concentrations at levels exceeding 1,000 mg/l. Additionally, similar to soil vapors at the former omega Chemical property, Freons (both 11 and 113) and TCE have also been detected in groundwater in concentrations exceeding 1 mg/l. Other detected compounds in groundwater include 1,1,1-TCA, 1,1-DCE, and cis-1,2-DCE.

Data collected for the RI suggest that the groundwater contamination has been derived, at least in part, by the vertical migration of VOCs from source areas at the ground surface through the vadose zone to groundwater. The 30-foot unit appears to provide some impediment to this vertical transport, but is not considered a complete barrier. This migration pathway has resulted in the partitioning of vertically migrating contaminant mass onto the soil matrix, which in turn can provide a continuing source to soil vapor. The potential existed for direct transmission of contaminants to groundwater by one or more artificial conduits (e.g., historical

monitoring wells). Such a migration pathway would have minimal impact on soils in the vadose zone.

The high concentrations of individual VOCs in groundwater, most notably PCE, suggest the presence of a dense non-aqueous phase liquid (DNAPL). MIP data, discussed in the following section, demonstrate the highest content of VOCs within the capillary fringe, suggesting that DNAPL is present as residual saturation in this depth interval. The DNAPL is likely a continuous source of groundwater contamination at the former Omega Chemical property, as evidenced by persistently high VOC concentrations in groundwater at Putnam Street.

Characterization of the extent of groundwater contamination is beyond the scope of this RI. However, it is known that groundwater contamination extends downgradient (i.e., in a southwesterly direction) of the former Omega Chemical property, toward and beyond Putnam Street. In a parallel activity to this On-Site Soils RI/FS, this contaminated groundwater will be contained at Putnam Street under a Non-Time Critical Removal Action. The groundwater upgradient of this containment remedy may pose a continuing source of contamination of soil vapor via (a) sorption to soil matrix materials within the capillary fringe, and subsequent partitioning to soil vapor, and (b) direct "off-gassing" from groundwater.

5.3 Contaminant Fate and Transport

The fate and transport of the Site COCs in soils is affected by a variety of chemical, physical and biological processes. Some of these processes are destructive and result in contaminant mass removal from the soils. Destructive mechanisms include both chemical and biological processes. Other mechanisms are non-destructive and do not result in a change in contaminant mass or migration ability. Non-destructive mechanisms, which do not reduce overall contaminant mass and may result in redistribution and migration in the vapor phase, include sorption, matrix diffusion, advective and diffusive transport, and volatilization. Typically the most important processes contributing to the ultimate fate of soil contaminants are volatilization and biodegradation. The characteristics of individual compounds also affect the fate and transport processes active at the Site. For example, Freons appear to have migrated to greater distances likely due to their lesser degree of degradation and sorption.

Migration Pathways

Migration of contaminants at the Site is postulated to have been via vertically through the unsaturated zone soil profile. As migration took place, lateral spreading occurred when contrasting permeability zones were encountered, such as within the sandy materials overlying the 30-foot unit. Vertical leakage through this 30-foot unit may have occurred as contamination moved laterally along the 30-foot unit, and then downward through the unit into the saturated zone. Contaminants may also be transported with groundwater and volatilize back into the vadose zone, where they diffuse laterally and vertically through the unsaturated materials. In addition, surface

runoff is another possible pathway which may have contributed to the lateral spreading of contamination.

Potential Indoor Air Transport Mechanisms

The contaminant vapor migration pathway into buildings is of particular concern. Contaminant vapors migrate laterally from subsurface soils beneath the former Omega Chemical property to soils beneath buildings on adjacent properties. VOC vapors also occur through volatilization (off-gassing) of contaminants dissolved in groundwater beneath the buildings; these vapors can then migrate upward. Once VOC vapors have migrated into soils beneath buildings on or adjacent to the former Omega Chemical property, they could enter through cracks, fractures, and holes in the building slab. Utility corridors through the building slab and/or walls can also act as preferential conduits for the transport of VOC vapors into the buildings.

Natural Attenuation Processes

Various naturally-occurring processes affect the transport of contaminants in soils. Most of these mechanisms or processes combine to decrease the contaminant concentration. However, other processes, such as desorption of adsorbed contaminants and matrix diffusion may prolong the time necessary for soils remediation. The following mechanisms also affect the fate and transport of contaminants in the Site soils:

- Biological transformation (biodegradation)
- Adsorption to and desorption from the soils
- Matrix diffusion
- Abiotic degradation (chemical transformation)
- Volatilization
- Dispersion

Volatilization plays a significant role in contamination fate and transport at this Site, as the majority of contaminants are VOCs. In particular, Freons in general have relatively high vapor pressures and will tend to exist mainly in the vapor phase. This, coupled with their low adsoption to soils and resistence to biodegradation, leads to low retardation factors for Freons. This may result in Freons being transported from release points over wider areas compared to other VOCs found at the Site.

The main mechanism for the transformation of VOCs in the subsurface ia probably biochemical biodegradation, as discussed in more detail below.

Biological Transformation

The principal contaminants in soils are chloroethanes (e.g,. 1,1,1-TCA) and chloroethenes (e.g., PCE and TCE) and their respective family of metabolic products and Freons. Petroleum hydrocarbons are also found in Site soils. In general terms, the biodegradation of petroleum hydrocarbons and other organic compounds (e.g., naturally-occurring organic materials such as humic substances) serve as the carbon and energy sources (i.e., electron donors) for microorganisms. The metabolism of these compounds can employ chlorinated VOCs as electron acceptors. In the process of acting as electron acceptors, the chlorinated VOCs are reductively dechlorinated (reduced). The sequential reduction of chlorinated VOCs eventually leads to the production of innocuous end-products such as ethene/ethane.

A schematic pathway for the primary contaminants and their degradation products is shown in Figure 5-9. For PCE and TCE, reductive dechlorination could eventually result in the formation of ethene and ethane. However, incomplete reductive dechlorination could lead to the accumulation of intermediate toxic products (e.g., VC), although the lower chlorinated contaminants may subsequently degrade to innocuous carbon dioxide through oxidation processes.

The presence of cis-1,2-DCE and vinyl chloride in some soil vapor samples suggests that there are at least limited locations where subsurface conditions favor anaerobic degradation of PCE and/or TCE.

TCA, an additional source contaminant present at the Site, is subject to abiotic transformations under aerobic and anaerobic conditions, and biological transformations under anaerobic conditions. TCA transformations and breakdown products are also summarized in Figure 5-9. The abiotic and biotic pathways are important to the ultimate fate of chloroethanes. In particular, 1,1,1-TCA may be transformed abiotically to form 1,1-DCE that can then undergo reductive dechlorination to form VC, and ultimately over time ethene and ethane. The frequent presence of 1,1-DCE in the subsurface is likely due, at least in part, to the abiotic degradation of 1,1,1-TCA.

Under anaerobic conditions, 1,1,1-TCA may also be rapidly transformed by biotic processes into 1,1-DCA, which may be further reduced to CA. CA is relatively stable biologically under anaerobic conditions, but is transformed rapidly to ethanol and chloride by an abiotic hydrolysis reaction.

In general, biodegradation of Freons is expected to be a minor contributor to the fate of this class of compounds in the subsurface.

5.4 Summary of the Human Health Risk Assessment

The Human Health Risk Assessment (HHRA) was finalized and submitted to USEPA on November 9, 2007. A summary of the final HHRA as presented in the Executive Summary of the November 9, 2007 document (HHRA Sections ES.1 through ES.6) is

provided below. References for this section are provided in Section 9 of the Final HHRA.

Approach

This HHRA follows risk assessment guidance from USEPA and with accommodations for consistency with similar guidance from California Environmental Protection Agency (CalEPA) as necessary.

The following tasks were performed as part of the risk assessment:

- Examined the history of the Omega Chemical site in Whittier, CA, and identified types of chemicals used and likely release mechanisms for these chemicals to enter the environment
- Evaluated data collected to characterize the site and existing contamination and used the most recent of these data to select chemicals of potential concern (COPCs) and to calculate exposure point concentrations
- Analyzed the potential for exposure to COPCs at the site though an evaluation of people that might be exposed, exposure pathways that might result in significant contact between these people and COPCs, and identification of exposure parameters appropriate for quantifying exposure resulting from this contact.
- Identified appropriate toxicity criteria for site COPCs
- Estimated risk to current and potential future receptors (people) that might contact contamination
- Evaluated uncertainties in data, exposure, toxicity and risk characterization aspects of the risk assessment
- Calculated health-based remediation goals (site-specific PRGs) for use in remediation decisions for the site

Analytical Data

Data used in the HHRA were obtained from recent sampling events conducted by CDM. During the RI, samples were collected from surface soils, subsurface soils, soil gas, indoor air, and ambient air.[1] Sample locations are shown in HHRA Figures ES-2 and ES-2b and analytical summary tables for all samples collected during the RI are provided in the RI report. Selection of data used to support quantitative evaluation is based on quality, quantity, comparability (e.g., similar detection limits), and representativeness of data for current site conditions and potential exposures at the site. These data are then used in selection of COPCs and in estimation of exposure point concentrations used in the calculation of possible chronic daily intake.

[1] Throughout the text, tables, and appendices of the Final HHRA, "ambient air" is defined to be "outdoor air." The two terms are used interchangeably throughout the HHRA.

Exposure Pathways

Potentially exposed populations evaluated in the HHRA are future on-site residents, current and future on-site and off-site indoor industrial workers, future on-site outdoor industrial workers, and a future on-site construction worker. Currently, no plans exist for residential development at the Site, and the Site location suggests that residential development in areas adjacent to the Site is unlikely. The City intends to allow redevelopment that consists of commercial and retail uses with the construction of multi-level buildings. Specifically, City representatives have stated that it is unlikely that the Omega property will be redeveloped for residential uses (Adams, 2007), although the zoning of the site as the Whittier Boulevard Specific Plan-Workplace District allows for Live/Work units and multi-family housing. Therefore, although residential use of the site is not expected to occur in the future, quantitative analysis of future residential exposures is included to provide additional information to the risk manager. Section 4 of the HHRA provides a more detailed discussion of current and reasonable future land uses of the site.

The SCEM for soils at the Omega Site (HHRA Figure ES-3) includes theoretically feasible exposures and provides a basis for discussing the likelihood and importance of potential exposure pathways at the site. As illustrated in the SCEM, potential exposure pathways include:

- Oral/Dermal Contact with Surface Soil and Inhalation of Fugitive Dust - Current Industrial Worker
- Inhalation of Indoor Air - Current Industrial Worker
- Inhalation of Ambient Air - Current Industrial Worker
- Oral/Dermal Contact with Regraded Surface/Subsurface Soil and Inhalation of Fugitive Dust – Future Residents, Future Industrial Indoor and Outdoor Workers, Future Construction Workers
- Inhalation of Indoor Air from Soil Gas – Future Residents and Future Industrial Indoor Workers
- Inhalation of Ambient Air from Soil Gas – Future Residents and Future Industrial Indoor Workers, Future Construction Workers, and Future Industrial Outdoor Workers

Currently, groundwater underlying the Site and in the immediate vicinity is not used for any purpose. Use for potable purposes within this area is also unlikely for the future due to the presence of high concentrations of total dissolved solids (TDS). TDS concentrations in groundwater samples from 2004 to 2006 ranged from 630 to 1,700 milligrams per liter (mg/L). The USEPA secondary standard for TDS in drinking water is 500 mg/L while the CalEPA maximum contaminant level (MCL) for drinking water ranges from 500 mg/L (recommended) to 1,000 mg/L (upper) with a short-

term concentration of 1,500 mg/L. Use of groundwater at and downgradient of the site will be addressed in a separate report, and is not included in this risk assessment.

Toxicity Assessment

The purpose of a toxicity assessment is to review and summarize available information on the potential for each COPC to cause adverse effects in exposed individuals. Risk characterization combines exposure information with toxicological criteria to estimate carcinogenic risks and non-carcinogenic hazards. Potential cancer risks and potential non-cancer hazards are separately calculated.

Cancer risks are estimated by multiplying exposure estimates for carcinogenic chemicals by corresponding cancer slope factors. The result is a risk estimate expressed as the odds of developing cancer. Commonly, risks (or odds) of developing cancer of one to 100 in one million (1×10^{-6} to 1×10^{-4}) or less are considered to fall within a potentially acceptable range, although decisions on the need for remediation or mitigation are made on a site-by-site basis. Lower risks are typically considered de minimis, while higher risks are often deemed unacceptable (EPA, 1992). In such instances, mitigation of risks may be considered necessary.

Chronic non-cancer hazard indices are calculated by dividing exposure estimates by reference doses. Reference doses are estimates of highest exposure levels that would not cause adverse health effects even if exposures continue over a lifetime. The ratio of exposure to reference dose is termed the hazard quotient (HQ). A HQ greater than one indicates an exposure greater than that considered safe. Impacts of exposure to multiple chemicals are accounted for by adding estimated HQs for non-carcinogenic chemicals that affect the same target organ or tissue in the body. Addition of HQs for COPCs that produce effects in similar organs and tissues results in a HI that reflects possible cumulative hazards.

Risk Characterization

The risk assessment provides quantitative estimates of cancer risk and non-cancer hazard for people that might be exposed to exposure to residual soil and groundwater contamination.

Cancer Risk

Total cancer risk estimates for current commercial/industrial worker on the Site parcel (Three Kings Construction CTE, 2E-5 to 9E-5 and RME, 4E-5 to 1E-4; Star City Auto Body CTE, 3E-5 to 6E-5 and RME, 4E-5 to 9E-5) are above the point of departure of one in one million but within the EPA risk range (HHRA Table ES-1). Cancer risks for the industrial/commercial indoor worker are primarily attributable to inhalation of indoor air. HHRA Figure ES-4 shows the cancer risks due to inhalation of indoor air for the different buildings. Inhalation of benzene accounts for 38 (Star City) to 46 (Three Kings) percent of the cancer risk. Onsite, sources at Star Auto Body and/or 3 Kings Construction could be responsible for some or all of the benzene detected in indoor air. Inhalation of methylene chloride accounts for 38 percent of the cancer risk

for commercial/industrial workers at Three Kings, while inhalation of PCE accounts for 50 percent of the risk at Star City Auto Body (HHRA Figure ES-5).

For the other buildings, cancer risks were assessed only for the inhalation of vapors intruding into indoor air. Estimated inhalation cancer risks for these parcels were similar to, or lower than, those for the Site parcel, except for the West Parcel – Terra Pave. All inhalation cancer risks were above the point of departure of one in one million but within the EPA risk range.

Total cancer risk estimates for future commercial/industrial indoor worker based on data from All Parcels (CTE, 9E-6 to 3E-4 and RME, 1E-5 to 5E-4) are above the EPA risk range (HHRA Table ES-2; HHRA Figure ES-6). Total cancer risk estimates for future commercial/industrial outdoor worker based on data from All Parcels (CTE, 1E-5 to 2E-5 and RME, 1E-5 to 2E-5) are above the point of departure of one in one million but within the EPA risk range. Cancer risks for the future industrial/commercial indoor worker are primarily attributable to inhalation of indoor air. PCE in soil gas accounts for 90 percent of the total inhalation risk. Cancer risks for future industrial/commercial outdoor worker are primarily attributable to exposure to COPCs in soil.

Total cancer risk estimates for the future construction worker (CTE, 2E-7 to 4E-7 and RME, 1E-06 to 2E-6) on the Site parcel; on the Others Parcels (CTE, 2E-7 to 4E-7 and RME, 1E-06 to 2E-6); and on All Parcels (CTE, 2E-7 to 3E-7 and RME, 1E-06 to 2E-6) are above the point of departure of one in one million but within the EPA risk range. Cancer risks for construction workers are primarily attributable to exposure to COPCs in soil. Benzo(a)pyrene accounts for about 44 to 48 percent of the cancer risk from soil exposure for construction workers (RME and CTE, respectively). PCB-1254 and total PCBs collectively accounts for about 25 to 28 percent of the cancer risk from soil exposure for construction workers (RME and CTE, respectively).

Total cancer risk estimates for future residents (adult, 5E-5 to 3E-3; adult+child, 8E-5 to 3E-3; and child, 4E-5 to 1E-3) on the Site parcel and on the Others Parcels (adult, 2E-5 to 4E-3; adult+child, 4E-5 to 5E-3; and child, 3E-5 to 2E-3) are above the EPA risk range(HHRA Figure ES-7). Cancer risks for residents are primarily attributable to inhalation of indoor air. Inhalation of PCE in soil gas accounts for 90 to 95 percent of the total inhalation risk.

Chronic Non-Cancer Hazards

Chronic non-cancer hazards for the current commercial/industrial worker (Three Kings CTE, 0.4 to 1.2 and RME, 0.6 to 2; Star City Auto CTE, 0.5 to 5.1 and RME, 0.8 to 8) are above the threshold of 1. HIs for the current commercial/industrial worker are primarily attributable to inhalation of indoor air (HHRA Figure ES-8). HIs for the current commercial/industrial worker on the Site parcel at the Three Kings building are attributable to inhalation exposure to toluene (18 percent), m,p-xylenes (27 percent), methylene chloride (21 percent), PCE (12 percent), and benzene (12 percent).

Inhalation HIs for the five parcels are summarized as follows. HIs for the north parcel (Medlin and Sons, CTE, 0.09 to 0.6 and RME, 0.1 to 1; Medlin and Sons North, CTE, 0.05 and RME, 0.08) are primarily attributable to exposure to acetone (55 percent) with a lesser contribution from PCE (32 percent). HIs for the west parcel (TerraPave, CTE, 0.5 to 1.2 and RME, 0.7 to 1.8) are primarily attributable to exposure to PCE (90 percent). HIs for the south parcel – Bishop (CTE, 0.1 to 0.4 and RME, 0.2 to 0.6) are primarily attributable to exposure to PCE (76 percent) with a lesser contribution from 1,1-DCE (6 percent). HIs for the south parcel – LA Carts (CTE, 0.06 to 0.8 and RME, 0.1 to 1.3) are primarily attributable to exposure to toluene (74 percent) with a lesser contribution from acetone (15 percent). HIs for the south parcel – Oncology Care (CTE, 0.09 and RME, 0.14 to 0.15) are primarily attributable to exposure to toluene (20 percent), 1,2-DCA (23 percent), benzene (14 percent) and acetone (11 percent).

Total HIs for future residents (Site Parcel: adult, 0.7 to 30; adult+child 1.4 to 39; and child, 4.1 to 74; Other Parcels: adult, 0.4 to 45; adult+child 1 to 58; and child, 3.4 to 108) are above the target threshold (HHRA Figure ES-9). The highest HQs for residents are calculated from data from the Other Parcels and are attributable to inhalation exposure to PCE and 1,1-DCE, which account for 90 and 6 percent of HIs for the adult+child resident and 86 and 8 percent of HIs for the child adult+child resident on the Site Parcel.

Total HIs for future commercial/industrial indoor workers (CTE, 0.15 to 4 and RME, 0.3 to 7) based on data from All Parcels are above the target threshold (HHRA Figure ES-10). Inhalation of indoor air is attributable for most of this hazard. Similar to the resident, PCE and 1,1-DCE account for most of the hazard, contributing 84 and 9 percent, respectively. When the total HI is divided by target organ for the RME future commercial/industrial indoor worker, HI associated with liver is the largest portion (90 percent of the total HI, or an HI of 6.4). HIs for all other endpoints are less than the threshold of 1. Total HIs for future commercial/industrial outdoor worker (CTE, 0.2 to 0.3 and RME, 0.3 to 0.5) based on data from All Parcels are below the target threshold of one.

Total hazard indices for the construction worker (Site Parcel: CTE, 0.08 to 0.13 and RME, 0.8 to 1.2; Other Parcels: CTE, 0.08 to 0.12 and RME, 0.8 to 1.2; and All Parcels: CTE, 0.08 to 0.12 and RME, 0.08 to 1.1) are below or at the target HI of one. Roughly 30 percent of the hazards for the future construction worker are related to inhalation of ambient air. Hazards are higher on the Site Parcel than on the Other Parcels and All Parcels. HIs for all calculated endpoints (liver, body weight effects, and kidneys) are less than the threshold of 1.

Conclusions

Important results of the risk assessment that follow from the HHRA can be summarized as follows:

- Field investigations since 2004 provide a recent and complete site characterization. High confidence can be assigned to use of these data to select chemicals of potential concern and to estimate exposure point concentrations.

- Commercial/industrial land use is an appropriate assumption for future site use. The site has been used for such purpose since it was developed from agricultural land in the 1950's. In addition, City representatives have stated that it is unlikely that the former Omega Chemical property will be redeveloped for residential uses (Adams, 2007), although the zoning of the site as Whittier Blvd. Specific Plan-Workplace District allows for Live/Work units and multi-family housing.

- Among receptors potentially exposed to site-related contaminants, the highest cancer risks and noncancer hazards are associated with exposure of hypothetical future residents, with risks above the EPA risk range and hazards above the target threshold.

- The pathway that suggests the highest potential for exposure involves intrusion of vapors into indoor air spaces. Inhalation of these vapors indoors results in the highest estimates of potential cancer risk and noncancer hazard.

- PCE is the primary COPC of concern at the site. For example, inhalation of indoor air suggests potential total inhalation cancer risks for current industrial workers ranging from 8E-6 to 7E-5. Cancer risk associated with inhalation exposure to PCE alone ranges from 5E-7 to 4E-05. Estimated hazards for PCE were relatively low, however. HQs for exposure to indoor air for PCE ranged from 0.01 to 1.6 compared to a total inhalation HIs ranging from 0.06 to 8.

- Potential risks associated with exposure to ambient (urban background) concentrations of VOCs are as high as $3x10^{-5}$ and may account for 12 to essentially 100 percent of total risks estimated for indoor exposures, depending on parcel. LA Carts/Oncology Care may not be affected by site-related VOCs. Further, subsurface VOC contamination appears to be insufficient to sustain releases that would produce significant ambient air concentrations over extended periods of time.

- Ambient air risks for construction workers are within and near the lower end of the EPA risk range, and ambient air hazards are below the target threshold. . Subsurface VOC contamination appears to be insufficient to sustain releases that would produce significant ambient air concentrations over the one-year time period assumed for construction worker exposures.

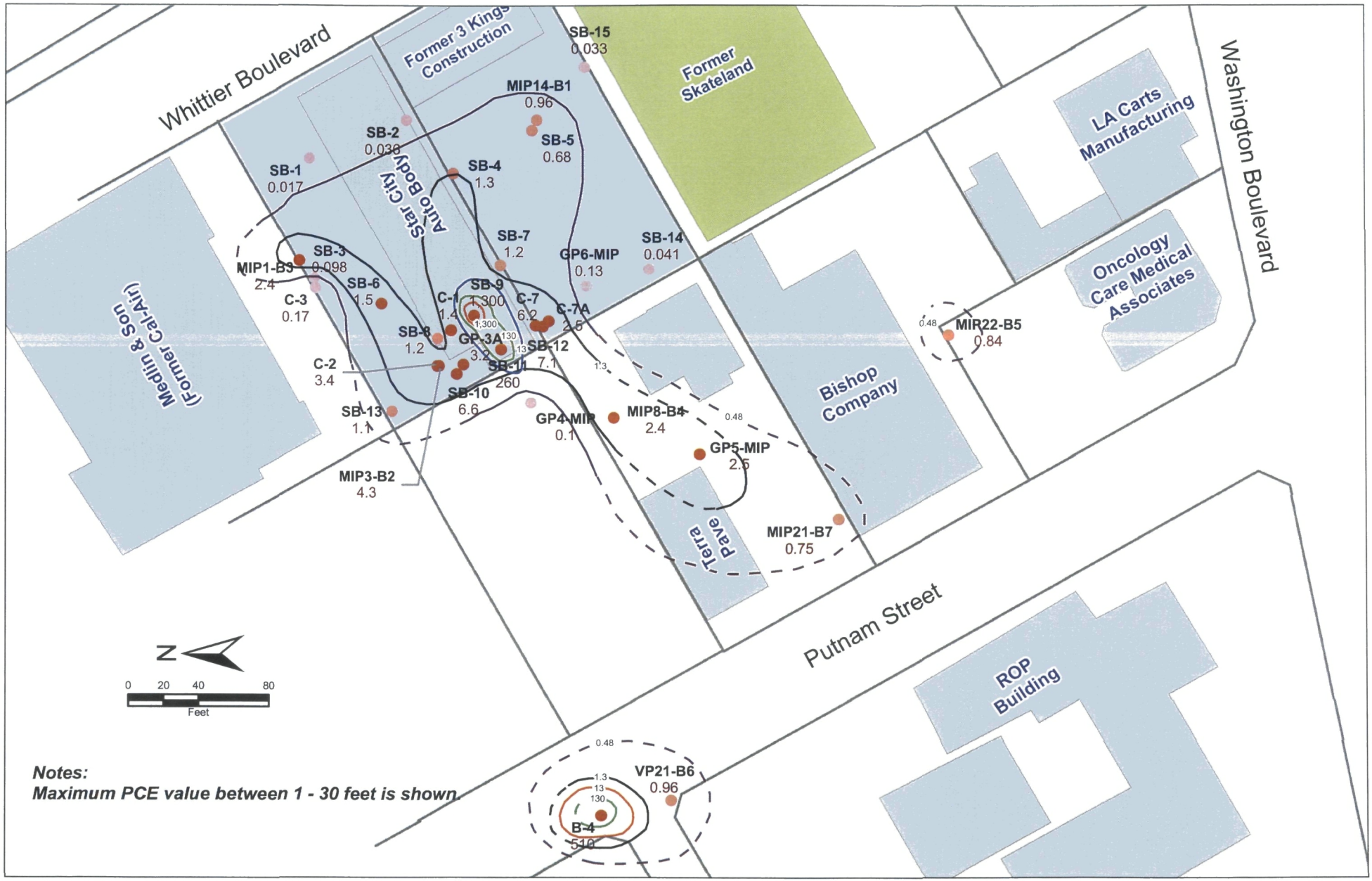
- Hypothetical exposure to contaminants in soil is unlikely to occur, since soil is currently covered with buildings, asphalt, and concrete and such cover is likely to remain even if the site is redeveloped for other commercial/industrial purposes in the future. Even if the current property cover is replaced by green-belt type landscape, it is unlikely that contaminated soils would be exposed at the ground surface where direct contact (e.g., dermal contact or ingestion) could occur. Further, volatile COPCs, in particular PCE, acetone, and toluene, will not persist in non-volatile form in soils exposed during excavation, and direct contact exposures (incidental ingestion and dermal contact) for construction worker exposures via these pathways are expected to be minimal. These VOCs along with benzo(a)pyrene were associated with the bulk of risks and hazards estimated for direct contact exposure to surface soils.

- Uncertainties in the risk assessment suggest that site-related risks have been adequately characterized to support risk management decisions. In fact, the database is biased toward source/release areas and likely overstates levels of contamination for the site as a whole.

- Site-related risks involving exposure to PCE vapors in indoor air appear to be adequately assessed using available site-specific data.

- Site-specific PRGs developed for PCE can be used upon approval by EPA with confidence in evaluating remedial alternatives, if the site is deemed by EPA to pose an unacceptable risk.

For detailed discussion of the risk assessment procedures, findings, and conclusions, please refer to the *Final Human Health Risk Assessment for On-Site Soils* (CDM, November 9, 2007).



Notes:
Maximum PCE value between 1 - 30 feet is shown

Legend

- Property Boundary
- Former Omega Chemical Property
- Existing Building
- Former Building
- Not Detected
- < 0.48 mg/kg
- 0.48 - 1.3 mg/kg
- > 1.3 mg/kg

PCE (mg/kg)

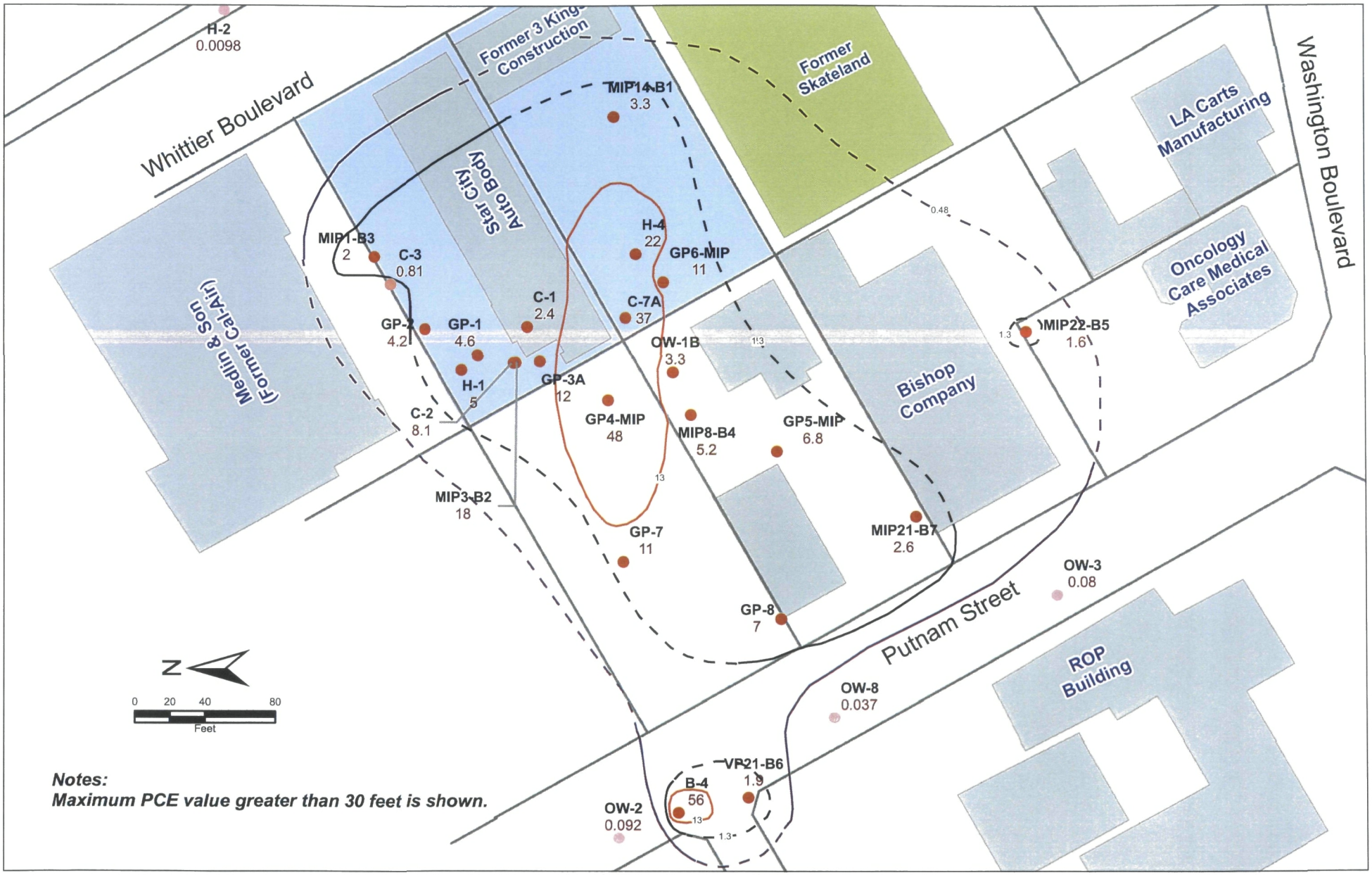
- Residential PRG (0.48 mg/kg)
- Industrial / Commercial PRG (1.3 mg/kg)
- Industrial / Commercial PRG x 10 (13 mg/kg)
- Industrial / Commercial PRG x 100 (130 mg/kg)
- Industrial / Commercial PRG x 1,000 (1,300 mg/kg)

(Dashed where inferred.)

CDM

Omega Chemical
Locations with Soil PCE
PRG Exceedance from 1 to 30 Feet

Figure 5-1



Notes:
Maximum PCE value greater than 30 feet is shown.

Legend

- Property Boundary
- Former Omega Chemical Property
- Existing Building
- Former Building

- Not Detected
- < 0.48 mg/kg
- 0.48 - 1.3 mg/kg
- > 1.3 mg/kg

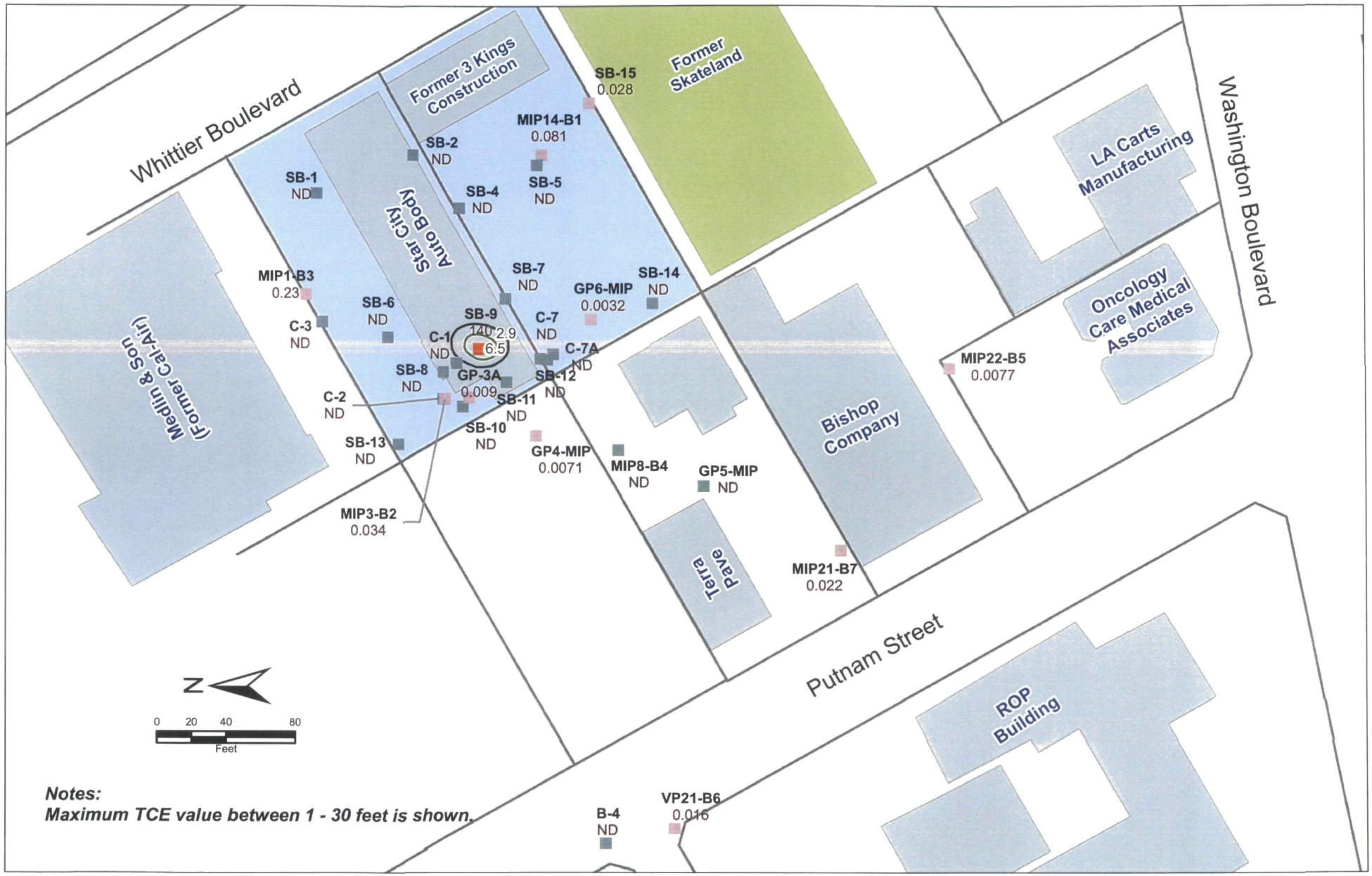
PCE (mg/kg)

- Residential PRG (0.48 mg/kg)
- Industrial / Commercial PRG (1.3 mg/kg)
- Industrial / Commercial PRG x 10 (13 mg/kg)
- Industrial / Commercial PRG x 100 (130 mg/kg)
- Industrial / Commercial PRG x 1,000 (1,300 mg/kg)

(Dashed where inferred.)

CDM

Omega Chemical
Locations with Soil PCE PRG Exceedance from Greater Than 30 Feet
Figure 5-2



Notes:
Maximum TCE value between 1 - 30 feet is shown.

Legend

- Property Boundary
- Former Omega Chemical Property
- Existing Building
- Former Building
- Not Detected
- < 0.48 mg/kg
- 0.48 - 1.3 mg/kg
- > 1.3 mg/kg

TCE (mg/kg)

- Residential PRG (2.9 mg/kg)
- Industrial / Commercial PRG (6.5 mg/kg)
- Industrial / Commercial PRG x 100 (650 mg/kg)

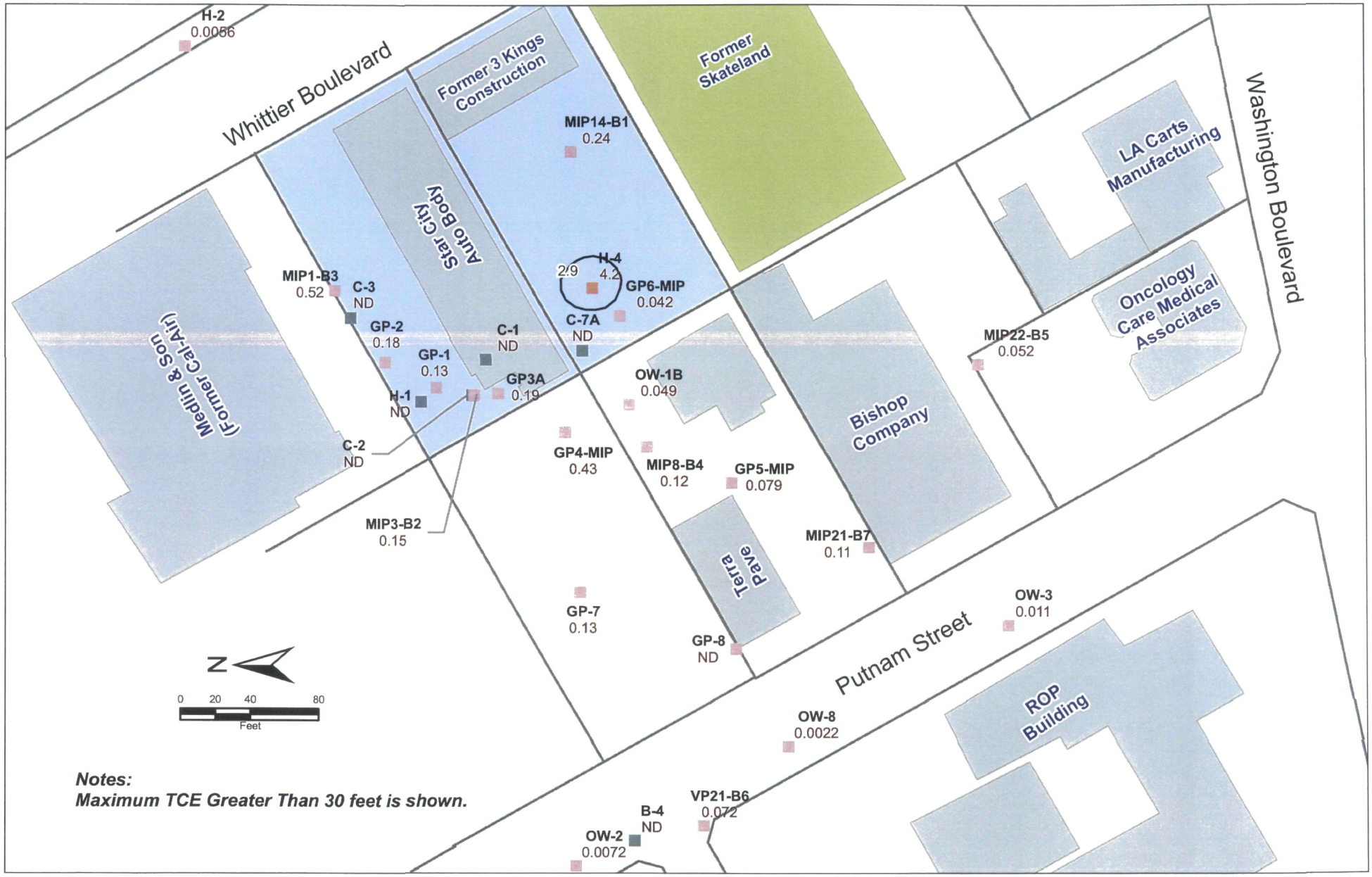
Dashed where inferred.

CDM

Omega Chemical

Locations with Soil TCE PRG Exceedance from 1 to 30 Feet

Figure 5-3



Legend

- Property Boundary
- Former Omega Chemical Property
- Existing Building
- Former Building
- Not Detected
- < 0.48 mg/kg
- 0.48 - 1.3 mg/kg
- > 1.3 mg/kg

TCE (mg/kg)

- Residential PRG (2.9 mg/kg)
- Industrial / Commercial PRG (6.5 mg/kg)
- Industrial / Commercial PRG x 100 (650 mg/kg)

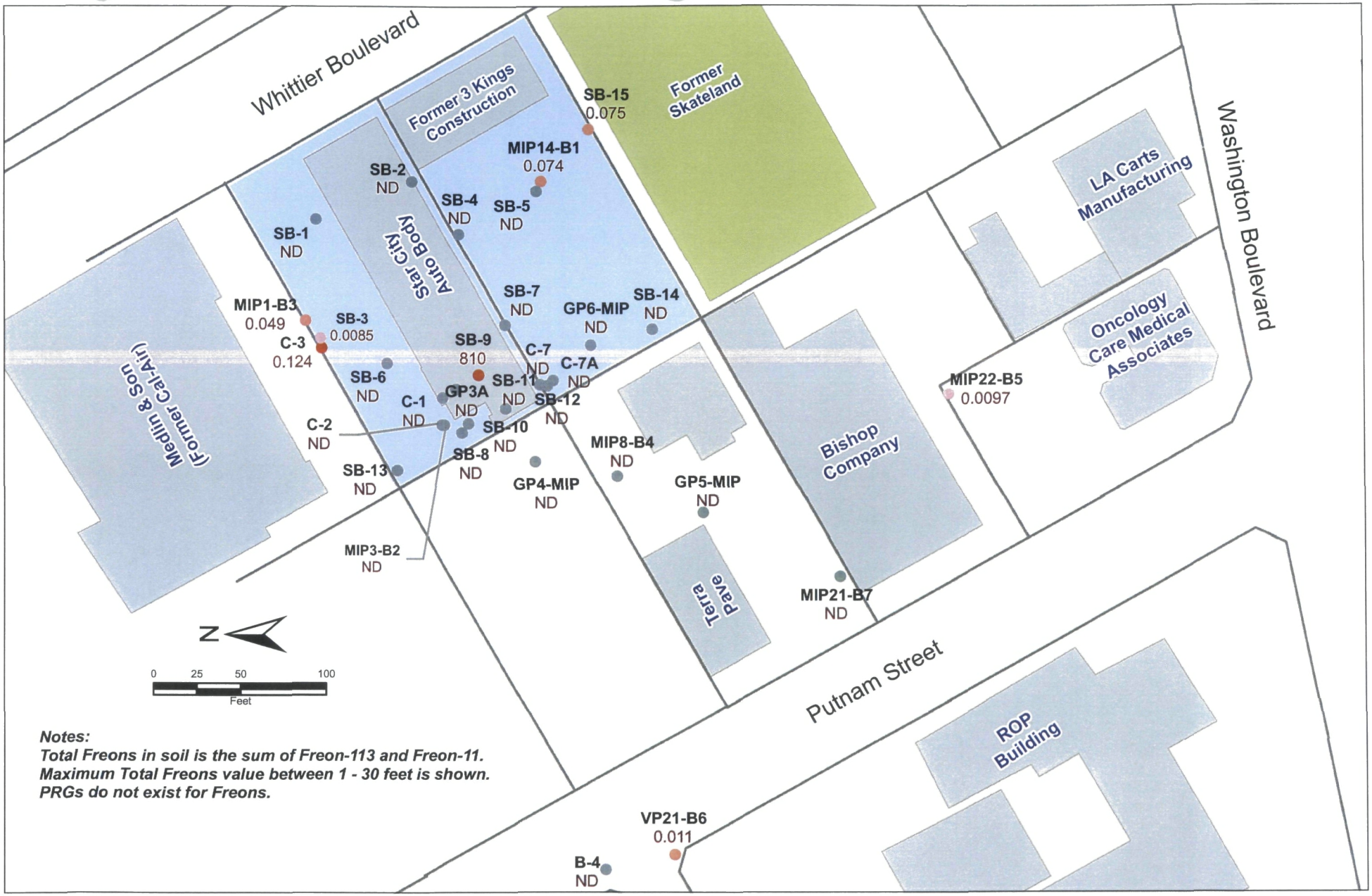
Dashed where inferred.

CDM

Omega Chemical

Locations with Soil TCE PRG Exceedance from Greater Than 30 Feet

Figure 5-4



Notes:
Total Freons in soil is the sum of Freon-113 and Freon-11.
Maximum Total Freons value between 1 - 30 feet is shown.
PRGs do not exist for Freons.

Legend

- Property Boundary
- Former Omega Chemical Property
- Existing Building
- Former Building

Total Freons (mg/kg)

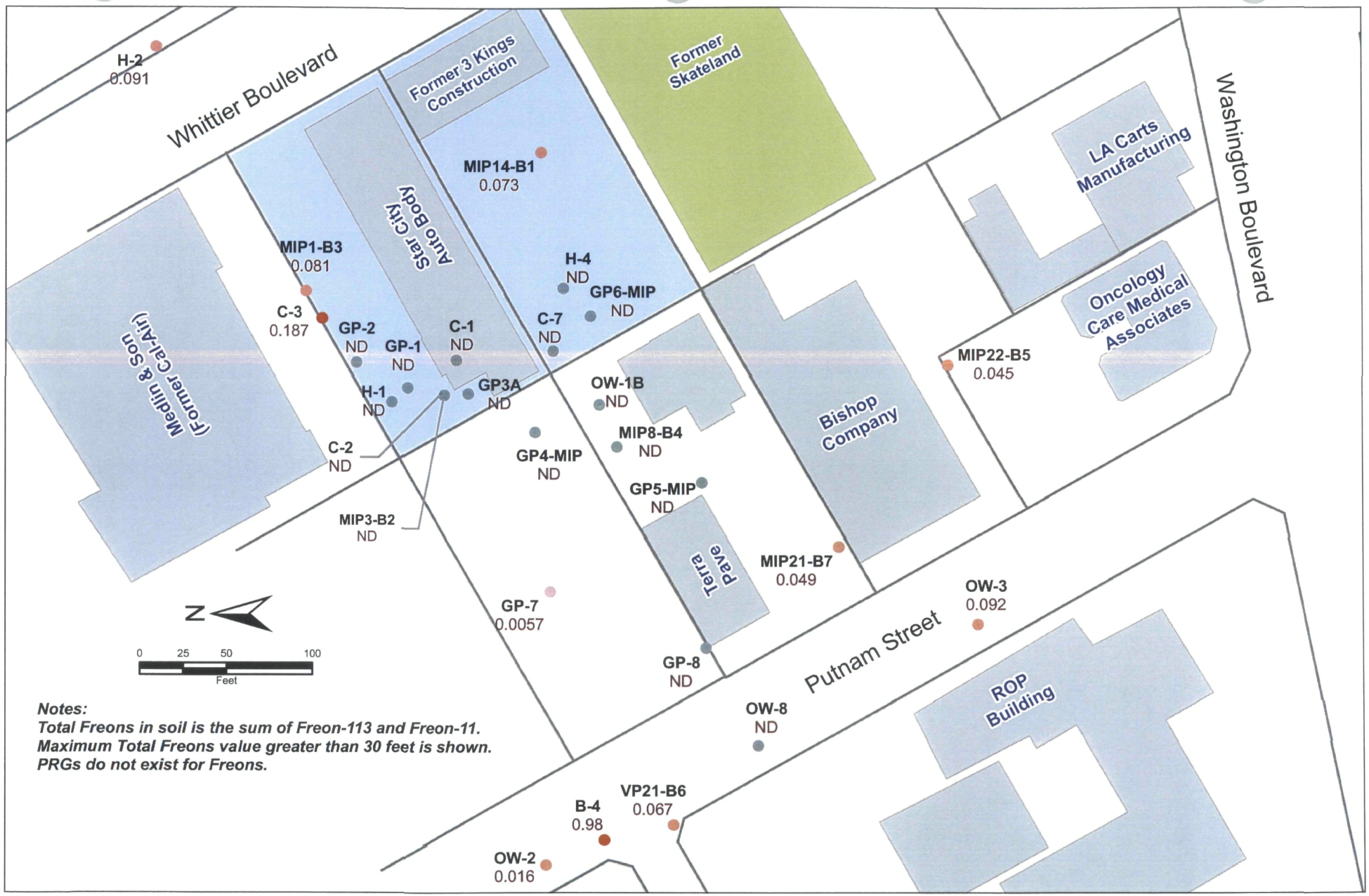
- Not Detected
- < 0.01
- 0.01 - 0.1
- > 0.1

CDM

Omega Chemical

Locations with Soil Total Freons from 1 to 30 Feet

Figure 5-5



Notes:
Total Freons in soil is the sum of Freon-113 and Freon-11.
Maximum Total Freons value greater than 30 feet is shown.
PRGs do not exist for Freons.

Legend

- Property Boundary
- Former Omega Chemical Property
- Building

Total Freons (mg/kg)

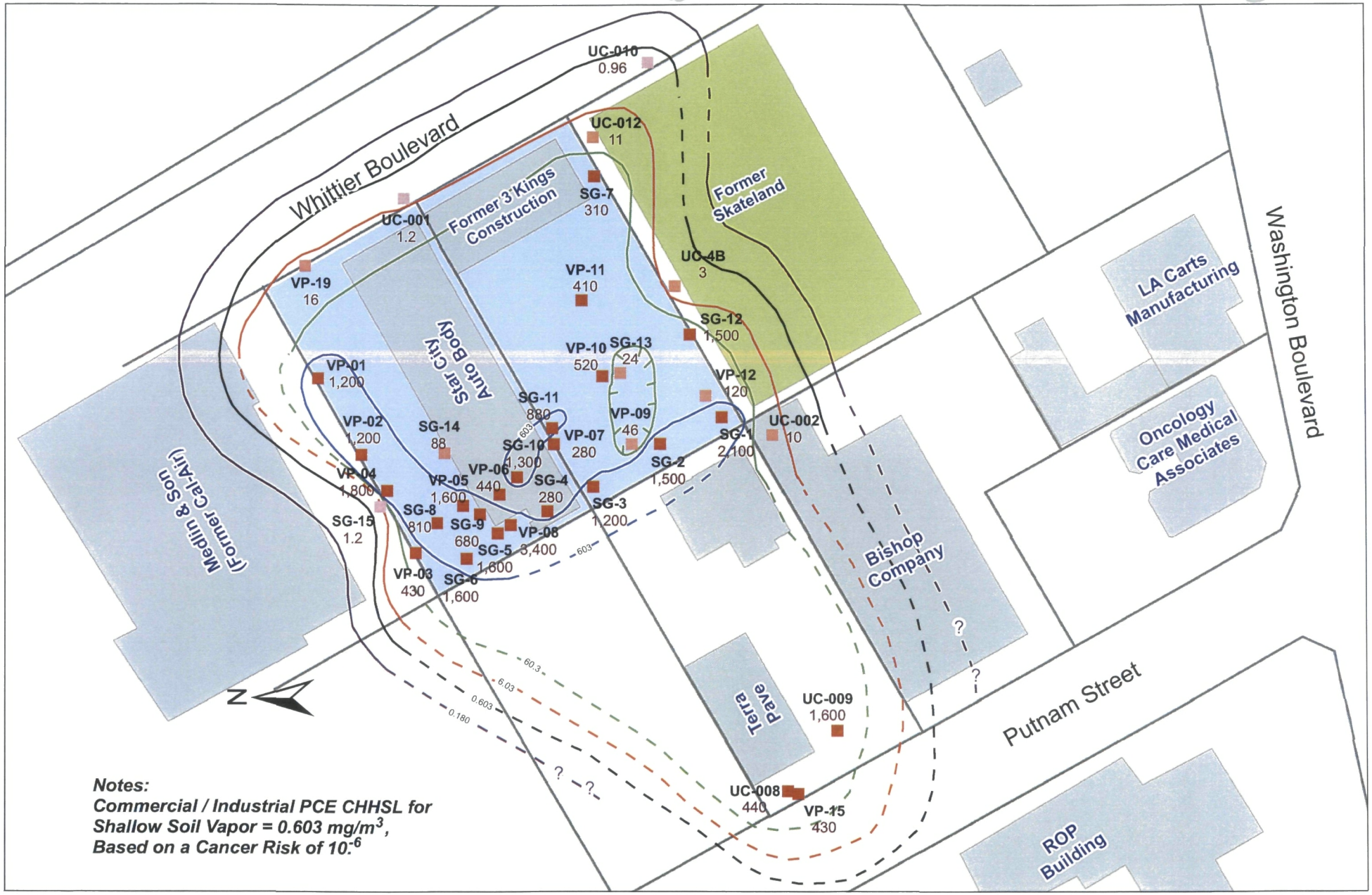
- Not Detected
- < 0.01
- 0.01 - 0.1
- > 0.1

CDM

Omega Chemical

Locations with Soil Total Freons Greater Than 30 Feet

Figure 5-6



Notes:
Commercial / Industrial PCE CHHSL for Shallow Soil Vapor = 0.603 mg/m^3, Based on a Cancer Risk of 10^{-6}

Legend

- Property Boundary
- Former Omega Chemical Property
- Building

- Not Detected
- < 0.603 mg/m^3
- 0.603 - 60.3 mg/m^3
- > 60.3 mg/m^3

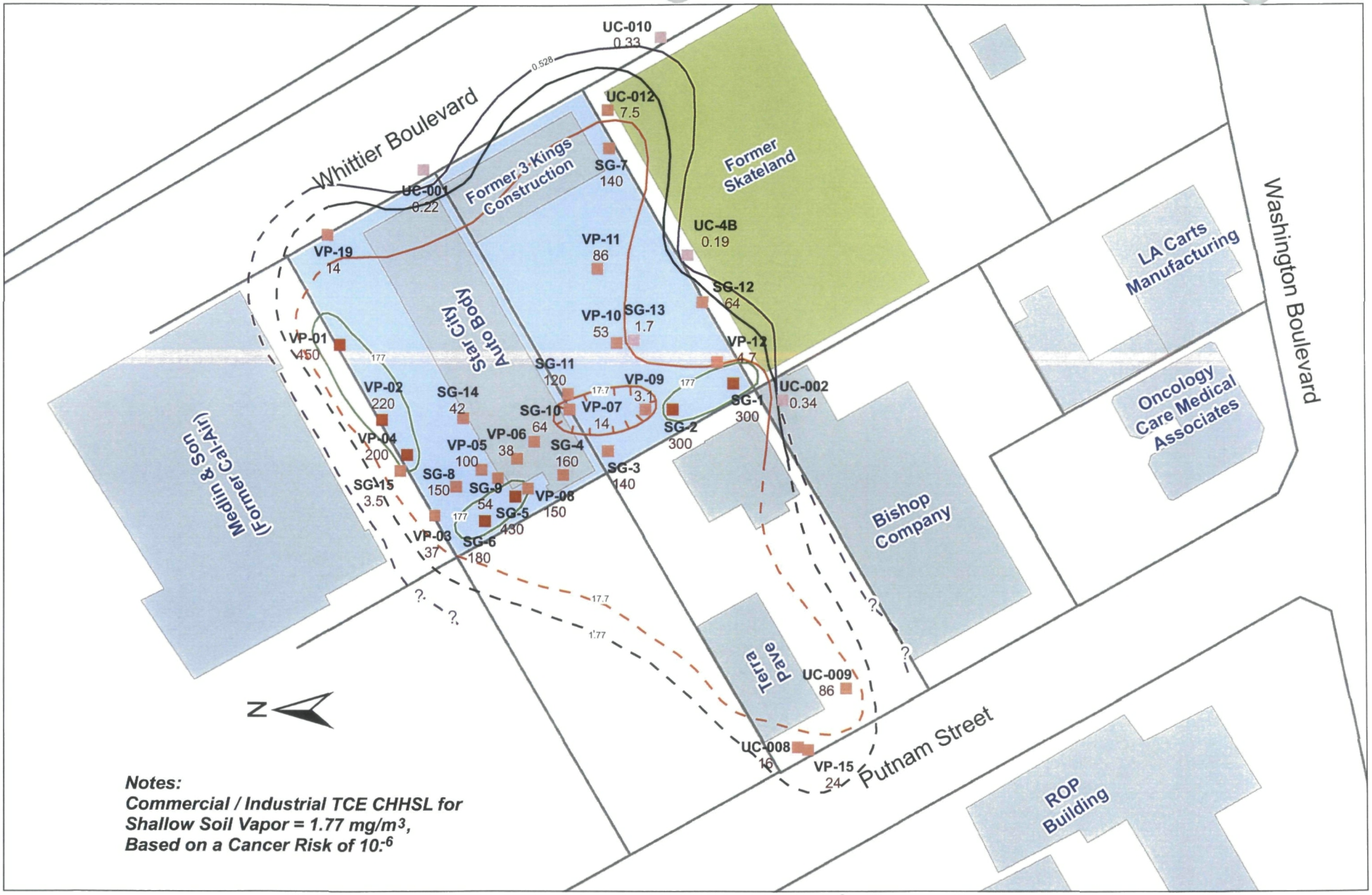
PCE (mg/m^3)

- Residential CHHSL (0.180 mg/m^3)
- Industrial / Commercial CHHSL (0.603 mg/m^3)
- Industrial / Commercial CHHSL x 10 (6.03 mg/m^3)
- Industrial / Commercial CHHSL x 100 (60.3 mg/m^3)
- Industrial / Commercial CHHSL x 1,000 (603 mg/m^3)

Dashed where inferred.

CDM

Omega Chemical
Locations with Soil Vapor PCE CHHSL Exceedances From 0 - 6 Feet
Figure 5-7



Legend

- Property Boundary
- Former Omega Chemical Property
- Building

- Not Detected
- < 1.77 mg/m3
- 1.77 - 177 mg/m3
- > 177 mg/m3

TCE (mg/m3)

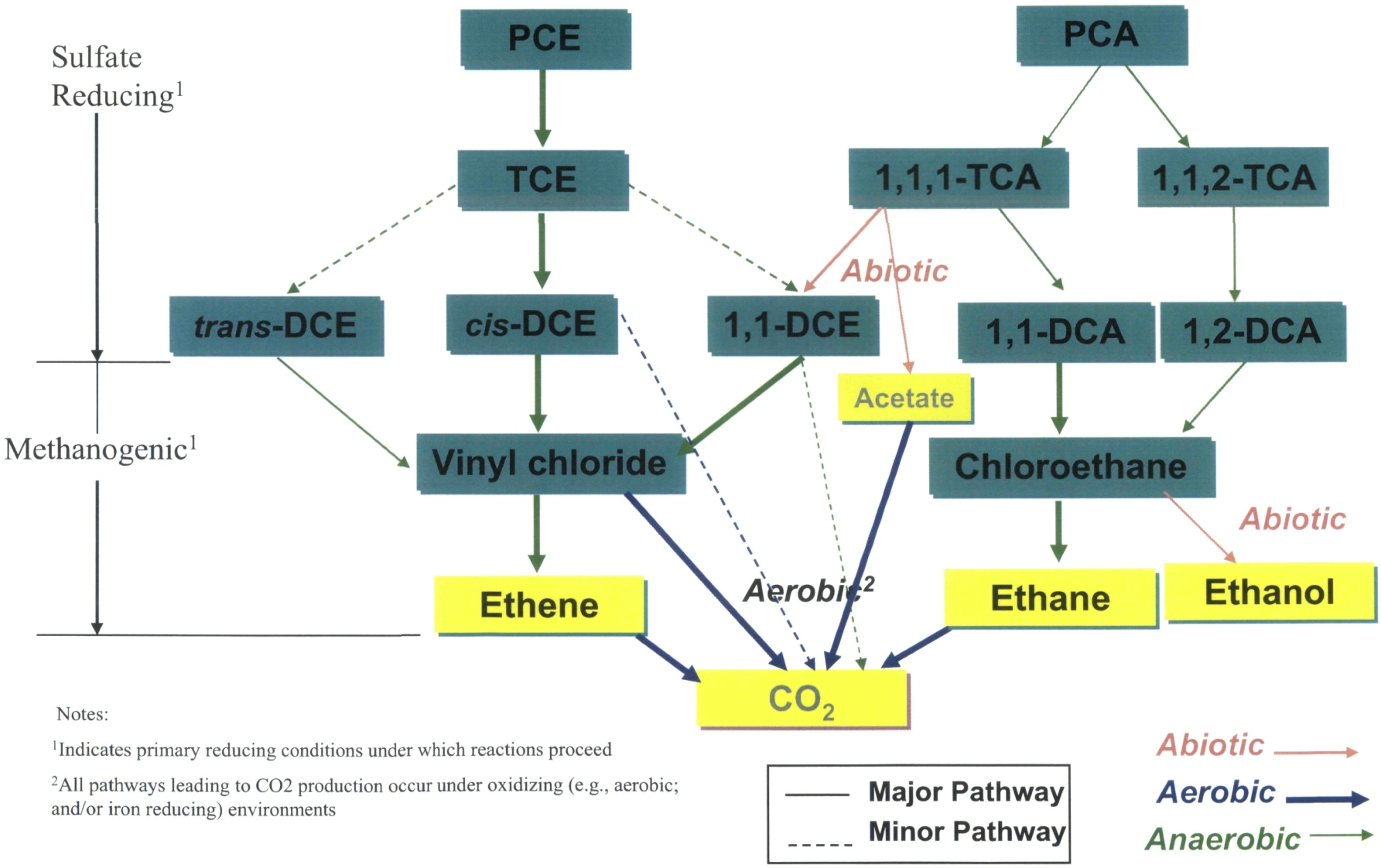
- Residential CHHSL (0.528 mg/m3)
- Industrial / Commercial CHHSL (1.77 mg/m3)
- Industrial / Commercial CHHSL x 10 (17.7 mg/m3)
- Industrial / Commercial CHHSL x 100 (177 mg/m3)

Dashed where inferred.

CDM

Omega Chemical
Locations with Soil Vapor TCE CHHSL Exceedances From 0 - 6 Feet
Figure 5-8

Figure 5-9 - Biotransformation Pathways for Chlorinated Compounds



Notes:

[1]Indicates primary reducing conditions under which reactions proceed

[2]All pathways leading to CO2 production occur under oxidizing (e.g., aerobic; and/or iron reducing) environments

Section 6

Section 6
Conclusions

This section presents the primary conclusions of the RI as they relate to the objectives of the investigation. The RI was conducted to characterize the nature and extent of contamination in Site soils to the extent necessary to assess the threat these contaminants pose to human health and the environment, and to evaluate remedial action alternatives to eliminate, reduce, or control risks to human health and the environment at the Site. In this regard, the following conclusions have been made:

Contaminants

A total of 44 VOCs were detected at least once in the soil vapor samples. A variety of VOCs were also detected in soil and air samples collected during the RI. PCE is the most widespread compound at the Site and poses the highest risk; thus, it is used to define the extent of contamination. Other compounds are present at high concentrations and are widely distributed, e.g. Freons; however, they pose less risk.

Sources and Contaminant Migration

The subsurface contaminants present at the Site were likely released to the subsurface via a combination of the mechanisms described in Section 5.1. Once in the ground, the contaminants likely infiltrated into the vadose zone, dispersing laterally at permeability contrasts until the 30-foot unit was encountered. The 30-foot unit appears to be a partial barrier to migration, which led to accumulation and further spreading of contamination laterally across the top of this unit. The elevation of the top of this permeability contrast slopes toward the southwest, which likely led to preferential lateral transport in this direction. Released liquids may have penetrated the 30-foot unit and continued to infiltrate to the water table. The presence of significant VOC concentrations beneath the 30-foot unit over a wide area (as evidenced by soil vapor, soil and MIP results) was noted. There may also be localized areas where the 30-foot unit may not be present.

Soil and Soil Vapor Sampling

PCE is the compound that is the most widespread and poses the highest risk to human health, thus, it is used to define the area that has been impacted by contaminant releases from the former Omega Chemical property. Review of Figures 4-1 and 4-2 provided in Section 4 indicates that PCE concentrations in soils above 30 feet bgs generally decrease with distance from the former Omega Chemical property. Soil vapor PCE results for the same depth interval (Figure 4-15) also show a similar trend. Location B-4, sampled in 1996, is anomalous and may represent an additional source area, since elevated concentrations are present at shallow depths.

Below the 30-foot unit, vadose zone soil vapor VOC concentrations are also high between the Star City and Medlin buildings, and are also high near the Terra Pave building (VP-14 and VP-15) and the Bishop building (VP-18). Moderate total VOC concentrations were present in >30 foot soil vapor samples collected from a location southeast of the former Skateland property (VP-24) and to the southwest of the Medlin building (VP-29, VP-21 and VP-17).

In general, the utility corridor and other soil vapor sample results do not suggest that utility corridors play a significant role in the distribution of VOCs in the vadose zone.

Indoor Air Sampling

At the Skateland property, the highest PCE concentrations were detected during the May 2004 sampling event, with 1,100 ug/m3 and 880 ug/m3 detected in the original and duplicate samples, respectively, collected from the center of the skating rink floor. As discussed in Section 5.2.5, shortly before the May 2004 sampling event the facility operator applied a new urethane coating to the skating rink floor which contained PCE. PCE concentrations during subsequent sampling events were significantly lower, and ranged from 300 ug/m3 in August 2004 to 56 ug/m3 in January 2005.

PCE concentrations in indoor air samples collected from facilities in the vicinity of the former Omega property, with exception of Skateland, ranged from <0.43 to 110 ug/m^3. The maximum PCE concentration of 110 ug/m^3 was detected in the indoor air sample collected from Terra Pave. PCE was detected at significantly lower concentrations at the remaining buildings.

Overall Conclusions

Data and graphical depictions provided in Section 5 define the lateral and vertical extent of contamination in the vadose zone for the Site. These data, and accompanying interpretation, are adequate to complete the development, screening, and evaluation of remedial alternatives through the FS process, including estimation of costs associated with the remedial alternatives in the FS. The data are also adequate to complete the HHRA. This RI Report compares observed soil and soil vapor concentrations in the vadose zone to USEPA PRGs and CHHSLs, respectively. Because both of these criteria are relatively generic screening criteria, the HHRA proposes Site-specific HBRGs. Once approved by USEPA, HBRGs will be used to assist in the selection, design, and implementation of the appropriate remedial measures.

Section 7

Section 7
References

Adams, Jeff. 2007. City of Whittier Planning Services Manager, Omega Chemical Site - Future Land Uses (personal communication via e-mail), April 10.

Cardinal Environmental Consultants. 1991. *Phase I Environmental Site Assessment of the Property Located at 12511 Putnam Street (Terra Pave).* September 11.

Centec Engineering. 1997. *Phase I Environmental Assessment for Property Located at 12484 Whittier Boulevard (Cal-Air Conditioning Company).* August 5.

Camp Dresser & McKee Inc. (CDM). *Technical Memorandum Expanded Soil Vapor Extraction Pilot Test Findings.* August 31, 2007.

CDM. 2007. *Revised Second Addendum to February 5, 2007 Technical Memorandum.* April 20.

CDM. 2007. *Technical Memorandum for Soil Vapor Extraction Pilot Test Initial Findings.* February 5.

CDM. 2007. *Final Human Health Risk Assessment for On-Site Soils.* November 9.

CDM. 2006. *Groundwater Extraction and Treatment Pilot Testing Technical Memorandum.* November 7.

CDM. 2006. *HVAC Evaluation and Chemical Use Inventory Results and Proposed Indoor Air Quality Sampling Locations Technical Memorandum.* July 18.

CDM. 2006. *Analytical Results for Final Vapor Probes (VP26, VP27, and VP30).* June 30.

CDM. 2006. *On-Site Soils R/FS Work Plan Addendum No. 2, Summary of Additional Findings from Soil Vapor and MIP Sampling.* April 14.

CDM. 2006. *On-Site Soils RI/FS Work Plan Addendum No. 2, Summary of Additional Findings from Soil Vapor and MIP Sampling.* Omega Chemical Superfund Site. January 27.

CDM, 2005. *Skateland Sub-Slab Depressurization Testing Technical Memorandum,* December 16.

CDM. 2005. *On-Site Soils RI/FS Work Plan Addendum No. 2. Summary of Initial Findings from Soil Vapor and MIP Sampling with Recommendations for Additional Sampling Locations.* November 1.

CDM. 2005. *Final On-Site Soils RI/FS Work Plan Addendum No. 2. Scope of Work for Additional Investigation.* Omega Chemical Superfund Site. August 17.

CDM. 2005. *Revised Report Addendum for Additional Data Collection in the Phase 1A Area.* Omega Chemical Superfund Site. March 30.

CDM. 2005. *Preliminary Evaluation of Soil Gas Results from November 2005.* February 3.

CDM. 2004. *On-Site Soils Work Plan Addendum, Scope of Work for Additional Investigation.* Omega Chemical Superfund Site. October 20.

CDM. 2003. *On-Site Soils Remedial Investigation/Feasibility Study Work Plan.* Prepared for the Omega Chemical Site PRP Organized Group. September 29.

CDM. 2001. *Data Summary Report for On-Site Soils. Omega Chemical Superfund Site.* Whittier, California. Prepared for Omega Chemical Site PRP Organized Group. December 4.

Department of Water Resources (DWR), 1961. *Bulletin 104: Planned Utilization of the Groundwater Basins of the Coastal Plain of Los Angeles County, Appendix A: Groundwater Geology,* Department of Water Resources, State of California.

England & Associates and Hargis + Associates, Inc. 1996. *Phase II Close Out Report, Omega Chemical Site.* October 1.

ENSR Consulting and Engineering. 1988. *Report on Site Assessment Investigations at Omega Recovery Facility.* October.

USEPA. 2006. Request for a Removal Action, Omega Chemical Superfund Site, Whittier, Los Angeles County, California. April 6.

USEPA. 2006. First Amendment for the Consent Decree for the Omega Chemical Superfund Site. April 6.

USEPA. 2001. Consent Decree for the Omega Chemical Superfund Site. February 28.

USEPA. 2000. *Aerial Photographic Analysis. Omega Chemical Site.* Whittier, California. TS-PIC-20009934S. Environmental Sciences Division. April.

Appendices

Appendix A
Boring and MIP Logs, Laboratory Reports, and Analytical Summary Tables

(See attached CD)

Appendix B
Soil Gas, MIP, and SVE Pilot Testing Technical Memoranda

(see attached CD)

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