



*Prepared for
ConocoPhillips Company
San Francisco Refinery
Rodeo, California*

**ConocoPhillips Company
San Francisco Refinery
Rodeo, California**

***Revised Closure Report
Bulk/Container Storage Unit
San Francisco Refinery, Rodeo, California***

October 2005



*Prepared by:
MWH
1340 Treat Blvd., Suite 300
Walnut Creek, California*

**REVISED CLOSURE REPORT
BULK/CONTAINER STORAGE UNIT
SAN FRANCISCO REFINERY, RODEO, CALIFORNIA**

Prepared for:

**ConocoPhillips Company
Environmental Services Department
1380 San Pablo Avenue
Rodeo, CA 94572**

Prepared by:

**MWH
1340 Treat Blvd., Suite 300
Walnut Creek, CA 94597**

October 26, 2005

MWH
Prepared by:

// Original signed By //

John Dowdakin
Senior Scientist

MWH
Approved by:

//Original Signed By //

Andrew Kerr, P.G.
Project Manager

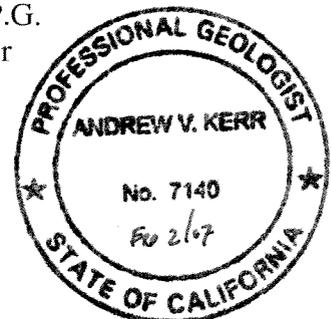


TABLE OF CONTENTS

1.0 INTRODUCTION.....	1-1
1.1 SITE IDENTIFICATION.....	1-2
1.1.1 Owner and Operator.....	1-2
1.1.2 EPA ID Number.....	1-2
1.1.3 Contact Person.....	1-2
1.1.4 Preparer of Closure Plan.....	1-3
1.2 PROJECT BACKGROUND.....	1-3
1.3 BCSU FACILITY DESCRIPTION.....	1-4
1.3.1 Waste Management.....	1-4
1.3.2 Location and Setting.....	1-5
1.4 REPORT ORGANIZATION.....	1-6
2.0 INACTIVE WASTE SITE 6C SITE HISTORY AND SUBSURFACE CONDITIONS....	2-1
2.1 SITE IDENTIFICATION.....	2-1
2.2 INITIAL EVALUATION.....	2-1
2.3 INCORPORATION OF IWS-6C INTO SFR REMEDIAL PROGRAMS.....	2-2
2.4 1997 FOLLOW-ON ASSESSMENT.....	2-3
2.5 REMEDIAL PROGRAM.....	2-4
2.6 CURRENT STATUS OF IWS-6C.....	2-5
3.0 PHASE I CLOSURE PROCESS.....	3-1
3.1 DISPOSAL OF WASTES FORMERLY STORED AT THE BCSU.....	3-2
3.2 DECONTAMINATION OF BCSU SURFACES, EQUIPMENT, AND STRUCTURES.....	3-2
3.3 CONFIRMATION SAMPLING OF DECONTAMINATED SURFACES, EQUIPMENT, AND STRUCTURES.....	3-3
3.3.1 Asphalt Chip Samples.....	3-4
3.3.2 Concrete Chip Samples.....	3-5
3.3.3 Wipe Samples.....	3-5
3.4 SAMPLING OF THE SOIL, GROUNDWATER, AND SOIL VAPOR BENEATH THE BCSU.....	3-6
3.4.1 Primary Soil Samples.....	3-7
3.4.2 Background Soil Samples.....	3-7

3.4.3	Groundwater Samples	3-7
3.4.4	Soil Vapor Samples	3-8
3.5	SAMPLING OF WATER IN THE LINED CONCRETE CONTAINMENT PAD COLLECTION SUMPS	3-8
4.0	CLOSURE RESULTS	4-1
4.1	LITHOLOGY BENEATH THE BCSU.....	4-1
4.1.1	Upper and Lower Terraces	4-1
4.1.2	Middle Terrace	4-2
4.2	CHEMISTRY RESULTS FROM CONFIRMATION AND CLOSURE SAMPLES	4-2
4.2.1	Asphalt Chip Samples	4-3
4.2.2	Concrete Chip Samples	4-4
4.2.3	Wipe Samples	4-4
4.2.4	Soil Samples	4-5
4.2.5	Groundwater Samples	4-5
4.2.6	Soil Vapor Samples	4-6
4.2.7	Sump Water Samples	4-6
4.3	STATISTICAL ANALYSIS OF METALS CHEMISTRY DATA	4-6
4.4	QUALITY ASSURANCE / QUALITY CONTROL (QA/QC) DATA REVIEW	4-7
4.5	COMPOUNDS DETECTED AT BCSU AS COMPARED TO IWS-6C	4-8
5.0	HUMAN HEALTH RISK ASSESSMENT	5-1
5.1	INTRODUCTION	5-1
5.1.1	Purpose and Objectives	5-2
5.1.2	Scope	5-3
5.1.3	Organization	5-4
5.2	DATA EVALUATION AND IDENTIFICATION OF COPCS	5-5
5.2.1	Soil.....	5-6
5.2.2	Soil Vapor.....	5-7
5.2.3	Groundwater	5-7
5.2.4	Selection of COPCs.....	5-7
5.3	SCREENING RISK EVALUATION	5-8
5.3.1	Screening Risk Characterization Methodology.....	5-8
5.3.2	Screening Risk Characterization Results	5-11
5.4	BASELINE HHRA.....	5-14

5.4.1	Exposure Assessment	5-15
5.4.2	Toxicity Assessment.....	5-19
5.4.3	Risk Characterization	5-21
5.4.4	Uncertainty Analysis	5-25
6.0	SUMMARY AND CONCLUSIONS.....	6-1
6.1	REMOVING THE IWS-6C SOIL FROM THE BCSU CLOSURE PROCESS	6-1
6.2	SUMMARY OF ASSESSED CONDITIONS AT EACH BCSU MEDIA	6-2
6.2.1	Asphalt Surfaces.....	6-2
6.2.2	Concrete Pads	6-2
6.2.3	Structures.....	6-3
6.2.4	Soil.....	6-3
6.2.5	Soil Vapor.....	6-4
6.2.6	Groundwater	6-5
6.3	CONCLUSIONS.....	6-5
6.4	CLOSURE REQUEST	6-7
7.0	REFERENCES	7-1

LIST OF TABLES

Table 1	Revised Project Schedule
Table 2	Summary of Groundwater Chemistry Data
Table 3	Asphalt Chip Sample Chemistry Data
Table 4	Background Asphalt Chip Sample Chemistry Data
Table 5	Concrete Chip Sample Chemistry Data
Table 6	Background Concrete Chip Sample Chemistry Data
Table 7	Wipe Sample Chemistry Data
Table 8	Wipe Background Sample Chemistry Data
Table 9	Subsurface Soil Sample Chemistry Data
Table 10	Background Subsurface Soil Sample Chemistry Data
Table 11	Groundwater Sample Chemistry Data
Table 12	Soil Vapor Sample Chemistry Data
Table 13	Washwater and Sump Sample Chemistry Data
Table 14	Identified Chemicals of Potential Concern
Table 15	Screening Criteria for Cancer Risk and Noncancer Hazard Calculations
Table 16	Screening Cancer Risk and Noncancer Hazard Calculations for Shallow Soil – All Data
Table 17	Screening Cancer Risk and Noncancer Hazard Calculations for Deep Soil – All Data
Table 18	Screening Cancer Risk and Noncancer Hazard Calculations for Soil Vapor
Table 19	Screening Cancer Risk and Noncancer Hazard Calculations for Groundwater
Table 20	Human Health Exposure Parameters
Table 21	Human Health Toxicity Values
Table 22	Summary of Baseline Human Health Risk Assessment Results – Shallow Soil
Table 23	Summary of Baseline Human Health Risk Assessment Results – Deep Soil
Table 24	Summary of Baseline Human Health Risk Assessment Results – Soil Vapor

LIST OF FIGURES

Figure 1	Site Location Map
Figure 2	Bulk/Container Storage Unit Location
Figure 3	Bulk/Container Storage Unit Waste Storage/Handling Facilities
Figure 4	BCSU Relative to the “Southeast Area” and IWS-6C
Figure 5	Closure Sampling Locations
Figure 6	Background Sample Locations
Figure 7	Geologic Cross Sections
Figure 8	Human Health Conceptual Site Model

LIST OF APPENDICES

- Appendix A Attachment A-1. Final Reconnaissance Evaluation of the Areal Extent of Former Inactive Waste Site 6C at the Unocal San Francisco Refinery, Rodeo, California. December 5, 1995.
- Attachment A-2. Results of Additional Investigation and Remediation Plan, Inactive Waste Site 6C. August 1997.
- Attachment A-3. Addendum to the Inactive Waste Site 6C Report – “Results of Additional Investigation and Remediation Plan, August 1, 1997.” January 7, 1998.
- Appendix B Phase I Closure - Decontamination and Confirmation/Closure Sampling
- Appendix C Statistical Comparison of Compliance and Background Samples
- Appendix D Quality Assurance/Quality Control Data Review
- Appendix E Exposure Point Concentration and Risk Calculation Spreadsheets
- Appendix F Excerpts from August 2003 Phase I Closure Plan (Historical Waste Information) (Analytical Testing Information)

LIST OF ACRONYMS

AST	aboveground storage tank
bgs	below ground surface
BCSU	Bulk/Container Storage Unit
BTEX	benzene, toluene, ethylbenzene, and xylenes
Cal-EPA	California Environmental Protection Agency
CSF	cancer slope factor
CCR	California Code of Regulations
CFR	Code of Federal Regulations
CHHSL	California Human Health Screening Level
cm	centimeter
COPCs	chemicals of potential concern
CSM	Conceptual Site Model
CV	coefficient of variation
C&T	Curtis and Tompkins, Ltd.
DQO	Data Quality Objective
DTSC	Department of Toxic Substances Control
EF	exposure frequency
ESL	Environmental Screening Level
EPA	United States Environmental Protection Agency
EPC	exposure point concentration
GQMP	Groundwater Quality Monitoring Program
GSU	Geological Services Unit
HEAST	Health Effects Assessment Summary Tables
HHRA	Human Health Risk Assessment
HI	hazard index
HQ	hazard quotient
ILCR	incremental lifetime cancer risk
IRIS	Integrated Risk Information System
IWS	Inactive Waste Site
MCL	maximum contaminant level
MEK	methyl ethyl ketone
msl	mean sea level
mg/kg	milligrams per kilogram
mg/kg-day	milligrams per kilogram per day
mg/L	milligrams per liter
NCEA	National Center for Environmental Assessment
NFA	no further action

NOAEL	no observable adverse effect level
OEHHA	Office of Environmental Health Hazard Assessment
PAH	polycyclic aromatic hydrocarbons
PCB	polychlorinated biphenyls
PRG	Preliminary Remediation Goal
QA/QC	quality assurance/quality control
RAGS	Risk Assessment Guidance for Superfund
RCRA	Resource Conservation and Recovery Act
RfD	reference dose
RWQCB	Regional Water Quality Control Board, San Francisco Bay Region
SFR	San Francisco Refinery
SQL	sample quantitation limit
SVOC	semi-volatile organic compound
TEF	toxicity equivalency factor
TEQ	Toxicity Equivalent Concentration
TPH	total petroleum hydrocarbons
TTLC	Total Threshold Limit Concentration
TSDf	Treatment, Storage, and Disposal Facility
ug/dl	micrograms per deciliter
ug/L	micrograms per liter
95% UCL	95 percent upper confidence limit
URF	unit risk factor
USGS	United States Geological Survey
VOCs	volatile organic compounds
WDR	Waste Discharge Requirements
WMU	Waste Management Unit
WWTP	Waste Water Treatment Plant

1.0 INTRODUCTION

This Revised Closure Report summarizes the results of the closure activities for the Bulk/Container Storage Unit (BCSU), ConocoPhillips Company (ConocoPhillips) San Francisco Refinery (SFR), Rodeo, California. The BCSU is a hazardous waste management facility that has been operating under Interim Status since 1995. The closure has been performed under the oversight of the California Department of Toxic Substances Control (DTSC) pursuant to the requirements of 40 Code of Federal Regulations (CFR) Part 265 Subpart G and California Code of Regulations (CCR) Title 22 Division 4.5, Chapter 15, Articles 7, 8 and 10. Upon approval of the closure, the BCSU will be used as a 90-day accumulation unit. A 90-day accumulation unit is an established facility for the accumulation of regulated hazardous waste for a period of no greater than 90 days.

The BCSU Closure Report was originally submitted to the DTSC in September, 2004 (MWH, 2004c). DTSC comments on the report were forwarded to ConocoPhillips in a letter dated August 5, 2005 (DTSC, 2005). This Revised Closure Report addresses DTSC comments, with the major revision being a new risk assessment section of the report. ConocoPhillips responses to each specific DTSC comment are also included in a Response-to-Comments cover letter included in the front of this report. The new risk assessment report section addresses potential current and future exposure to site workers and visitors to residual chemicals of potential concern (COPCs) from two sources:

- (1) Those associated with the BCSU, and
- (2) Those associated with the Inactive Waste Site 6C (IWS-6C) materials that underlie the southern portion of the BCSU.

Additional information on the physical attributes and histories of the BCSU and IWS-6C sites are presented in the remaining subsections of Section 1.0 and Section 2.0, respectively.

1.1 SITE IDENTIFICATION

Site identification information is summarized below.

1.1.1 Owner and Operator

The owner and operator of the SFR and the BCSU is:

ConocoPhillips Company
San Francisco Refinery
1380 San Pablo Avenue
Rodeo, California 94572
(510) 799-4411

1.1.2 EPA ID Number

The United States Environmental Protection Agency (EPA) identification number for the SFR facility is:

CAD009108705

1.1.3 Contact Person

The SFR contact person for the BCSU is:

Mr. Stephan Rosen
Environmental Services Department
ConocoPhillips Company
San Francisco Refinery
1380 San Pablo Avenue
Rodeo, California 94572
(510) 245-4618
Stephan.Rosen@conocophillips.com

1.1.4 Preparer of Closure Plan

This revised report was principally prepared by Mr. Andrew V. Kerr, P.G., Mr. John Dowdakin, and Mr. Bruce Narloch, Ph.D., DABT, of MWH on behalf of ConocoPhillips. Dr. Narloch completed the risk assessment calculations and prepared the text presented in Section 5.0. Questions concerning the plan should be directed to Mr. Rosen of ConocoPhillips at (510) 245-4618, or Mr. Kerr of MWH at (925) 975-3505. Mr. Narloch can be called directly at (425) 896-6937 if the questions related directly to the risk assessment work.

1.2 PROJECT BACKGROUND

The SFR is located in Rodeo, California, as shown on [Figure 1](#), and is owned and operated by ConocoPhillips. The BCSU is a 2.44-acre facility that was constructed in several different phases between late 1988 and 1993 for the storage and handling of nonhazardous and hazardous (Federal Resource Conservation and Recovery Act [RCRA] and California) wastes at SFR. The BCSU is located along the southern edge of SFR, within the area of the refinery known as the Lower Tank Farm, as shown on [Figure 2](#).

The closure of the BCSU was performed under the oversight of the DTSC pursuant to the requirements of 40 CFR Part 265 Subpart G and CCR Title 22 Division 4.5, Chapter 15, Articles 7, 8 and 10. ConocoPhillips intends to operate the area after closure as a 90-day accumulation unit. The closure process was structured in two phases per DTSC instructions, with Phase I being a data collection and evaluation phase, and Phase II focusing on the final closure approach and performance standards. This report addresses both closure phases.

The timeline for the closure project is summarized in [Table 1](#). The closure process was begun with the submittal of a *Closure Plan* (ConocoPhillips, 2003) document to the DTSC in April 2003. The proposed closure plan was revised as per the July 1, 2003, letter from the DTSC (DTSC, 2003a), and re-submitted to the DTSC in August 2003 in the *Phase I Closure Work Plan* (MWH, 2003) prepared by MWH on behalf of ConocoPhillips. The closure plan was ultimately finalized per DTSC comments put forth in the *Conditional Approval and Response to Action*

Items letters dated December 11, 2003 (DTSC, 2003b), and February 11, 2004 (DTSC, 2004a), respectively, and MWH's *Response-to-Comments* letter (MWH, 2004a) dated February 27, 2004. DTSC authorized the Phase I Closure Work Plan in a *Conditional Approval* letter dated April 26, 2004 (DTSC, 2004b).

1.3 BCSU FACILITY DESCRIPTION

1.3.1 Waste Management

Historically, the BCSU has been subdivided into three waste management areas (Areas A, B, and C), as shown on [Figure 3](#). Area A is not addressed by this closure process, as it was clean-closed under DTSC oversight in 1999-2000 and is currently used as a 90-day accumulation unit. Areas B and C comprise the area addressed under this closure project. Wastes handled at Areas B and C are currently managed such that they are transported to properly permitted off-site recyclers or treatment, storage, and disposal facilities (TSDFs) within 90 days. A list of wastes managed at the BCSU historically was presented as Table 2 of the Phase I BCSU Closure Work Plan (MWH, 2003); the table is one of the items incorporated into this report for reference within Appendix F.

Containment within the BCSU is provided by engineered surfaces with either asphalt or concrete covering, and perimeter curbing that control run-on and run-off (see [Figure 3](#)). The only uncovered portion of the BCSU is the graded slope that provides the transition between the different elevations of Areas A, B, and C. Liquid and solid wastes have historically been handled or stored within the facility's primary containment areas, including the three polyethylene storage tanks and three concrete pads (see [Figure 3](#)). The other areas of the BCSU are typically used for temporary staging of filled and unfilled storage bins or containers.

SFR records indicate that no RCRA hazardous waste has been spilled at the BCSU since it opened in 1989, and that only a single spill of five barrels (210 gallons) of non-RCRA hazardous waste (spent Stretford Solution) has occurred. Stretford solution has been used historically at SFR as part of processes that strip hydrogen sulfide from gas streams. Spent Stretford solution

typically contains hazardous concentrations of Vanadium. The spill of Stretford Solution was caused by operator error and occurred on the Lower Terrace concrete pad. The spilled material did not escape the pad's secondary containment system and was promptly cleaned up.

1.3.2 Location and Setting

The BCSU is located at the edge of an approximately 20-acre, gentle northwest-sloping portion of the Lower Tank Farm that contains six aboveground storage tanks (ASTs) (Tanks 107, 108, 156, 157, 158, and 180) (see [Figure 4](#)). This area is referred to as the "Southeast Area" of the Lower Tank Farm in this report. The Southeast Area was initially developed in the 1950s as the SFR expanded along its southern perimeter. The area is defined by abrupt changes in topography, including the northern and western boundaries, where ground surface drops approximately 20 to 30 feet toward the SFR buffer zone and the nearby ASTs (Tanks 104, 105, 106, and 155). The southern and eastern boundaries are marked by steeply rising topography toward the Interstate 80 roadway and other offsite property (see [Figure 4](#)).

The Southeast Area of the Lower Tank Farm was developed through grading and filling of an originally north-sloped natural surface that is thought to have included several small hills. The area is known to include a former landfill site known as Inactive Waste Site 6C (IWS-6C). IWS-6C was identified in 1994 during subsurface investigations, and then further evaluated and delineated between 1995 and 1998. The extent of IWS-6C based on those investigations and the results from the BCSU closure process is shown on [Figure 4](#). Additional detail regarding IWS-6C including the site history and associated subsurface soil and groundwater quality is summarized in [Section 2.0](#).

The BCSU was built into the current topography of the Southeast Area with three distinct work terraces, as annotated on [Figure 3](#). For the purposes of this project, the terraces are being referred to as the Upper, Middle, and Lower Terraces. The Upper Terrace is located at an elevation of approximately 60 feet above mean sea level (msl); the terrace is mostly flat, but graded to control stormwater. The Middle Terrace is a gentle, north-sloping surface that resides

at a mean elevation of approximately 55 feet msl. The Lower Terrace is located at an elevation of approximately 50 feet msl, and is mostly flat with grading to control stormwater.

1.4 REPORT ORGANIZATION

The Closure Report is organized into this Introduction, and six other report sections:

Section 1.0	Introduction
Section 2.0	Inactive Waste Site 6C Site History and Subsurface Conditions
Section 3.0	Phase I Closure Process
Section 4.0	Closure Results
Section 5.0	Human Health Risk Assessment (HHRA)
Section 6.0	Summary and Conclusions
Section 7.0	References

2.0 INACTIVE WASTE SITE 6C SITE HISTORY AND SUBSURFACE CONDITIONS

The site and regulatory history of IWS-6C, including detail about known subsurface conditions, is presented below.

2.1 SITE IDENTIFICATION

Soils containing petroleum hydrocarbons and petroleum coke were encountered in 1994 during a subsurface investigation in the Southeast Area of the Lower Tank Farm. The waste deposits were named IWS-6C due to their proximity to previously identified IWS's 6, 6A, and 6B, and the similarity of the material.

2.2 INITIAL EVALUATION

An initial evaluation of IWS-6C that included reviewing historical SFR site plans and tank drawings, results from previous environmental and geotechnical investigations of the area, and archived aerial photographs was completed in 1994 and 1995. The evaluation concluded the following:

- The IWS-6C area approximately coincides with an area of the SFR referred to as “L-4” on a 1958 SFR plot plan. The L-4 site is believed to have been a land disposal area, as the “L” designation is known to have been an identifier used for other refinery waste sites.
- The original footprint of the L-4 waste material based on a December 8, 1954, photograph, appeared to be an approximately 6-acre, trapezoidal-shaped parcel centered around current ASTs 156 and 158.
- The main portion of this original land disposal site appears to have only been active for a few years, as ASTs 155 through 158 were constructed in the area between 1954 and 1957.
- The final extent of the IWS-6C waste material is thought to be different than the original land disposal footprint, as additional fill soil and/or waste materials may have been

placed in outlying areas, and/or earthwork associated with construction of the ASTs and development of this portion of the Lower Tank Farm may have redistributed the material.

- The materials comprising IWS-6C appear to be a heterogeneous mix of miscellaneous debris, petroleum coke, petroleum coke conglomerations, soil with petroleum hydrocarbons, and clean soil imported to level the site and provide appropriate tank foundation materials. Chemical tests of the waste materials indicates the presence of heavy-end petroleum hydrocarbons, polycyclic aromatic hydrocarbons (PAHs), lead, and mercury. Lead and mercury were detected at concentrations less than the total threshold limit concentrations (TTL) for non-RCRA waste, total petroleum hydrocarbons (TPH) were detected at concentrations up to 11,000 milligrams per kilogram (mg/kg), and PAHs (chrysene) were detected at concentrations up to 46 mg/kg.

The scope-of-work and results of the evaluation are described in a letter report entitled, *Reconnaissance Evaluation of the Areal Extent of Former Inactive Waste Site 6C* (Montgomery Watson, 1995). A copy of this document is included in [Appendix A](#) as [Attachment A-1](#).

2.3 INCORPORATION OF IWS-6C INTO SFR REMEDIAL PROGRAMS

The identification of IWS-6C occurred when the regulatory oversight of the SFR was being consolidated under the lead of the Regional Water Quality Control Board, San Francisco Bay Region (RWQCB). The EPA was originally administering the investigation and mitigation of the former SFR waste sites, but was satisfied with the status of the refinery in 1994/1995, after the approval of the Corrective Measures Study (Woodward-Clyde, 1993), construction of SFR Interceptor Trench system, and establishment of the Groundwater Quality Monitoring Program (GQMP). The framework for further investigation and mitigation of IWS-6C was thus developed in conjunction with the RWQCB, and addressed as Provision C.2.j of Waste Discharge Requirements (WDR) Order No. 97-027 issued in February 1997. IWS-6C is now officially classified as an inactive waste management unit (WMU) under the new WDR Order issued for SFR in June 2005 (No. R2-2005-0026), which superceded and rescinded the 97-027 WDR Order.

2.4 1997 FOLLOW-ON ASSESSMENT

IWS-6C was further assessed per provision C.2.j of RWQCB WDR Order No 97-027 during the Summer and Fall of 1997. The project scope included refining the horizontal and vertical extent of IWS-6C waste material using soil borings, and collecting soil and groundwater quality data to evaluate the affect of the waste on potential receptors (nearby residents/visitors, site workers, and groundwater). The assessment concluded the following:

- The footprint of the IWS-6C site should be revised to a location approximately 400 feet further west, based on the presence/absence of fill material in the 20 soil borings completed around the originally identified site. The revised location of IWS-6C is more consistent with the topography of this portion of the Lower Tank Farm and the abrupt elevation changes that are located near the boundary of the site.
- The fill material comprising IWS-6C is a heterogeneous mixture of soil and waste materials, consisting of interbedded layers of clay, silt, sand, decomposed bedrock, and waste material including soil with heavy-end petroleum components and petroleum coke. The occurrence of waste compounds in the fill is highly variable, including low concentrations of residual hydrocarbons in soil, intervals with high percentages of coke conglomerations, and thin but discrete (1- to 4-inch thick) layers of sand-sized coke particles.
- The waste materials are generally buried beneath several feet of overlying clean fill, but extend to (or near) the top of the underlying buried soil horizon or colluvial unit.
- The compounds that typically characterize the waste are TPH, PAHs, lead, and mercury. The detected concentrations of these compounds typically decrease with depth, and are either not detected or detected at much lower concentrations in the underlying soil horizon and colluvial unit.
- Leachate from the waste materials in the fill is not impacting groundwater, as groundwater chemistry results from a well screened in first water immediately below the waste material does not contain TPH, PAHs, lead, or mercury.

The evaluation was summarized in the *Results of Additional Investigation and Remediation Plan - IWS-6C* (Montgomery Watson, 1997) and *Addendum to the IWS-6C Report* (Montgomery Watson, 1998) documents. Copies of these documents are included in [Appendix A](#) as Attachments [A-2](#) and [A-3](#), respectively.

2.5 REMEDIAL PROGRAM

The 1997 assessment recommended a remedial program that included the following:

- 1) Leave the waste in place with the existing soil cover as a contact barrier, and
- 2) Implement a *detection* groundwater monitoring program per CCR Chapter 15, Article 5 requirements, similar to that approved in the SFR GQMP for the other WMUs at SFR.

The remedial approach considered the relatively low mobility of the chemicals in the waste materials, and the observation that leachate from the waste materials was not impacting groundwater. The recommended remedial program also considered the current and projected land use of the waste site area: an active, modern, aboveground petroleum storage tank farm within the confines of an operating petroleum refinery. The program was appropriate because from a risk management standpoint, the most reasonable potential for human exposure to the waste material was deemed intrusive activities, which would be managed as conducted, under site-specific safety plans and the oversight of a SFR safety officer.

The proposed detection monitoring program included regular sampling and water level gauging at four (4) wells (MW-137, MW-139, MW-211, and MW-6B2), and statistical analysis of groundwater chemistry results to evaluate concentration trends and identify releases to groundwater. The locations of the wells are shown on [Figure 4](#). The program was initially to be conducted quarterly, and then reduced to semi-annually after one year as chemistry results were shown to be similar to those from the original investigation samples.

The proposed remedial program was approved by the RWQCB in 1998. Groundwater sampling was implemented at the IWS-6C wells beginning during the Winter Quarter 1998, and has continued through 2005. The frequency of groundwater sampling was reduced from quarterly to semi-annually at the beginning of 1999 as per the proposed program.

2.6 CURRENT STATUS OF IWS-6C

IWS-6C is currently one of 14 sites included in the ongoing SFR GQMP administered by the RWQCB. IWS-6C is now formally classified by the RWQCB as an inactive WMU under the current WDR Order (No. R2-2005-0026). SFR continues to conduct a *detection* groundwater monitoring program per CCR Chapter 15, Article 5 requirements (now incorporated into CCR Title 27, Subdivision 1, Chapter 3). Sampling frequency of the IWS-6C monitoring wells was revised from semi-annual to annual under WDR Order R2-2005-0026, based on the historic water quality results.

Groundwater quality data for IWS-6C are available from the initial 1997 evaluation and 17 monitoring events conducted between March 1998 and May 2005. A summary of chemistry results from each event is included as [Table 2](#). Chemistry results from the monitoring well samples have been very similar to those from the initial groundwater investigations from 1997, and continue to indicate no impact of the shallow groundwater from the waste materials in the soil:

- Groundwater results from well MW-211, which is screened in shallow groundwater immediately below IWS-6C waste material, consistently indicates no detected chemicals. The only exception was one detection of extractable TPH in the sample from May 1999, which is not consistent with all the other results, and may be attributable to a lab or field contaminant.
- Polychlorinated biphenyls (PCBs) have not been detected in groundwater at any of the wells, and lead and mercury have only been detected periodically at low concentrations near the method detection limits.
- There are extractable range hydrocarbons in the groundwater from wells MW-137 and MW-138, but these compounds are believed to be associated with hydrocarbon handling at the nearby ASTs and SFR units and not the waste deposits of IWS-6C.

Further mitigation of IWS-6C is not planned at this time. If the detection monitoring program identifies a release of waste material to the groundwater, the site would move into an evaluation program per Chapter 15 Article 5 requirements.

3.0 PHASE I CLOSURE PROCESS

The Phase I closure process at the BCSU was developed per the scope-of-work and methods/procedures outlined in the Phase I Closure Work Plan (MWH, 2003), the *Response-to-Comments* letter dated February 27, 2004 (MWH, 2004a), and DTSC's Conditional Approval letter dated April 26, 2004 (DTSC, 2004b). The analytical program for closure sampling was developed to address potential contamination from materials historically managed at the BCSU. The scope of the program was proposed in the Phase I Closure Work plan (MWH, 2003) and accepted by the DTSC; pertinent sections from the work plan that detail the basis and elements of the program have been included in Appendix F for reference.

The agreed upon Phase I closure activities included:

- Disposing of waste currently stored at the BCSU;
- Decontaminating the BCSU surfaces, equipment, and structures;
- Collecting confirmation samples from the decontaminated BCSU media;
- Collecting closure samples of soil, groundwater, and soil vapor from the BCSU subsurface; and
- Collecting water samples from the sumps of the lined concrete containment pads.

The different elements of the Phase I Closure process are discussed below, with the achieved timeline presented in [Table 1](#). A more detailed description of the scope and timing of the closure activities is presented in [Appendix B](#) (Phase I Closure - Decontamination and Confirmation / Closure Sampling). As discussed with DTSC on July 13, 2004, in a phone conversation and on August 20, 2004, during the progress meeting, field conditions required several deviations in the number or location of confirmation and closure samples. The rationale for the sampling changes is discussed in the appropriate sections below, but is summarized in detail in [Appendix B](#).

In addition, ConocoPhillips requested in August 2004 that the planned soil sampling beneath the concrete containment pad be waived, based on site engineering and the current conditions of the containment pads and structures, as well as empirical and analytical data from the field investigation (MWH, 2004b). DTSC has not issued a formal approval of the request, but indicated at the time that they agreed to the changed scope-of-work.

3.1 DISPOSAL OF WASTES FORMERLY STORED AT THE BCSU

The wastes previously stored at the BCSU were removed as of Thursday, June 10, 2004. Stored wastes were either transported off-site for treatment and disposal following waste characterization and acceptance, or moved to an interim waste management facility developed and constructed at a different location within the SFR approximately ¼ mile away. Waste moved to the interim facility was handled within the appropriate timeframes as part of the ongoing SFR waste management program. All BCSU wastes were handled following SFR waste management practices, including proper packaging, labeling, manifesting, transportation, and disposal.

3.2 DECONTAMINATION OF BCSU SURFACES, EQUIPMENT, AND STRUCTURES

The following components of the BCSU were decontaminated:

- Two Area B concrete containment pads (including their collection trenches);
- Areas of asphalt cover, including the loading/unloading portion of Area B and the interim storage grounds of Area C;
- Three polyethylene storage tanks on the Lower Terrace concrete containment pad in Area B;
- Aboveground piping for the storage tanks;
- Surface water catch basins; and
- Ancillary BCSU structures including fencing, staircases, and scaffolding.

The decontamination of the BCSU was performed between Friday, June 11 and Monday, June 21, 2004. The process included an initial sweep of the asphalt paved areas by an SFR maintenance vehicle on Friday, June 11, followed by a thorough pressure washing of all areas by ONYX Industrial Services, Benicia, California between Monday, June 14 and Monday, June 21. The pressure washing process was conducted using mechanical scrubbing units that circulated a solution of tap water and industrial detergent (d-Limonene® solution) over the exposed surfaces, followed by manual rinsing with SFR firewater. Wash and rinse water was contained using sandbags and squeegees, collected by vacuum trucks or the BCSU stormwater collection system, and then pumped into a 20,000-gallon storage tank.

A sample of the decontamination rinsate was collected from the storage tank on June 18, 2004, and chemically tested to evaluate its quality relative to hazardous waste criteria. The sample, identified as WASHWATER, was submitted to Curtis and Tompkins, Ltd. (C&T) of Berkeley, California, where it was analyzed for TPH as diesel and motor oil using EPA Method 8015B, volatile organic compounds (VOCs) using 8260B, and semi-volatile organic compounds (SVOCs) using EPA Method 8270C. The sample contained TPH in the parts per million range (mg/L) and assorted metals, the most elevated of which was vanadium at 1.9 mg/L. A sample of the water was also tested by the SFR Waste Water Treatment Plant (WWTP) for pH and found to be within the 5 to 8 range. The collective chemical testing results indicated the rinse water was non-hazardous, and met the requirements for integration with the regular WWTP flow. The water was then discharged to the SFR process water sewer system for conveyance to the WWTP.

3.3 CONFIRMATION SAMPLING OF DECONTAMINATED SURFACES, EQUIPMENT, AND STRUCTURES

Confirmation samples of the decontaminated BCSU surfaces, equipment, and structures were collected and chemically tested according to the Closure Work Plan. Samples included 31 asphalt chip samples, 20 concrete chip samples, and 21 wipe samples collected between Tuesday, June 15 and Monday, June 21. The purpose of the sampling and testing program was to assess the effectiveness of the decontamination process, and to evaluate the extent to

which residual chemicals remained in these features. The number of confirmation samples collected were equivalent to that originally proposed in the Closure Work Plan, with the exception of six fewer primary asphalt chip samples and one less concrete sample. The number of asphalt samples was reduced because the thickness of the paved surfaces did not allow for paired samples, while the concrete samples were reduced by one because of the difficulty of collecting the deeper member of one of the sample pairs.

3.3.1 Asphalt Chip Samples

The 31 asphalt chip samples included 19 primary and 12 background samples. The primary samples were collected from the upper 1 inch of asphalt at 19 sample locations, as shown on [Figure 5](#). The sample sites were spread around the BCSU as per the Closure Work Plan and cover the full range of post-decontamination asphalt quality, including the typical (circa 1989) BCSU asphalt, newer (year 2004) asphalt patches, and areas of noticeable low elevation, visible surficial cracking, or slight discoloration and staining. The condition of each sample site was noted and is described in the chemistry testing summary tables. The background asphalt chip samples were collected from 12 locations in and around the BCSU, as shown on [Figure 6](#). The background samples were also collected from the upper 1 inch of asphalt in containment curbs within the BCSU or the outer edge of the less traveled, perimeter SFR roadways. The Closure Work Plan proposed these locations as they were thought to be from the same or similar asphalt. These locations have had a diminished probability of being directly exposed to the hazardous substances handled at the BCSU, and likely have not routinely been exposed to contaminants from other SFR operations.

Each asphalt chip sample was sent to C&T and analyzed for pH using EPA Method 9045C, VOCs by EPA Method 8260B, and metals by EPA Methods 6010B and 7471. The asphalt samples were not tested for TPH or SVOCs because the chemicals that are included in these general categories are also primary components of asphalt, and would not yield useful results.

3.3.2 Concrete Chip Samples

The 19 concrete chip samples included 14 primary and 5 background samples. The primary samples were collected from 10 locations as shown on [Figure 5](#), including three locations on the Upper Terrace Area B containment pad and trench, five locations from the Lower Terrace Area B containment pad and trench, and two locations from the Area C concrete pad. The primary chip samples included one sample from the uppermost surface (0- to 1-inch depth) at each location, and four from paired deeper intervals (1 to 4.5 inches) to assess concentration differences with depth. Samples were not collected at deeper intervals, so as to protect the integrity of the pads. The five background chip samples were collected from the raised curbs surrounding the Upper and Lower Terrace Area B containment pads, as shown on [Figure 6](#). The Closure Work Plan proposed these locations as they were thought to be from the same concrete batches. These locations would have a diminished probability of being directly exposed to the hazardous substances handled at the BCSU and not routinely exposed to contaminants from other SFR operations.

The concrete samples were transported to C&T and analyzed using EPA Methods 8015B for TPH as diesel and motor oil, 8260B for VOCs, 8270C for SVOCs, and 6010B and 7471 for metals. Additionally, two primary and one duplicate concrete chip sample collected from the area closest to the former PCB storage shed were analyzed for PCBs using EPA Method 8082.

3.3.3 Wipe Samples

The 21 wipe samples included 19 primary and two background samples. The primary samples included two from each of the polyethylene storage tanks, two from the piping associated with each tank, two from each steel stairway, one from each refinery sewer system catch basin grate, and one from each concrete pad collection trench grate (see [Figure 5](#)). The two background wipe samples were collected on piping just east of the BCSU, including a 2-inch-diameter galvanized water line and a 24-inch-diameter painted-steel hydrocarbon conveyance line. Samples were collected by wiping a 10 centimeter (cm) by 10 cm area with

a filter of specified size (125 millimeter diameter). Three quality assurance/quality control (QA/QC) wipe samples were also collected, including one wipe blank and two wipe duplicates.

The wipe samples were transported to C&T and analyzed using EPA Methods 8015B for TPH as diesel and motor oil, 8270C for SVOCs, and 6010B and 7470 for metals. The wipe sample from the Lower Terrace, collection trench grate was also tested for PCBs using EPA Method 8082, given its location relative to the former shed in which PCB wastes were stored. Wipe samples were not tested for VOCs or pH given their unlikely presence due to the exposure of the sample surface to the atmosphere and the decontamination process.

3.4 SAMPLING OF THE SOIL, GROUNDWATER, AND SOIL VAPOR BENEATH THE BCSU

Closure samples were collected to assess the quality of the soil, groundwater, and soil vapor underlying the BCSU, and to evaluate the potential for releases from the unit to the subsurface. The samples included 38 soil samples (18 primary and 20 background), two groundwater samples, and four soil vapor samples collected between Monday, June 28 and Wednesday, July 7, 2004. The closure samples were collected according to the original Closure Work Plan scope. However, the number of groundwater and soil vapor samples was reduced because groundwater was not encountered in most of the borings, and bedrock restricted attainable boring depths in many areas of the BCSU. The soil, groundwater, and soil vapor closure samples were collected from eight soil borings advanced around the BCSU, as located on [Figure 5](#). Background soil samples were collected from bedrock outcrops or shallow subsurface locations outside of the BCSU area, as shown on [Figure 6](#). Soil boring and background soil sample locations were chosen per the Closure Work Plan, with only minor deviations because of drill rig positioning or the location of suitable bedrock outcrops.

3.4.1 Primary Soil Samples

The 18 primary soil samples included two samples each from six of the soil borings, and three samples each from the other two soil borings. Generally, one sample was collected just below the asphalt paving within the 0.5 to 1.0 foot below ground surface (bgs) interval, with the second and third samples collected between 3 and 9 feet bgs as subsurface conditions warranted. Soil samples were transported to C&T and chemically tested using EPA Method 9045C for pH, 8015B for TPH as diesel and motor oil, 8260B for VOCs, 8270C for SVOCs, and 6010B and 7471 for metals.

3.4.2 Background Soil Samples

Twenty soil samples were collected to establish a background soil quality population for metals. As per the Closure Work Plan, the samples were collected such that there were 10 samples from each of the two known types of bedrock in the BCSU area. All but one of the background samples were collected from bedrock surface outcrops, after chipping away the upper 4 to 6 inches of exposed material to ensure a representative background sample. One soil sample was collected using the hydraulic coring drill rig. Background samples were transported to C&T and analyzed for metals using EPA Method 6010B and 7471.

3.4.3 Groundwater Samples

Two groundwater grab samples were collected from the BCSU subsurface. The original Closure Work Plan called for the sampling of groundwater from each of the eight soil borings if it was present within the planned 10 feet bgs total depth. Groundwater was only encountered in one of the borings (BCSU-SB-3). As per the Closure Work Plan, the soil boring downgradient of the BCSU concrete containment pads (BCSU-SB-7) was deepened to collect a second grab sample. Groundwater was not encountered in this boring until 40 feet bgs. The groundwater samples were transported to C&T and analyzed using EPA Methods 9040B for pH, 8015B for TPH as diesel and motor oil, 8260B for VOCs, 8270C for SVOCs, and 6020 and 7470 for metals.

3.4.4 Soil Vapor Samples

Four primary and one duplicate soil vapor samples were collected from the BCSU subsurface. The primary samples were collected at the three Middle Terrace soil borings (BCSU-SB-3, BCSU-SB-4, and BCSU-SB-5) and one Lower Terrace soil boring (BCSU-SB-8). Sample intervals of the soil vapor samples were within the 7 to 9 feet bgs range. Soil vapor at the other four soil borings was not sampled, as bedrock precluded advancing the borings past the minimum 4-foot bgs depth target range. The soil vapor samples were collected according to the methods and procedures summarized in [Appendix B](#), and transported to Air Toxics, Ltd., located in Folsom, California, for analytical testing for VOCs using EPA Method TO-14A.

3.5 SAMPLING OF WATER IN THE LINED CONCRETE CONTAINMENT PAD COLLECTION SUMPS

The BCSU concrete containment pad on the Lower Terrace and the concrete containment pad on the Upper Terrace that is not included in the BCSU, were installed with tertiary containment systems that include interstitial space monitoring sumps. Inspections during the Phase I Closure decontamination and field sampling program indicated that the sumps had between 4.0 and 6.0 feet of accumulated water. The water present in the collection sumps was sampled on July 14, 2004, and chemically tested by C&T using EPA Methods 9045C for pH, 8015B for TPH as diesel and motor oil, 8260B for VOCs, 8270C for SVOCs, and 6020 and 7470 for metals. The purpose of the sampling was to assess if water that accumulated in the interstitial space beneath the concrete pad contained chemicals associated with waste storage activities at the site.

4.0 CLOSURE RESULTS

Closure results including the encountered subsurface lithology, chemistry results from closure samples, and statistical comparisons of closure and background sample populations are summarized below.

4.1 LITHOLOGY BENEATH THE BCSU

The lithology beneath the BCSU was observed in the eight soil borings completed during the Phase I Closure field activities. The lithologic relationships relative to the BCSU components are described below and shown in the three cross sections included on [Figure 7](#). Soil boring logs are provided in [Appendix B](#) for each boring.

4.1.1 Upper and Lower Terraces

The lithology beneath the Upper Terrace includes a thin layer of fill and/or colluvium to approximately 2.0 feet bgs, and underlying competent bedrock of the Pinole Tuff and Neroly formations. The lithology beneath the Lower Terrace was similar to that beneath the Upper Terrace, with a generally thin (2- to 3-foot thick) layer of fill and/or colluvium and underlying competent Pinole Tuff bedrock. The only difference was that the fill and colluvium on the Lower Terrace thickened in the southeast corner of the terrace near the gate to a layer approximately 5 to 7 feet thick. The fill and/or colluvium on these two terraces is interpreted to be either clean fill brought in during the BCSU construction, or reworked portions of the original pre-BCSU soil horizon. The fill is interpreted to extend beneath the containment pads on both terraces, as concrete pads and liner systems are typically built on top of a layer of sand or gravel to provide a firm, flat construction base. However, the collective thickness of the fill and colluvium beneath the pads is projected to be relatively thin (approximately 1-foot-thick), as bedrock is known to be just below ground surface as it forms the cut slope between the two terraces.

4.1.2 Middle Terrace

The lithology of the Middle Terrace is noticeably different than that which occurs beneath the Upper and Lower Terraces, as it includes a thicker accumulation of fill that is interpreted to be correlative to IWS-6C materials (see [Section 2.0](#)). The correlation of the fill beneath the Middle Terrace to IWS-6C fill is represented on [Figure 7](#) (see cross sections A-A' and C-C'). The fill beneath the Middle Terrace has a similar thickness to the IWS-6C fill (approximately 15 to 20 feet thick), and contains the characteristic discrete layers of petroleum coke and an abundance of coke conglomerations in the other layers of clay, silt, and sand. The IWS-6C fill is underlain by Neroly and Pinole Tuff formation bedrock.

The observed lithology is similar to the expected site conditions. As discussed in the February 27, 2004, response to DTSC's Geological Services Unit (GSU) Comment No. 5 (see page 5, MWH, 2004a), the IWS-6C fill was projected to extend into the BCSU area westward from the Tank 180 and 107 containment cells. The one refinement is that the IWS-6C material is not present beneath the Upper and Lower Terraces, because this area contains relatively shallow bedrock that is likely an artifact of a former topographic high.

4.2 CHEMISTRY RESULTS FROM CONFIRMATION AND CLOSURE SAMPLES

Chemistry results from the Phase I confirmation and closure samples are discussed below and summarized in [Tables 3](#) through [13](#). The significance of the results are statistically evaluated in [Section 4.4](#) of this report. The tables include EPA Region IX Preliminary Remediation Goals (PRGs), or Environmental Screening Levels (ESLs) developed by the RWQCB when there is not an applicable PRG. The posting of the criteria are intended for comparison purposes only, and are not intended to replace the qualitative and quantitative evaluations provided in the HHRA (see [Section 5.0](#)).

4.2.1 Asphalt Chip Samples

The chemistry results from the primary and background asphalt chip samples have several distinct qualities (see [Tables 3](#) and [4](#), respectively). The asphalt at the BCSU includes detectable concentrations of most Title 22 metals, however the concentrations are typically consistent with those detected in the background samples. The pH and VOC results of the BCSU asphalt are also similar to the background asphalt, with the exception that the two confirmation samples from relatively new asphalt (Asph-2 and Asph-18) contain higher concentrations of four VOCs (acetone, methylene chloride, 2-butanone, and 2-hexanone) than that typically detected in the BCSU samples. These results are consistent with the fact that asphalt is comprised of compacted aggregate asphalt binders that typically contain residue from the crude oil distillation process, such as heavy residual oils, kerosene-type solvents, and naphtha and gasoline solvents. The proportions of distillate or solvent mixed with the aggregate can range from 25 to 45 percent by volume, depending on the desired viscosity (EPA, 1979). Some solvent is permanently retained in the road surface while the remainder of the solvent evaporates at varying rates depending on asphalt type (EPA, 1979). There are no available studies of concentrations of individual “solvent” compounds in asphalt, likely because this varies between different asphalt plants. However, emissions data for asphalt stored at batch plants are available for three of the VOCs that were detected in the BCSU samples: acetone emissions were detected at 0.055 percent, methylene chloride at 0.00027 percent and 2-butanone at 0.039 percent (EPA, 2004a). These results suggest that the concentration of VOCs in the BCSU samples are reasonable for newer asphalt.

Collectively, the chemistry results suggest that the condition of the asphalt (post-decontamination) is relatively unencumbered by chemicals that would have been sourced from wastes handled at the BCSU. The chemistry results are evaluated statistically in [Section 4.4](#).

4.2.2 Concrete Chip Samples

The chemistry results from the primary and background concrete chip samples are summarized in [Tables 5](#) and [6](#), respectively. The key concrete chemistry result is the detection of TPH as diesel or motor oil in approximately half of the samples at concentrations ranging from 1.0 to 550 mg/kg and the intermittent detection of selected VOCs and PAHs. In each case however, the detections are well below PRG or ESL screening values, and show significant attenuation with depth at the paired sample points (e.g., the sample points with both shallow and deep concrete samples). The BCSU concrete includes detectable concentrations of most Title 22 metals. However, similar to the asphalt samples, the detected concentrations are generally consistent with those noted in the background samples. Collectively, the concrete chemistry results suggest that the surface of the concrete containment pads (post-decontamination) includes some TPH and PAHs, but that concentrations are low and attenuate with depth into the concrete. The chemistry results are evaluated statistically in [Section 4.4](#).

4.2.3 Wipe Samples

The wipe and background wipe sample results suggest that the decontamination process was generally effective (see [Tables 7](#) and [8](#), respectively). TPH as diesel, SVOCs, and PCBs were not detected at concentrations greater than the reporting limits, and TPH as motor oil was only detected in one sample at a concentration slightly above the reporting limit. Metals were typically not detected or detected at low concentrations just above the reporting limits. The exceptions include lead detected in most wipe samples just above the reporting limit, and five to ten different metals detected at concentrations slightly above reporting limits in the three samples collected from the steel grates (WP-16, WP-17, and WP-19). The lead concentrations are not necessarily associated with the BCSU operations, as they were detected at similar concentrations in the background samples. The sample results from WP-16, WP-17, and WP-19 suggest there were some low concentrations of residual wastes remaining on the interior surfaces of the stormwater drop inlet and collection trench grates.

4.2.4 Soil Samples

The soil chemistry results indicate the presence of variable concentrations of TPH, PAHs, and metals in the subsurface (see [Tables 9](#) and [10](#) for site and background results, respectively). VOCs were not detected above method reporting limits, with the exception of acetone at a concentration slightly above the detection limit and well below screening levels in one sample (SB-4-9'). In general, the detected concentrations of TPH are relatively low (<200 mg/kg), and are less than ESL values in all but three samples. Of particular note, each TPH detection above the ESL was in a sample collected from the fill beneath the Middle Terrace that is interpreted to be IWS-6C waste material. The pattern of PAH detections is similar to the TPH results, with the highest concentrations detected in samples collected from the Middle Terrace in the fill interpreted to be IWS-6C waste material. Metals were detected in each soil sample. However, the concentrations were consistent with those detected in background samples, with the exception of lead in samples BCSU-SB-4-9' and BCSU-SB-5-8' (also from the IWS-6C fill beneath the Middle Terrace) at 1,200 and 1,400 mg/kg, respectively. Chemical concentrations in the samples collected from soil borings are also depicted on [Figure 7](#).

4.2.5 Groundwater Samples

The groundwater samples suggest groundwater beneath the BCSU is not impacted from activities at the BCSU (see [Table 11](#)). TPH and SVOCs were not detected above method reporting limits in either sample, and the only detections of VOCs included acetone and 2-Butanone in sample BCSU-SB-3W well below tap water PRGs. The VOC detections may be attributable to lab or field artifacts, as they are only slightly above the method reporting limits and are not noted elsewhere. Concentrations of metals in the samples were below tap water PRGs with the exception of arsenic. The arsenic results of 7.0 and 8.4 micrograms per liter (ug/L) are not considered high, as mean arsenic concentrations in public water supply are often in the 6 to 9 ug/L range (United States Geologic Survey [USGS], 1999) and the federal maximum contaminant level (MCL) is 10 ug/L (EPA, 2002a).

4.2.6 Soil Vapor Samples

Four soil vapor samples were collected (see [Table 12](#)) during the Phase I closure activities. As further discussed in [Section 4.4](#), the results of the soil vapor samples from soil borings SB-3 and SB-8 were rejected because the tracer compound used in the leak tests, isopropyl alcohol (2-propanol), is interpreted to have infiltrated the samples. 2-propanol was detected in soil vapor samples SB-3A and SB-8A at concentrations greater than the 10 ug/L value included in the 2003 active soil gas guidance document from the DTSC and Los Angeles Region RWQCB. VOCs detected in the two accepted soil vapor samples include several compounds, but all but one compound were present at concentrations well below residential ESL values. The exception was the detection of 1,1,2,2-tetrachloroethane at 0.47 ug/L in the SB-5A sample, which is above the ESL residential criteria of 0.042 ug/L. This sample was also located within the fill beneath the Middle Terrace that is interpreted to be IWS-6C material.

4.2.7 Sump Water Samples

The water from the Upper and Lower Terrace containment pad collection sumps did not contain VOCs or SVOCs, but included TPH at concentrations of approximately 200 ug/L, and the presence of three metals (antimony, arsenic, and molybdenum) at concentrations that slightly exceed tap water PRG concentrations. Sump water sample results are presented along with those of the decontamination rinsate sample in [Table 13](#). The TPH detections are not interpreted to be representative of a hydrocarbon compound, as the chromatograms suggest a single discrete peak rather than a series of resolved compounds as is typically present for petroleum hydrocarbons. The source of the metals in the water is not known, but it is expected that if these compounds were from a leak through the concrete pad, they would be present at much higher concentrations.

STATISTICAL ANALYSIS OF METALS CHEMISTRY DATA

The statistical analysis of the metals chemistry data was completed to systematically compare results from the confirmation and closure sampling activities (the compliance datasets) to background conditions (the background datasets). The objective of the process was to evaluate

whether the different media (asphalt, concrete, and soil) contained residual concentrations of constituents potentially from wastes that were previously handled at the BCSU. Samples of asphalt and concrete were collected after the decontamination process. The background data sets include 12 asphalt chip samples, 10 concrete chip samples (five from this sampling event and five from the 1999 Bulk Storage Unit Closure), and 20 soil samples (see [Section 3.0](#) and [Tables 4, 6, and 10](#) respectively). A complete summary of the procedures and results of the statistical analysis is included as [Appendix C](#) (Statistical Comparison of Compliance and Background Samples). Results are summarized below.

The first step of the statistical evaluation was to independently test the compliance and background datasets of each medium using the Shapiro-Wilkes W-test. This test evaluates whether the data fit either a normal or lognormal distribution. Compliance datasets were then statistically compared to background datasets, using the non-parametric Wilcoxon Rank Sum test.

The statistical analysis determined that the following analytes were present in compliance samples at concentrations greater than background:

<i>Asphalt:</i>	beryllium and mercury
<i>Concrete:</i>	barium, beryllium, nickel, and selenium
<i>Soil (shallow 0-3 ft)</i>	antimony and mercury
<i>(deep > 3 ft)</i>	cadmium and molybdenum

The presence of metals in the compliance samples at concentrations above background populations are further addressed in the HHRA, included as Section 5.0.

4.4 QUALITY ASSURANCE / QUALITY CONTROL (QA/QC) DATA REVIEW

A QA/QC data review of the BCSU samples is included in Appendix D. The review concluded the collected chemistry data was acceptable for the intended purposes with the applied qualifications. The exception is the soil vapor chemistry results from the soil borings SB-3 and

SB-8 samples, which were rejected as discussed in Section 4.2.6 because of the presence of the leak detection test tracer compound.

4.5 COMPOUNDS DETECTED AT BCSU AS COMPARED TO IWS-6C

Constituents detected in samples collected from the BCSU include extractable range hydrocarbons, four VOCs (acetone, methylene chloride, 2-butanone, 2-hexanone) (detected in asphalt chip samples only), two PAHs (benzo-b-fluoranthene and benzo-k-flouranthene) and Title 22 metals. These compounds were detected regularly in the closure samples attributed to the BCSU. As discussed in Section 2.2, constituents in soils associated with IWS-6C fill include heavy-end TPH, SVOCs (specifically PAHs), lead, and mercury. In addition, selected VOCs, including benzene, toluene, ethylbenzene, and xylene (BTEX); and 1,1,2,2-tetrachloroethane were also detected in soil vapor from the IWS-6C fill, and petroleum coke is a common constituent of the IWS-6C fill. The key differences in constituents between the two sites are the presence of multiple PAHs and distinct layers and conglomerations petroleum coke in the IWS-6C fill, and BTEX and 1,1,2,2- tetrachloroethane in soil vapor in the IWS-6C fill.

5.0 HUMAN HEALTH RISK ASSESSMENT

This section describes the methods and results of the HHRA conducted for the BCSU. This HHRA is intended to provide an analysis of the existing and potential future risks that may be posed to human health by residual contaminants associated with the BCSU. The results of this HHRA will be used to determine if residual levels of contaminants present on surface structures and in the subsurface beneath the BCSU are sufficiently low that human health is protected. Consistent with planned future use of the BCSU as part of the operating refinery, potential human health risks associated with the BCSU were evaluated for current and anticipated future industrial land uses. In addition, this HHRA evaluated potential unrestricted land use of the BCSU in order to determine whether the site is appropriate for “clean closure” or if some form of deed notification is required.

5.1 INTRODUCTION

This HHRA was conducted in accordance with methods and procedures described in the EPA’s *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part A)* (EPA, 1989), California Environmental Protection Agency’s (Cal-EPA’s) *Use of California Human Health Screening Levels (CHHSLs) in Evaluation of Contaminated Properties* (Cal-EPA, 2005), and Cal-EPA’s *Preliminary Endangerment Assessment Guidance Manual* (Cal-EPA, 1999).

The HHRA that was conducted for the BCSU includes both a screening evaluation of risk and a baseline HHRA. The screening-level risk evaluation is a conservative evaluation of potential human health risks based upon upper bound contaminant concentrations and health-protective assumptions relative to land uses and exposure pathways. The screening HHRA typically evaluates an unrestricted (i.e., residential) land use, and the results are compared to a screening carcinogenic risk level of 1×10^{-6} and a noncarcinogenic hazard criterion of 1 (Cal-EPA, 1999; EPA, 1991a). Sites associated with screening carcinogenic risk and noncarcinogenic hazard estimates less than these criteria are generally considered appropriate for unrestricted future land

use. Sites associated with screening carcinogenic risk and noncarcinogenic hazard estimates that exceed one or both of these criteria are generally proposed for further evaluation, which may include performance of a baseline risk assessment (Cal-EPA, 1999). The baseline risk assessment typically considers average estimates of site contaminant concentrations and reasonably anticipated assumptions relative to current and potential future land uses and exposure assumptions (EPA, 1989). Sites associated with baseline carcinogenic risk estimates between 1×10^{-6} and 1×10^{-4} , and a noncarcinogenic hazard estimate less than 1, are generally considered appropriate for no further evaluation, pending evaluation of site-specific factors including land uses, nature of the sources and contaminants, and potentially exposed populations (EPA, 1991a). Sites associated with baseline carcinogenic risk and noncarcinogenic hazard estimates greater than 1×10^{-4} and 1, respectively, are generally considered appropriate for further evaluation, including consideration of potential remedial options (EPA, 1991a).

5.1.1 Purpose and Objectives

The purpose of this HHRA was to evaluate potential human health risks associated with human exposures to chemicals present in surface structures (e.g., asphalt, concrete) and subsurface media including soil, soil vapor, and groundwater associated with the BSCU. The specific objectives of this HHRA are to estimate potential cancer risks and noncancer hazards for human receptors that might be exposed to impacted media and contaminants. The individual steps included in this HHRA are consistent with EPA's Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part A) (EPA, 1989), as follows:

1. Identification of contaminant source areas, media, and chemicals of concern;
2. Identification of potentially complete exposure pathways between sources of contaminants and human receptors;
3. Quantification of potential human exposures (i.e., intakes);
4. Characterization of potential cancer risks and noncancer hazards for human receptors; and
5. Evaluation of the uncertainties in the baseline HHRA.

5.1.2 Scope

This HHRA presents quantitative risk estimates for the following media of concern: soil, soil vapor, and groundwater at the BCSU. The statistical evaluation described in Section 4.3 of this report, demonstrated that several metals and organic compounds are present in asphalt/concrete chip samples and wipe samples from steel grates at concentrations elevated above background locations. Because of uncertainties in quantitatively evaluating human exposures to such materials, potential risks associated with these results are qualitatively evaluated in this HHRA.

The baseline HHRA presented herein provides a quantitative and qualitative evaluation of potential human health risks associated with site-related contaminants detected in soil, soil vapor, and groundwater beneath the BCSU. Consistent with DTSC policy, the baseline HHRA considers only those soil samples collected at depths of 0.0 to 10 feet bgs. Eighteen soil samples from five locations were collected within the range of interest; including eleven shallow (0.0 to 3 feet bgs), and seven deeper (>3 to 9 feet bgs) subsurface soil samples. [Note: All soils at the BCSU are covered by asphalt or concrete; therefore, soil samples in the 0 – 3 feet bgs range are referred to as shallow soil samples.] It should also be noted that subsurface soil sampling data collected from three sample locations within Area C (i.e., samples BCSU-SB-3A, BCSU-SB-4A and BCSU-SB-5A) are associated with historic contamination related to the former IWS-6C, and are not attributed to the BCSU. Consequently, potential human health risks were evaluated by first assuming exposure to all sampling locations across the site (i.e., Areas A, B and C), and then excluding soil sampling results collected from Area C, the former IWS-6C (i.e., samples from BCSU-SB-3A, BCSU-SB-4A and BCSU-SB-5A). These latter risk estimates define potential human health risks attributed to the BCSU proper.

The baseline HHRA for the BCSU was conducted in accordance with the following guidance documents and reference sources prepared by Cal-EPA and EPA:

- Use of California Human Health Screening Levels (CHHSLs) in Evaluation of Contaminated Properties, January (Cal-EPA, 2005).
- Region 9 PRGs Table - 2004 Update, October (EPA, 2004b).

- Risk Assessment Guidance for Superfund (RAGS), Part E: Supplemental Guidance - Dermal Risk Assessment, Interim Guidance (EPA, 2004c).
- Preliminary Endangerment Assessment Guidance Manual (Cal-EPA, 1999).
- Exposure Factors Handbook, Volume I: General Factors (EPA, 1997a)
- Exposure Factors Handbook, Volume III: Activity Factors (EPA, 1997b)
- Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions, OSWER Directive 9355.0-30 (EPA, 1991a)
- Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors (EPA, 1991b)
- Guidance for Data Usability in Risk Assessment - Interim Final (EPA, 1990)
- Risk Assessment Guidance for Superfund (RAGS) - Volume I: Human Health Evaluation Manual (Part A) (Baseline Risk Assessment) (EPA, 1989)

5.1.3 Organization

The information presented in this HHRA is organized as follows:

- Section 5.1 Introduction:** Presents a brief overview of the risk assessment process and describes the purpose and scope of the HHRA for the BCSU.
- Section 5.2 Data Evaluation and Identification of Chemicals of Potential Concern (COPCs):** Presents data evaluation procedures, and identifies contaminants to be evaluated in the screening and baseline risk evaluations for the BCSU
- Section 5.3 Screening Risk Evaluation:** Provides a conservative (i.e., protective) evaluation of potential risks that may be posed to human health by chemicals present in contaminated media associated with the BCSU. Methods used in, and results of, the screening-level risk evaluation for the BCSU are presented in this section.
- Section 5.4 Baseline HHRA:** Describes methods and assumptions used in the baseline evaluation of risks to human receptors that are posed by site contaminants. This section includes descriptions of potentially complete and incomplete exposure pathways, methods for the estimation of human exposures, and procedures used in the quantification of human health cancer risks and

noncancer hazards. This section also describes results of the screening risk evaluation and baseline HHRA conducted for the BCSU.

5.2 DATA EVALUATION AND IDENTIFICATION OF COPCS

The data sources selected for quantitative use must be comparable and of sufficient quality to meet project data quality objectives (DQOs) (EPA, 1990). The data sources selected for use in screening COPCs for the BCSU included laboratory results for eighteen soil, four soil vapor, and three groundwater samples that were collected in June 2004. Each soil and groundwater sample was analyzed for metals, VOCs, SVOCs, and TPH using standard EPA field collecting techniques and laboratory analysis. Each soil vapor sample was analyzed for VOCs using standard EPA field collecting techniques and laboratory analysis.

Analytes detected in soil, soil vapor, and groundwater were evaluated for inclusion in the HHRA in accordance with guidance provided in EPA (1990) and Cal-EPA (2005 and 1999). Briefly, all validated chemical data derived from soil, soil vapor, and groundwater samples were evaluated based on the following criteria:

1. If a single, unqualified value was provided for a given sample result, the value was used “as is.”
2. If a chemical was detected at least once in a given medium, the non-detects were included in the data base at one-half the sample quantitation limit (SQL).
3. In the case of duplicate samples, the average of the primary and duplicate sample was used as the representative value.
4. Values identified as estimated (“J” flag for organic chemicals, and “B” flag for inorganic chemicals) were used “as is.”
5. For organic chemicals that occurred in blanks, the “B” flag was assigned.
6. Rejected values (“R” flag) were not evaluated in the risk assessment.

Analytical methods should be sufficiently sensitive to meet required detection limits for metals and quantitation limits for nonmetals (EPA, 1990). Analytical results for all analytes and media met required detection limits with the exception of PAHs in subsurface soil sample

BCSU-SB-5-8'. Detection limits for PAHs were elevated in this sample due to the presence of relatively high concentrations of TPH as diesel (8,100 mg/kg) and motor oil (43,000 mg/kg).

The baseline HHRA presented herein provides a quantitative evaluation of potential human health risks associated with site-related contaminants detected in soil, soil vapor, and groundwater beneath the BCSU. The data associated with these media are briefly summarized below.

5.2.1 Soil

Consistent with DTSC policy, this HHRA considered only those soil samples collected at depths between 0.0 and 10 feet bgs. Eighteen soil samples from five locations were collected within the range of interest; including eleven shallow (0.0 to 3 feet bgs), and seven deeper (>3 to 9 feet bgs) subsurface soil samples. Detected chemicals include various metals, the VOC acetone, PAHs, and TPH as diesel and motor oil. Risks associated with shallow and deeper subsurface soil contamination were evaluated separately.

In addition to evaluating shallow and deeper subsurface soil separately, two potential scenarios encompass the exposure associated with this medium. The first scenario includes all 18 soil samples collected and is representative of risk to potential receptors over the entire site (i.e., the BCSU and historic contamination associated with the former IWS-6C located beneath Area C). This scenario is referred to as "**All Data**" for purposes of this HHRA, and was quantitatively evaluated in the Screening Level HHRA and the Baseline HHRA. The second scenario omits results collected from Soil Borings BCSU-SB-3, -4, and -5, which are locations associated with IWS-6C. This scenario is representative of future risks associated with potential exposures to the BCSU, proper, and is referred to as "**Revised Data**" for purposes of this HHRA. This scenario was quantitatively evaluated in the Baseline HHRA, only.

5.2.2 Soil Vapor

Soil vapor samples BCSU-SB-3A through BCSU-SB5A and BCSU-SB8A were collected from depths of 7.0 to 9.0 feet bgs at four sampling locations. Detected chemicals include acetone, BTEX, and 1,1,2,2-tetrachloroethane. However, soil vapor sampling methods were determined to be inadequate for samples BCSU-SB-3A and BCSU-SB8A due to leakage as determined from break-through of the tracer chemical, 2-propanol. Consequently, results for these samples were rejected. Therefore, only soil vapor samples BCSU SB-4A and BCSU SB-5A, which were judged to be acceptable, were quantitatively evaluated in this HHRA.

5.2.3 Groundwater

Groundwater samples were collected from two sampling locations. Detected chemicals include metals and the VOCs, acetone and 2-butanone (methyl ethyl ketone [MEK]).

5.2.4 Selection of COPCs

All results for organic chemicals, other than rejected values, were quantitatively evaluated in the baseline HHRA. Positively identified inorganic chemicals in shallow and deeper subsurface soil were first evaluated in a statistical comparison of compliance sample concentrations versus background concentrations, as described in Section 4.3. This statistical comparison was performed in compliance with EPA's Guidance for Comparing Background and Chemical Concentrations at Superfund Sites (EPA, 2002b). Based upon this statistical comparison, the only inorganic chemicals present in shallow soil at concentrations statistically elevated above background were antimony and mercury. The only inorganic chemicals present in deeper subsurface soil at concentrations statistically elevated above background were cadmium and molybdenum. These inorganic chemicals, and all positively identified organic chemicals in shallow and deeper subsurface soils were identified as COPCs and quantitatively evaluated in the baseline HHRA.

Chemicals present in soil vapor and groundwater were not evaluated in the statistical comparison against background because (1) only organic chemicals were analyzed for in soil vapor samples,

and (2) no samples of background soil vapor or groundwater were collected. Therefore, all positively identified chemicals detected in soil vapor and groundwater were identified as COPCs and quantitatively evaluated in the baseline HHRA.

The COPCs identified for shallow soil, deeper subsurface soil, soil vapor, and groundwater are summarized in Table 14.

5.3 SCREENING RISK EVALUATION

The screening HHRA described in this section is intended to provide a conservative (i.e., protective) evaluation of potential risks that may be posed to human health by residual chemicals present at the BCSU. The methods used in this screening human health evaluation and the results of this assessment are presented in the following subsections.

5.3.1 Screening Risk Characterization Methodology

The screening HHRA evaluates risks to current and potential future human receptors based on protective assumptions relative to land use, complete exposure pathways, and chemical concentrations. Cal-EPA (1999) recommends that site screening be performed based on an “unrestricted” land use scenario. Based on this guidance, the screening HHRAs presented in this report evaluated human health risks for potential residential land uses based on either the maximum concentrations of contaminants detected in site soils or the calculated exposure point concentration (EPC), as described in Section 5.3.1.1 below. It should be noted that the residential exposure scenario was evaluated to assess the potential for unrestricted future land use of the BCSU, consistent with Cal-EPA (2005, 1999). However, these guidance documents also state that use of this unrestricted exposure scenario is for screening purposes only and in no way obligates the risk manager to clean up to this level if other scenarios are ultimately appropriate. In the case of the BCSU, neither current nor future land uses are consistent with residential development. For purposes of comparison, screening risks were also evaluated for an industrial site worker.

To calculate screening-level cancer risk and noncancer hazard estimates, the EPC for each COPC was divided by its respective risk-based screening level and a ratio was calculated. Risk-based screening levels for soil and soil vapor were obtained from the use of CHHSLs (Cal-EPA, 2005). Because Cal-EPA (2005) does not include CHHSLs for groundwater, Tap Water PRGs were obtained from Region 9 PRGs – 2004 Update (EPA, 2004b). Screening criteria for cancer risk and noncancer hazard calculations are presented in Table 15. For carcinogens, the resulting ratios were multiplied by 10^{-6} and tabulated. For non-carcinogens, the actual ratio was tabulated. Cumulative screening cancer risks and non-cancer hazards were estimated by summing the cancer and non-cancer ratios, respectively, for each medium (i.e., shallow soil, deeper subsurface soil, soil vapor and groundwater). In this way, cumulative incremental lifetime cancer risk (ILCR) estimates and noncancer hazard index (HI) estimates were calculated.

Finally, screening ILCR and non-cancer HI estimates were compared to appropriate risk criteria. Sites that have a cumulative cancer risk less than or equal to 1×10^{-6} and a cumulative non-cancer HI less than or equal to 1 in the screening HHRA are generally not considered for further action in regard to human health concerns (Cal-EPA, 1999; EPA, 1991a). Sites for which the screening-level cumulative cancer risk is greater than 1×10^{-6} or the cumulative non-cancer HI is greater than 1 are generally recommended for further evaluation.

5.3.1.1 Quantification of Exposure Point Concentrations

Calculations of EPCs for soil were based on measured concentrations and non-detect results. If a data set contained non-detect results, one-half the sample quantitation limit was assumed for that sample. The EPC was estimated as either the maximum or the 95 percent upper confidence limit (95% UCL) on the arithmetic mean concentration detected in site media. If the calculated 95% UCL was greater than the maximum value, then the maximum value was assumed as the EPC; otherwise the 95% UCL was used.

The 95% UCL was calculated based on a normal or lognormal distribution, according to the methods described in Gilbert (1987). First, sampling results for individual chemicals were evaluated in order to identify whether the data population is representative of an underlying

normal or lognormal distribution. The Shapiro-Wilks W test, D'Agostino's test, coefficient of variation (CV) statistic, and z-score distribution analysis (Gilbert, 1987), as necessary, were used to test the underlying data distribution. For data sets that were best represented by a normal distribution, the 95% UCL was calculated based on the student-t statistic. The equation for calculating the 95% UCL on the arithmetic mean for a normal distribution is given by:

$$UCL = \bar{x} + t (s/\sqrt{n})$$

where:

- UCL = upper confidence limit
- \bar{x} = mean of the transformed data
- s = standard deviation of the untransformed data
- t = student-t statistic (from table published in Gilbert, 1987)
- n = number of samples

For data sets that are best represented by a lognormal distribution, the 95% UCL was calculated based on the H-statistic. Four-point Lagrangian interpolation and an H table from Gilbert (1987) were used to determine H values for use in the UCL calculation. The equation for calculating the UCL of the arithmetic mean for a lognormal distribution (Gilbert, 1987) is given by:

$$UCL = e^{\bar{x} + 0.5 s^2 + sH/\sqrt{(n-1)}}$$

where:

- UCL = upper confidence limit
- e = constant (base of the natural log, equal to 2.718)
- \bar{x} = mean of the transformed data
- s = standard deviation of the transformed data
- H = H-statistic (Gilbert, 1987)
- N = number of samples

For data sets that were inconclusive in terms of their underlying distribution, bootstrapping procedures were used to derive 95% UCL on the mean concentrations, consistent with methods described in EPA (2002c).

5.3.1.2 Exposure Point Concentrations

Sufficient samples were available to calculate 95% UCLs for the “All Data” scenario, shallow soil (0 – 3 feet bgs) and deeper subsurface soil (>3 – 9 feet bgs). Calculated 95% UCLs and EPCs for shallow soil and deeper subsurface soil are presented in Appendix E (Tables E-1 and E-2, respectively). Data sets for soil vapor and groundwater were of insufficient size to calculate 95% UCLs. Therefore, maximum detected concentrations of each COPC in soil vapor and groundwater were used as EPCs for these media.

5.3.1.3 Calculation of PAH Toxicity Equivalent Concentration (TEQ)

Screening risk estimates for carcinogenic PAHs were evaluated using the toxicity equivalency factor (TEF) approach described in EPA’s *Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons* (EPA, 1993). The TEF approach modifies EPCs for carcinogenic PAHs based on their estimated carcinogenic potency relative to benzo(a)pyrene. Benzo(a)pyrene is assigned a TEF of 1.0, and other carcinogenic PAHs are assigned a TEF ranging from 1.0 to 0.001, depending upon their carcinogenic potency relative to benzo(a)pyrene. The concentration of each carcinogenic PAH detected in a given sample is multiplied by its respective TEF, and the resulting values are summed across all carcinogenic PAHs in the sample to derive a sample-specific toxicity equivalent (TEQ) concentration. The derivation of TEQs for carcinogenic PAHs in shallow and deeper subsurface soils is presented in Appendix E for the “All Data” and “Revised Data” scenarios (Tables E-5 and E-6, respectively).

5.3.2 Screening Risk Characterization Results

Screening ILCR and non-cancer HI estimates for shallow soil, deeper subsurface soil, soil vapor, and groundwater are presented in Tables 16 through 19, respectively, and discussed in the following subsections.

5.3.2.1 Soil

The cumulative screening ILCR for a hypothetical future resident exposed to shallow soil (0 to 3 feet bgs) was estimated as 7×10^{-6} (Table 16). This cancer risk estimate exceeds the screening

risk criterion of 1.0×10^{-6} , and was attributable to the presence of carcinogenic PAHs in shallow soil. The cumulative HI for a hypothetical future resident exposed to shallow soil was estimated as 0.4, which does not exceed the screening HI criterion of 1 (Table 16). Cumulative screening ILCR and HI estimates for a hypothetical future industrial worker exposed to shallow soil were 2×10^{-6} and 0.04, respectively (Table 16). The ILCR, but not the noncancer HI, for the hypothetical future industrial worker exceeds the acceptable screening criterion (Cal-EPA, 1999; EPA, 1991a). Exceedance of the cancer risk criterion for the hypothetical future industrial worker was, again, attributable to the presence of carcinogenic PAHs in shallow soil. Screening criteria were not available for TPH measured as diesel and motor oil present in shallow soil. Therefore, noncarcinogenic COPCs associated with this medium were carried through and quantitatively evaluated in the baseline HHRA.

The cumulative screening ILCR for a hypothetical future resident exposed to deeper subsurface soil (>3 to 9 feet bgs) was estimated as 1×10^{-4} (Table 17). This cancer risk estimate exceeds the screening risk criterion of 1.0×10^{-6} , and was attributable to the presence of carcinogenic PAHs in deeper soil. The cumulative screening HI for a hypothetical future resident exposed to deeper subsurface soil was estimated as 0.2 (Table 17), which does not exceed the screening HI criterion of 1. Cumulative screening ILCR and HI estimates for a hypothetical future industrial worker exposed to deeper soil were 4×10^{-5} and 0.05, respectively (Table 17). The screening ILCR, but not the noncancer HI, for the hypothetical future industrial worker exceeds the acceptable screening criterion (Cal-EPA, 1999; EPA, 1991a). Exceedance of the cancer risk criterion for the hypothetical future industrial worker was, again, attributable to the presence of carcinogenic PAHs in deeper soil. Soil screening criteria published in Cal-EPA (2005) are not available for many noncarcinogenic COPCs present in deeper soil. Therefore, noncarcinogenic COPCs associated with this medium were carried through and quantitatively evaluated in the baseline HHRA.

5.3.2.2 Soil Vapor

Consistent with Cal-EPA (2005), VOCs detected in soil vapor were evaluated for potential vapor intrusion to indoor air. The cumulative screening ILCR for a hypothetical future resident

exposed to VOCs in indoor air derived from soil vapor was estimated as 1×10^{-7} (Table 18). This cancer risk estimate does not exceed the screening risk criterion of 1.0×10^{-6} . The cumulative screening HI for a hypothetical future resident exposed to VOCs in indoor air derived from soil vapor was estimated as 0.2 (Table 18). This noncancer HI is below the acceptable screening HI criterion of 1.0. The cumulative screening ILCR and HI estimates for a hypothetical future industrial worker exposed VOCs in indoor air derived from soil vapor were 4×10^{-8} and 0.04, respectively (Table 18). These ILCR and noncancer HI estimates are within the acceptable screening-level cancer risk and noncancer HI criteria of 1×10^{-6} and 1, respectively (Cal-EPA, 1999; EPA, 1991a). Screening criteria were not available for a number of carcinogenic and noncarcinogenic COPCs present in soil vapor. Therefore, these COPCs were carried through and quantitatively evaluated in the baseline HHRA.

5.3.2.3 Groundwater

Screening cancer risk and non-cancer hazard estimates for groundwater were derived based on the maximum monitoring well sampling results for each COPC. The cumulative screening ILCR for hypothetical future use of groundwater as a drinking water supply was estimated as 2×10^{-4} (Table 19). This cancer risk estimate exceeds the screening risk criterion of 1.0×10^{-6} , and was solely attributable to the maximum detected concentration of arsenic in groundwater. It should be noted, however, that detected arsenic concentrations in groundwater beneath the BCSU (i.e., 7.0 and 8.4 ug/L) are within regional ambient concentrations. Mean arsenic concentrations measured in public water supply wells and other wells within the Pacific Mountain System by the USGS were reported as 6 and 9 ug/L, respectively (USGS, 1999). In addition, measured concentrations of arsenic in groundwater beneath the BCSU are less than the revised federal MCL of 10 ug/L for arsenic.

The screening noncancer HI for hypothetical future use of groundwater as a drinking water supply was estimated as 1 (Table 19). This noncancer HI does not exceed the screening HI criterion of 1. Consistent with DTSC policy (Cal-EPA, 1999), lead is not included in the cumulative HI estimate. Lead was detected in groundwater samples collected from the BCSU at a maximum concentration of 4.2 ug/L. Inclusion of this value in the *California Lead Risk*

Assessment Spreadsheet (Bloodpb7.xls) resulted in 99th percentile blood-lead estimates for a residential child and occupational worker of 7.9 micrograms per deciliter (ug/dl) and 1.8 ug/dl, respectively. These blood-lead estimates are below the generally acceptable blood-lead criterion of 10 ug/dl.

Based on the above results, chemicals detected in groundwater were not further evaluated in the baseline HHRA.

5.4 BASELINE HHRA

Based on results of the screening HHRA, a baseline HHRA was conducted for the BCSU. The baseline HHRA evaluated potential health risks associated with carcinogenic chemicals detected in site soils, because carcinogenic risk estimates for the BCSU Site exceeded the screening cancer risk criterion of 1×10^{-6} . Noncarcinogenic effects were also evaluated in the baseline HHRA because screening criteria were not available for a number of soil COPCs. In addition, potential health risks associated with carcinogenic and noncarcinogenic chemicals detected in soil vapor were evaluated because screening criteria were not available for a number of soil vapor COPCs.

The baseline HHRA is intended to evaluate risks based on more reasonable assumptions relative to potential land uses and exposure pathways (EPA, 1989). Consistent with EPA's *Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions* (EPA, 1991a), the results of the baseline HHRA are evaluated based on EPA's risk management range of 1.0×10^{-6} to 1.0×10^{-4} and a noncancer HI of 1.0. Sites for which the cumulative cancer risk is between 1.0×10^{-6} and 1.0×10^{-4} , and the noncancer HI is less than 1.0, may be considered appropriate for no further action (NFA), depending upon site-specific considerations including current and potential future land uses. Source areas and media that are associated with cumulative cancer risk or noncancer hazard estimates greater than these criteria are generally considered appropriate for further investigation or evaluation of remedial alternatives (EPA, 1991a). These criteria were used to evaluate results of the baseline HHRA for the BCSU.

5.4.1 Exposure Assessment

Exposure assessment is an analysis of the potential exposure pathways between the source of a chemical or physical contaminant and human receptors. The exposure analysis considers current and future land uses, human receptors and activities consistent with these land uses, and exposure pathways between human receptors and contaminated media. The exposure assessment for the BCSU is described in the following subsections.

5.4.1.1 Conceptual Site Model

A conceptual site model (CSM) for the BCSU is presented as Figure 8. The CSM represents complete and incomplete exposure pathways between potential human receptors and contaminated media associated with the BCSU.

The BCSU is part of the ConocoPhillips SFR, and will remain part of the operating facility for the foreseeable future. Currently, the BCSU and immediate vicinity are covered by asphalt paving or concrete. No buildings are presently located at the BCSU. Groundwater beneath the site is not currently used for potable or industrial uses. As shown in the CSM, direct pathways between COPCs in the subsurface and current Site Workers and Site Visitors are incomplete. Potentially complete exposure pathways for current Site Workers and Site Visitors are limited to entrainment of dust from pavement or concrete and subsequent inhalation of dust-borne contaminants, or migration of VOCs in soil vapor to above ground air and subsequent inhalation. However, these potential exposures are deemed to be insignificant. The qualitative and statistical evaluations of the chemistry data detailed in Sections 4.2 and 4.3 identified several metals and organic compounds at the BCSU present in the asphalt/concrete chip samples, and the wipe samples at BCSU structures at concentrations above those at background locations. The residual metals on the grates are believed to be associated with the difficulty of cleaning the interior surfaces of the grates. To resolve this issue, ConocoPhillips performed additional cleaning of the grates in October 2004. The grates were removed and taken to the SFR Steam Wash Pad for cleaning with pressurized steam water and detergent. The cleaning was directed at the difficult, hard to reach interior surfaces of the grate, and yielded visually cleaner steel structures. Returning to the collective wipe, concrete, and asphalt residual concentrations, it is noteworthy

that the only potentially complete exposure pathways between Site Workers and Site Visitors and these media are dermal contact and incidental ingestion. Because chemicals in or on these media are not readily mobile or bioavailable, it is highly unlikely that they would result in significant exposures. In addition, all workers and visitors in the area are required to wear personal protective equipment (including gloves and coveralls) that reduce the likelihood of dermal contact and incidental ingestion pathways. Consistent with the above, potential risks to current Site Workers and Site Visitors were not quantified in the baseline HHRA because current exposure pathways are either incomplete or insignificant.

In the future, it is possible that the paving and concrete could be removed and the site could be used for industrial activities. Future Site Workers could be exposed to site soils via incidental ingestion, dermal contact, or inhalation of dust or VOCs. It is also possible that a building or other permanent structure could be erected at this location, resulting in potential exposure of Site Workers to VOCs in indoor air. Because ConocoPhillips is seeking closure of the BCSU, potential risks associated with future unrestricted land use were also evaluated in this baseline HHRA. Therefore, a Hypothetical Future Resident was evaluated. Potentially complete soil exposure routes for future Site Workers and Hypothetical Future Residents include incidental ingestion of soil, dermal contact with contaminants in soil, and inhalation of VOCs or particulates in outdoor air derived from soil. In the event that an industrial building or residence were constructed at the site, future Site Workers or Hypothetical Future Residents could be exposed to VOCs in indoor air through vapor intrusion. Although groundwater exposure pathways could be potentially complete for a Hypothetical Future Resident, the only groundwater COPC above screening criteria (i.e., arsenic) is present at concentrations within regional ambient levels (refer to Section 5.3.2.3). Therefore, potential groundwater exposure pathways were not quantitatively evaluated in this baseline HHRA.

5.4.1.2 Quantification of Exposure

As described in Section 5.3.1.1, the maximum or 95% UCL on the arithmetic mean concentration for COPCs, whichever was lower, was used as the soil EPC. Section 5.3.1.1 describes the methods used to calculate the 95% UCLs for COPCs. Calculated 95% UCLs and

EPCs for shallow soil “All Data” and deeper subsurface soil “All Data” scenarios are presented in Appendix E (Tables E-1 and E-2, respectively). As described in Section 5.2, a second “Revised Data” scenario omitted results from Soil Borings BCSU-SB-3, -4, and -5 which are associated with historical contamination at the ICW-6C. This scenario is representative of future risks associated with potential exposures to the BCSU proper. Calculated 95% UCLs and EPCs for shallow soil “Revised Data” and deeper subsurface soil “Revised Data” are presented in Appendix E (Tables C-3 and C-4, respectively).

5.4.1.3 Calculation of Exposure Doses

The quantification of exposure doses for future Site Workers and Hypothetical Future Residents potentially exposed to COPCs in soil and soil vapor was performed in accordance with EPA guidance for conducting exposure assessments (EPA, 2004c; 1997a,b; 1991b; and 1989).

The specific assumptions used in quantifying exposures for receptors are summarized in Table 20. Where available and applicable, default EPA (2004c; 1997a,b; 1991b; and 1989) or Cal-EPA (1999) exposure parameters were generally used. An exception to the use of default exposure assumptions cited in EPA (2004c; 1997a,b; 1991b; and 1989) or Cal-EPA (1999) is the exposure frequency for Site Workers. The EPA (2002d) has published exposure frequency (EF) values for commercial/industrial workers that vary between outdoor workers (EF = 225 days per year) and indoor workers (EF = 250 days per year). Exposure doses for future Site Workers exposed to soil or dust while working outdoors were calculated assuming an EF of 225 days per year (Table 20).

5.4.1.3.1 Soil

The specific equations used in the quantification of exposures to COPCs in soil are as follows:

$$\text{Ingestion Intake (mg/kg-day)} = \frac{\text{CS} \times \text{IR} \times \text{CF} \times \text{EF} \times \text{ED}}{\text{BW} \times \text{AT}}$$

Where:

CS = Concentration in Soil (mg/kg)
IR = Ingestion Rate (mg soil/day)
CF = Conversion Factor (10^{-6} kg/mg)
EF = Exposure Frequency (days/year)
ED = Exposure Duration (years)
BW = Body Weight (kg)
AT = Averaging Time (period over which exposure is averaged - days)

$$\text{Dermal Intake (mg/kg-day)} = \frac{\text{CS} \times \text{CF} \times \text{SA} \times \text{AF} \times \text{ABS} \times \text{EF} \times \text{ED}}{\text{BW} \times \text{AT}}$$

Where:

CS = Concentration in Soil (mg/kg)
CF = Conversion Factor (10^{-6} kg/mg)
SA = Skin Surface Area Exposed (cm^2)
AF = Adherence Factor for Soil ($\text{mg}/\text{cm}^2\text{-day}$)
ABS = Skin Absorption Factor (unitless)
EF = Exposure Frequency (days/year)
ED = Exposure Duration (years)
BW = Body Weight (kg)
AT = Averaging Time (period over which exposure is averaged–days)

$$\text{Inhalation Intake for VOCs (mg/kg-day)} = \frac{\text{CS} \times (1/\text{VF}) \times \text{InhR} \times \text{EF} \times \text{ED}}{\text{BW} \times \text{AT}}$$

Where:

CS = Concentration in Soil (mg/kg)
VF = Volatility Factor (m^3/kg)
InhR = Inhalation Rate (m^3/day)
EF = Exposure Frequency (days/year)
ED = Exposure Duration (years)
BW = Body Weight (kg)
AT = Averaging Time (period over which exposure is averaged - days)

$$\text{Inhalation Intake for Particulates (mg/kg-day)} = \frac{\text{CS} \times (1/\text{PEF}) \times \text{InhR} \times \text{EF} \times \text{ED}}{\text{BW} \times \text{AT}}$$

Where:

CS =	Concentration in Soil (mg/kg)
PEF =	Particulate Emission Factor (m^3/kg)
InhR =	Inhalation Rate (m^3/day)
EF =	Exposure Frequency (days/year)
ED =	Exposure Duration (years)
BW =	Body Weight (kg)
AT =	Averaging Time (period over which exposure is averaged - days)

5.4.1.3.2 Soil Vapor

Quantification of exposures to COPCs in soil vapor was evaluated using DTSC's version of the Johnson & Ettinger Model, SG-ADV (Version 2.0-Mod1; 07/03) with all default assumptions, except for soil gas depth and soil type. Site-specific input parameters for "Soil gas sampling depth below grade" and "Thickness of soil stratum A" were used in these calculations. For these parameters, the soil gas depth corresponding to the maximum detected concentration was used (274 cm, which is equal to 9 feet bgs). Site-specific soil type was derived from soil boring logs for the locations where soil vapor samples were collected. The lithologic description for BCSU-SB-4 is 'sandy silt'. The lithologic description for BCSU-SB-5 is 'silty sand'. According to *User's Guide for Evaluating Subsurface Vapor Intrusion Into Buildings* (EPA, 2003), sandy silts and silty sands can be generally categorized as 'loamy sand' for evaluation in the Johnson & Ettinger Model. Finally, unit risk values for COPCs were updated to reflect 2004 Office of Environmental Health Hazard Assessment (OEHHA) Cancer Potency Factors (Cal-EPA, 2004).

5.4.2 Toxicity Assessment

The toxicity values used in this baseline HHRA were derived from EPA's Integrated Risk Information System (IRIS) database (EPA, 2005a). Dermal toxicity values have not been established by Cal-EPA or the EPA. Therefore, for evaluating exposure doses for the dermal pathway, oral toxicity values were used without modification. Toxicity values used in this HHRA are presented in Table 21.

5.4.2.1 Carcinogenic Effects of COPCs

The cancer slope factor (CSF) is the toxicity value used to quantitatively express the carcinogenic potential of cancer-causing constituents. The slope factor is expressed in units of milligrams per kilogram per day (mg/kg-day)⁻¹ and represents the cancer risk per unit daily intake of carcinogenic chemical. The OEHHA (Cal-EPA, 2004) has developed CSFs and carcinogenic unit risk factors (URFs) for a variety of carcinogenic chemicals. Where available, CSF or URF values were obtained from Cal-EPA (2004). When OEHHA carcinogenic toxicity factors were not available, values were obtained from other published sources according to the following hierarchy:

- EPA's IRIS Database (EPA, 2005a); and
- The National Center for Environmental Assessment (NCEA) (EPA, 2005b); or Health Effects Assessment Summary Tables (HEAST) (EPA, 1995).

5.4.2.2 Noncarcinogenic Effects of COPCs

Oral and inhalation reference doses (RfDs) are derived from human or animal studies in which a threshold effect or no-observed-adverse-effect-level (NOAEL) has been identified. An RfD is an average daily dose that is not expected to cause adverse health effects in even the most sensitive of individuals.

Cal-EPA does not promulgate noncancer toxicity criteria. Therefore, EPA RfDs were used to evaluate noncarcinogenic health hazards in this risk assessment. The current RfDs were obtained from EPA's IRIS database (EPA, 2005a). If values were not found in IRIS, the NCEA (EPA, 2005b) or HEAST (EPA, 1995) were consulted.

It should be noted that benzo(g,h,i)perylene is not considered by the EPA to be carcinogenic, nor are noncarcinogenic toxicity values (i.e., oral RfDs or inhalation reference concentrations) available for this chemical. Consequently, the potential noncarcinogenic hazard associated with this COPC was evaluated using another noncarcinogenic PAH compound, naphthalene, as a surrogate. Available toxicity criteria for naphthalene were used to evaluate benzo(g,h,i)perylene.

5.4.3 Risk Characterization

This section describes the risk characterization methods and results for the baseline HHRA conducted for the BCSU. Potential carcinogenic risks and noncarcinogenic hazards associated with COPCs present in soil and soil vapor at the BCSU were estimated from the dose calculations and chemical-specific dose-response information (e.g., route-specific CSFs) described in Sections 5.4.1 and 5.4.2, respectively.

Baseline human health risks were evaluated separately for carcinogenic effects and noncarcinogenic effects. The ILCR is an estimate of the increased risk of cancer due to lifetime exposure, at apportioned average daily doses, to constituents detected in each medium at the site. Carcinogenic risk estimates were calculated as the product of the exposure dose and the carcinogenic toxicity value, the CSF (EPA, 1989).

The equation for calculating carcinogenic risks is as follows:

$$\text{ILCR (unitless)} = \text{CSF} \times \text{Dose}$$

where:

$$\begin{aligned} \text{CSF} &= \text{Cancer slope factor (mg/kg-day)}^{-1} \\ \text{Dose} &= \text{Exposure dose (mg/kg-day)} \end{aligned}$$

Cancer risks from multiple COPCs were assumed to be additive, and were summed to estimate a total cumulative ILCR for all carcinogenic site contaminants. The resulting risk estimates are an indication of the increased risk, above that applying to the general population, which may result from the exposures assumed for each scenario.

To evaluate noncarcinogenic health effects due to potential exposures to site COPCs, a hazard quotient (HQ) was calculated for each COPC. The HQ was calculated as the ratio of the exposure dose to the RfD (EPA, 1989).

The equation for calculating noncarcinogenic hazards is as follows:

$$HQ \text{ (unitless)} = \frac{\text{Dose}}{RfD}$$

where:

Dose = exposure dose (mg/kg-day)

RfD = reference dose (mg/kg-day)

A HQ greater than 1.0 indicates that the estimated exposure dose for that COPC may exceed acceptable health-protective levels for noncarcinogenic effects. Although an HQ of less than 1.0 suggests that noncarcinogenic health effects should not occur, an HQ of slightly greater than 1.0 is not necessarily an indication that adverse effects will occur.

Individual HQs for site COPCs having similar endpoints or target organs are typically summed to produce a total cumulative HI. If the total HI estimate is less than 1.0, then noncarcinogenic chronic health effects are not anticipated. If the total HI estimate is greater than 1.0, then adverse health effects are considered possible.

5.4.3.1 Results

Detailed carcinogenic risk and noncarcinogenic hazard estimates for future Site Workers and Hypothetical Future Residents exposed to COPCs in soils and soil vapor associated with the BCSU are presented in Appendix E. Summaries of baseline risk assessment results are presented in Tables 22 through 24, and are described below.

5.4.3.1.1 Soils – All Data

The baseline cancer risk estimate for a future Site Worker exposed to BCSU shallow soils in the “All Data” scenario was estimated to be 1×10^{-6} (Table 22), which does not exceed EPA’s acceptable risk range of 10^{-6} to 10^{-4} (EPA, 1991a). The noncancer HI for a future Site Worker exposed to BCSU shallow soils in the “All Data” scenario was estimated to be 0.02 for exposure to inorganic COPCs, and 0.01 for exposure to TPH, which have different target organ responses. Both estimates are below the screening hazard criterion of 1.0.

The baseline cancer risk estimate for a future Site Worker exposed to BCSU deeper subsurface soils in the “All Data” scenario was estimated to be 2×10^{-5} (Table 23), which does not exceed EPA’s acceptable risk range of 10^{-6} to 10^{-4} (EPA, 1991a). The noncancer HI for a future Site Worker exposed to BCSU deeper subsurface soils in the “All Data” scenario was estimated to be 0.002 for exposure to inorganics, VOCs, and PAHs; and 0.8 for exposure to TPH (Table 23). Both estimates are below the screening hazard criterion of 1.0.

The baseline cancer risk estimate for a Hypothetical Future Resident exposed to BCSU shallow soils in the “All Data” scenario was estimated to be 4×10^{-6} (Table 22), which does not exceed EPA’s acceptable risk range of 10^{-6} to 10^{-4} (EPA, 1991a). The noncancer HI for a Hypothetical Future Resident exposed to BCSU shallow soils in the “All Data” scenario was estimated to be 0.1 for exposure to inorganic COPCs, and 0.2 for exposure to TPH (Table 22). Both estimates are below the screening hazard criterion of 1.0.

The baseline cancer risk estimate for a Hypothetical Future Resident exposed to BCSU deeper subsurface soils in the “All Data” scenario was estimated to be 7×10^{-5} (Table 23), which does not exceed EPA’s acceptable risk range of 10^{-6} to 10^{-4} (EPA, 1991a). The noncancer HI for a Hypothetical Future Resident exposed to BCSU deeper subsurface soils in the “All Data” scenario was estimated to be 0.04 for exposure to inorganics, VOCs, and PAHs; and 16 for exposure to TPH (i.e., diesel and motor oil) (Table 23). The HI associated with exposure to TPH, but not that associated with inorganics, VOCs, and PAHs, exceeds the screening hazard criterion of 1.0.

5.4.3.1.2 Soils – Revised Data

An alternate data set, the “Revised Data” scenario, omitted results from Soil Borings BCSU-SB-3, -4, and -5, which are associated with historical conditions at the IWS-6C. This scenario is representative of future risks associated with potential exposures to the BCSU proper.

The baseline cancer risk estimate for a future Site Worker exposed to BCSU shallow soils in the “Revised Data” scenario was estimated to be 5×10^{-7} (Table 22), which does not exceed EPA’s

acceptable risk range of 10^{-6} to 10^{-4} (EPA, 1991a). The noncancer HI for a future Site Worker exposed to BSCU shallow soils in the “Revised Data” scenario was estimated to be 0.02 for exposure to inorganic COPCs, and 0.01 for exposure to TPH (Table 22). Both estimates are below the screening hazard criterion of 1.0.

The baseline cancer risk estimate for a future Site Worker exposed to BCSU deeper subsurface soils in the “Revised Data” scenario was estimated to be 4×10^{-7} (Table 23), which does not exceed EPA’s acceptable risk range of 10^{-6} to 10^{-4} (EPA, 1991a). The noncancer HI for a future Site Worker exposed to BSCU deeper subsurface soils in the “Revised Data” scenario was estimated to be 0.001 for exposure to inorganic COPCs, and 0.0002 for exposure to TPH (Table 23). Both estimates are below the screening hazard criterion of 1.0.

The baseline cancer risk estimate for a Hypothetical Future Resident exposed to BCSU shallow soils in the “Revised Data” scenario was estimated to be 2×10^{-6} (Table 22), which does not exceed EPA’s acceptable risk range of 10^{-6} to 10^{-4} (EPA, 1991a). The noncancer HI for a Hypothetical Future Resident exposed to BSCU shallow soils in the “Revised Data” scenario was estimated to be 0.2 for exposure to inorganic COPCs and 0.1 for exposure to TPH (Table 22). Both estimates are below the screening hazard criterion of 1.0.

The baseline cancer risk estimate for a Hypothetical Future Resident exposed to BCSU deeper subsurface soils in the “Revised Data” scenario was estimated to be 1×10^{-6} (Table 23), which does not exceed EPA’s acceptable risk range of 10^{-6} to 10^{-4} (EPA, 1991a). The noncancer HI for a Hypothetical Future Resident exposed to BSCU deeper subsurface soils in the “Revised Data” scenario was estimated to be 0.03 for exposure to inorganic COPCs, and 0.003 for exposure to TPH (Table 23). Both estimates are below the screening hazard criterion of 1.0.

5.4.3.1.3 Soil Vapor

Quantification of carcinogenic risk and noncarcinogenic hazard estimates for future Site Workers and Hypothetical Future Residents exposed to COPCs in soil vapor was evaluated using DTSC’s version of the Johnson & Ettinger Model, as described in Section 5.4.1.3. Detailed vapor

intrusion to indoor air calculations are presented in Appendix E. Baseline cancer risk and noncancer HI estimates for a future Site Worker exposed to BCSU soil vapor COPCs were calculated as be 3×10^{-6} and 0.03, respectively (Table 24). Baseline cancer risk and noncancer HI estimates for a Hypothetical Future Resident exposed to BCSU soil vapor COPCs were estimated to be 5×10^{-6} and 0.04, respectively (Table 24). Neither the cancer risk nor the hazard estimate exceeds EPA's acceptable risk range of 10^{-6} to 10^{-4} (EPA, 1991a) or hazard criterion of 1.0.

5.4.4 Uncertainty Analysis

The presence of uncertainty is inherent in the risk assessment process. Generally, uncertainties in the risk assessment typically result from limitations in the available methods, information, and data used in the following:

- Characterization of contaminant sources;
- Identification of site COPCs;
- Evaluation of potential exposure scenarios and pathways;
- Toxicity assessment; and,
- Risk characterization.

The uncertainties associated with each of these steps, as they relate to the screening and baseline HHRAs for the BCSU, are described in the following.

5.4.4.1 Characterization of Contaminant Sources

There is a degree of uncertainty in the characterization of contaminant sources, since it is not possible to sample an entire site. The nature of the site investigation focused on known or suspected sources of contamination. While it is believed that sufficient samples were collected to characterize the nature and extent of contamination at the BCSU, it is possible that areas not sampled may have also contained contaminants. However, sample locations were generally chosen such that they represented the area with the greatest potential to detect contaminants, if present. Thus, estimated EPCs for chemicals evaluated in the HHRA are most likely biased high.

As described in Section 5.2, soil vapor sampling methods were determined to be inadequate for two of the four soil vapor samples collected at the BCSU (i.e., BCSU-SB-3A and BCSU-SB8A) due to tracer break-through. Consequently, results for these samples were rejected. Elimination of these samples from consideration in the quantitative HHRA results in potential uncertainty in the characterization of the nature and extent of VOCs in the subsurface, as well as uncertainties in the exposure assessment for the BCSU.

5.4.4.2 Identification of Site Chemicals of Potential Concern

The process used in the selection of site COPCs may also introduce a degree of uncertainty in the screening and baseline HHRA. All inorganic chemicals detected at concentrations above site-specific background levels, and all positively identified organic chemicals were selected as COPCs and evaluated in the screening and baseline HHRA for the BCSU.

5.4.4.3 Exposure Assessment

Because the exposure assessment is based on the estimation of *potential* rather than actual exposures, there is a degree of uncertainty in the dose estimate. The baseline HHRA for the BCSU Site included a worst-case analysis of exposure (i.e., the assumption of future residential land use). This exposure scenario was assumed to provide a basis for evaluating future unrestricted land uses of the site.

Potential risks to *current* Site Workers and Site Visitors were not quantified in the baseline HHRA because current exposure pathways were deemed to be either incomplete or insignificant. This assumption was based on the fact that the BCSU and vicinity is covered by asphalt or concrete. Although current Site Workers and Site Visitors are not currently exposed directly to COPCs in the subsurface, it is possible that these receptors could have brief, intermittent contact with contaminated surfaces (e.g., asphalt, cement, or the sewer grate where chemicals above background levels were detected). However, it is highly unlikely that such contact would result in significant exposures or risks, because such chemicals are either imbedded within, or adsorbed to, these materials. In addition, all workers and visitors in the area are required to wear personal

protective equipment (including gloves and coveralls) that reduce the likelihood of dermal contact and incidental ingestion pathways.

As described in Section 5.4.4.1, above, rejection of two of the four soil vapor samples collected from beneath the BCSU results in potential uncertainty in the exposure assessment for Future Site Workers and Hypothetical Future Residents.

5.4.4.4 Toxicity Assessment

There may also be uncertainty in the derivation of the toxicity values used in the baseline HHRA. As described in Section 5.4.2, CSFs and URFs were obtained from OEHHA (Cal-EPA, 2004) where available. When OEHHA toxicity values were not available, other EPA sources were used as described in Section 5.4.2. Generally, the toxicity values derived by Cal-EPA and EPA represent upper bound estimates, and incorporate uncertainty factors for extrapolation from animal data to humans, differences in individual sensitivity within populations, and the overall confidence in the dataset. Because the toxicity values established by EPA are based on NOAEL concentrations and incorporate uncertainty factors, they are generally considered to be protective. The use of conservative toxicity values in the risk estimate tends to overestimate actual risks.

In the case of benzo(g,h,i)perylene, no published toxicity values are available for this non-carcinogenic PAH. To evaluate this chemical in the baseline HHRA, naphthalene was used as a surrogate chemical. The use of toxicity values developed for naphthalene to evaluate potential noncarcinogenic hazards associated with benzo(g,h,i)perylene is thought to be protective.

5.4.4.5 Risk Characterization

The different sources of uncertainty previously described are incorporated in the risk estimate. Because the majority of these uncertainties error on the conservative side, the risk estimate is considered to be protective. The risk assessment process uses animal data to predict the probability of humans developing cancer over a 70-year lifetime. The estimated risks presented

in this baseline HHRA represent upper bound estimates; the actual risks are anticipated to be less.

6.0 SUMMARY AND CONCLUSIONS

The proposed closure approach for the BCSU includes:

- (1) Separating the BCSU closure and ongoing resolution of IWS-6C, given that soil conditions within the IWS-6C fill are representative of wastes previously recognized and being addressed separately under RWQCB oversight; and
- (2) Clean closing the BCSU on the basis of the decontamination and confirmation sampling that was conducted, and the results of the HHRA that was completed.

Key information presented in this Closure Report regarding these items are summarized in Sections 6.1 and 6.2 below.

6.1 REMOVING THE IWS-6C SOIL FROM THE BCSU CLOSURE PROCESS

The original conceptual model for the BCSU presented in the Phase I Closure Report (MWH, 2003) discussed that there was likely going to be chemicals in the soil underlying the BCSU where fill associated with IWS-6C was present. The closure sampling activities demonstrated that IWS-6C material was present beneath the southern portion of the BCSU, and that all of the highest detections of hydrocarbons, PAHs, and metals in soil during the closure process were from samples representative of the waste. Removing the IWS-6C wastes from this closure process and processing the closure of the BCSU separately is reasonable given the following facts:

- 1) The overlap of the BCSU and IWS-6C is limited to the Middle Terrace portion of the site (Area C) as shown on [Figure 4](#). The remainder of the BCSU (Areas A and B) do not overlie IWS-6C waste material.
- 2) The compounds in the soil underlying the BCSU and in the waste deposits in IWS-6C soils are similar in that hydrocarbons and selected metals are present. However, they are also characteristically different given that (1) the detections of chemicals in the IWS-6C wastes are typically 10 to 100 times larger, and (2) the IWS-6C waste is characterized by

large detections of multiple PAHs and distinct layers of petroleum coke and coke conglomerations.

- 3) The BCSU and IWS-6C are already separate sites administered under different regulatory programs -- the BCSU is administered by the DTSC, and IWS-6C is regulated under the new RWQCB WDR (No. R2-2005-0026) and monitored as part of the SFR soil and groundwater programs.

6.2 SUMMARY OF ASSESSED CONDITIONS AT EACH BCSU MEDIA

The BCSU was decontaminated, residual condition assessed qualitatively or statistically, and human health risks studied as presented in Sections 3.0 through 5.0. Key results of that process by media are summarized below.

6.2.1 Asphalt Surfaces

Condition (Residual Chemicals): Chemistry results from the chip samples suggest that the asphalt surfaces are relatively unencumbered by chemicals that would have been sourced from wastes handled at the BCSU. Statistical analysis indicate that only two metals (beryllium and mercury) are present at concentrations statistically above background asphalt areas.

Risks From Residual Chemicals: The risks associated with the residual compounds in the asphalt were not quantified in screening or baseline risk assessments, because the only potentially complete exposure pathways are dermal contact and incidental ingestion. Site worker and Hypothetical Future Resident exposures via these pathways are considered *insignificant*, given that the chemicals in this media are not readily mobile or bioavailable.

6.2.2 Concrete Pads

Condition (Physical): The concrete containment pads are in good condition with no apparent defects or failures that would undermine the integrity of the structures or suggest a release has occurred to subsurface soils (MWH, 2004b).

Condition (Residual Chemicals): Chemistry results from the chip samples suggest that the concrete pads include some residual TPH and PAHs that decrease with depth and selected metals. Statistical analysis indicated that only four of the metals (barium, beryllium, nickel, and selenium) are present at concentrations statistically above background.

Risks From Residual Chemicals: The risks associated with the residual compounds in the concrete pads were not quantified in screening or baseline risk assessments, because the only

potentially complete exposure pathways are dermal contact and incidental ingestion. Site worker and Hypothetical Future Resident exposures via these pathways are considered *insignificant*, given that the chemicals in this media are not readily mobile or bioavailable.

6.2.3 Structures

Condition (Residual Chemicals): Chemistry results from the wipe samples suggest that the decontamination process was generally effective. The only detections were TPH as motor oil in one sample at a concentration slightly above the reporting limit, and selected metals at concentrations generally just above the reporting limits. The exceptions included lead detected in most wipe samples just above the reporting limit, and five to ten different metals detected at concentrations slightly above reporting limits in the three samples collected from the steel grates (WP-16, WP-17, and WP-19). These metals are interpreted to have been associated with the difficulty of cleaning the interior surfaces of the grates, and as a resolution, ConocoPhillips re-cleaned the grates in October 2004.

Risks From Residual Chemicals: The risks associated with the residual compounds detected on the structures (before the re-cleaning) were not quantified in screening or baseline risk assessments, because the only potentially complete exposure pathways are dermal contact and incidental ingestion. Site worker and Hypothetical Future Resident exposures via these pathways are considered *insignificant*, given that the detected chemicals in this media are not readily mobile or bioavailable.

6.2.4 Soil

Soil Quality: Soil chemistry results indicated the presence of variable concentrations of TPH, PAHs, and metals in the subsurface, but with the highest concentrations were restricted to the samples that were representative of the IWS-6C waste. Soil samples from the area beneath the BCSU structures and not part of IWS-6C, contained relatively low concentrations of TPH (<75 mg/kg in all but one sample), no detected VOCs, and only several PAHs in the 200 to 400 ug/kg range.

Risks From Residual Chemicals: The risks to Site Workers and Hypothetical Future Residents were evaluated in a baseline risk assessment. The assessment looked at two (2) scenarios, including an “All Data” scenario, and a “Revised Data” scenario that eliminated the soil samples that were representative of IWS-6C waste. The calculated risks did not exceed acceptable ranges, and hazard indices were below accepted criterion with only 1 exception (see bolded number):

Scenario	Hypothetical Future Resident		Site Worker	
	Risk (Hazard Indices)*		Risk (Hazard Indices)*	
	<i>Shallow Soil</i>	<i>Deep Soil</i>	<i>Shallow Soil</i>	<i>Deep Soil</i>
<i>All Data</i>	4E-06 (0.1 / 0.2)	7E-05 (0.04 / 16)	1E-06 (0.02 / 0.01)	2E-05 (0.002 / 0.8)
<i>Revised Data</i>	2E-06 (0.2 / 0.1)	1E-06 (0.03 / 0.003)	5E-07 (0.02 / 0.01)	4E-07 (0.001 / 0.0002)

* Hazard indices correlate to all COPCs except petroleum hydrocarbons, and petroleum hydrocarbons, respectively.

6.2.5 Soil Vapor

Vapor Quality: Chemistry results from the two accepted samples included low concentrations of several VOCs, typically just above the method detection limits. The one notable detection was 1,1,2,2-tetrachloroethane at 0.47 ug/L in the SB-5A sample. The SB-5A sample was from an 8-foot depth within the IWS-6C fill soil.

Risks From Residual Chemicals: The cumulative risk to Site Workers and Hypothetical Future Residents of the accepted detections were evaluated in the baseline risk assessment. The cumulative calculated risks did not exceed acceptable ranges, and the hazard index was below accepted criterion of 1:

	Hypothetical Future Resident	Site Worker
	Risk (Hazard Index)	Risk (Hazard Index)
<i>Soil Vapor</i>	5E-06 (0.04)	3E-06 (0.03)

6.2.6 Groundwater

Quality: Chemistry results indicate that groundwater beneath the BCSU is not impacted from BCSU activities. TPH and SVOCs were not detected in the samples collected, and the only VOCs detected were acetone and 2-butanone at low concentrations. Selected metals were detected, but all were below tap water PRGs with the exception of arsenic.

Risks From Chemicals: The potential risk associated with the groundwater results were evaluated in the screening level risk assessment. A cumulative risk for hypothetical future use of groundwater as a drinking water supply was estimated as 2×10^{-4} , with a non-cancer hazard index of 1. The risk exceeded the criterion of 1×10^{-6} , but the exceedance was solely attributable to the maximum detected concentration of arsenic in groundwater. The risk associated with the chemicals in groundwater were not further evaluated in the baseline HHRA, as the risk and hazard index were directly correlative to input arsenic values that are within regional ambient concentrations for arsenic and below the revised federal MCL.

6.3 CONCLUSIONS

The following conclusions are put forth:

General

- All stored wastes were removed from the BCSU.
- The concrete containment pads are in good condition with no apparent defects of failures that would undermine the integrity of the structures or suggest a release has occurred.

Decontamination and Residual Chemicals

- Surfaces (asphalt and concrete), equipment, and structures were decontaminated. Waste residue was removed in most cases, with exceptions being some residual concentrations of metals and organics being above (either qualitatively or statistically) background levels.
- The residual concentrations in the asphalt/concrete and on the structures have been sufficiently addressed:

- The organic compounds in the concrete surface can not be removed without damaging the concrete pad and attenuate with depth.
- The highest VOC results in the BCSU asphalt correlate to the areas with newer pavement.
- ConocoPhillips performed additional steam-cleaning of the collection trench and drop inlet grates in October 2004.
- The compounds that are present in the fill material beneath the Middle Terrace are representative of IWS-6C waste, and are not from operation of (or releases from) the BCSU.
- Groundwater beneath the BCSU has not been impacted from BCSU activities.
- COPCs in the IWS-6C fill (and the potential of the COPCs leaching to groundwater) is being monitored and mitigated under the ongoing SFR remedial programs, as administered by the RWQCB under the current WDR Order (No. R2-2005-0026).

Risks From Chemicals Found at the BCSU

- There are no significant risks to Site Workers or Hypothetical Future Residents from the BCSU outside of EPA accepted ranges:
 - Exposures to the compounds detected on the surfaces, equipment, and structures are considered *insignificant*, given that the only potential exposure pathways are dermal contact and incidental ingestion, and chemicals in these media are not readily mobile or bioavailable.
 - Risk from the combined BCSU and IWS-6C soil were in the 10^{-5} to 10^{-6} range, with a hazard indices of 1 or less in all cases but one (petroleum hydrocarbons - deep soil).
 - Risk from soil vapor were in the 10^{-6} range with hazard indices below 1.
 - The potential risk associated with groundwater being used as a drinking water source exceeded the criterion of 1×10^{-6} . However, the risk not considered relative to the BCSU, as the exceedance was solely attributable to the maximum

detected concentration of arsenic in groundwater which were within regional ambient concentrations and below the revised federal MCL.

- When the soil samples from the IWS-6C fill were removed from the soil risk calculations, cumulative risks dropped to the 10^{-6} and 10^{-7} range, with hazard indices all below 1.

6.4 CLOSURE REQUEST

Therefore, we propose that the Closure Process that has been completed for the BCSU meets clean-closure requirements included in CCR Title 22 Division 4.5, Chapter 15, Articles 7, 8 and 10. The carcinogenic risks and noncarcinogenic hazard estimates associated with the current BCSU condition are within the ranges that are generally considered appropriate for unrestricted future land use.

7.0 REFERENCES

- California Environmental Protection Agency (Cal-EPA), 1999. Preliminary Endangerment Assessment Guidance Manual. Second Printing. January.
- Cal-EPA, 2004. Cancer Potency Factors – 2004 Update.
- Cal-EPA, 2005. Use of California Human Health Screening Levels (CHHSLs) in Evaluation of Contaminated Properties. January.
- ConocoPhillips, 2003. Closure Plan for the Bulk/Container Storage Unit. April.
- Department of Toxic Substance Control (DTSC), 2003a. Letter from Mr. Paul E. Ruffin to Mr. Willie C.W. Chiang, ConocoPhillips Company, “Notice of Deficiency, Closure Work Plan for the Bulk/Container Storage Unit, ConocoPhillips Company, Rodeo, California, EPA ID No. CAD009108705.” July 1.
- DTSC, 2003b. Letter from Mr. Paul E. Ruffin to Mr. Stephan Rosen, ConocoPhillips Company, “Conditional Approval of the Phase I Closure Work Plan for the Bulk/Container Storage Unit, ConocoPhillips Company, Rodeo, California, EPA ID No. CAD009108705.” December 11.
- DTSC, 2004a. Letter from Mr. Paul E. Ruffin to Mr. Stephan Rosen, ConocoPhillips Company, “Draft Response to Action Items on the Phase I Closure Work Plan for the Bulk/Container Storage Unit, ConocoPhillips Company, Rodeo, California, EPA ID No. CAD009108705.” February 11.
- DTSC, 2004b. Letter from Mr. Paul E. Ruffin to Mr. Stephan Rosen, ConocoPhillips Company, “Conditional Approval of the Phase I Closure Work Plan for the Bulk / Container Storage Unit, EPA ID No. CAD009108705”. April 26.
- DTSC, 2005. Letter from Mr. Sal Ciriello to Mr. Stephan Rosen, ConocoPhillips Company, “Comments on the Draft Closure Report for the Bulk / Container Storage Unit, ConocoPhillips Company, Rodeo California, EPA ID No. CAD009108705”. August 5.
- United States Environmental Protection Agency (EPA), July 1979. Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition, Volume I: Stationary Point and Area Sources, Chapter 4.5.
- EPA, 1989. Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual (Part A), Interim Final, EPA/540/1-89/002. December.
- EPA, 1990. Guidance for Data Usability in Risk Assessment - Interim Final. EPA/540/G-90/008. October.

- EPA, 1991a. Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions, OSWER Directive 9355.0-30.
- EPA, 1991b. Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors.
- EPA, 1993. Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons. U.S. Environmental Protection Agency, Office of Research and Development. EPA/600/R-93/089. July.
- EPA, 1995. Health Effects Assessment Summary Tables (HEAST). EPA/540-R-94-020. March.
- EPA, 1997a. Exposure Factors Handbook, Volume I: General Factors. Office of Emergency and Remedial Response. EPA/600/P-95/002 Fa. August.
- EPA, 1997b. Exposure Factors Handbook, Volume III: Activity Factors. Office of Emergency and Remedial Response. EPA/600/P-95/002 Fa. August.
- EPA, 2002a. 2002 Edition of the Drinking Water Standards and Health Advisories. EPA 822-R-02-038. Summer.
- EPA, 2002b. Guidance for Comparing Background and Chemical Concentrations at Superfund Sites. Office of Solid Waste and Emergency Response.
- EPA, 2002c. Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites, OSWER 9285.6-10. December.
- EPA, 2002d. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24. December.
- EPA, 2003. User's Guide for Evaluating Subsurface Vapor Intrusion Into Buildings. U.S. Environmental Protection Agency.
- EPA, 2004a. Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition, Volume I: Stationary Point and Area Sources, Chapter 11.1. April.
- EPA, 2004b. Region 9 PRGs – 2004 Update. October.
- EPA, 2004c. Risk Assessment Guidance for Superfund (RAGS), Part E, Supplemental Guidance for Dermal Risk Assessment. EPA/540/R/99/005.
- EPA, 2005a. Integrated Risk Information System (IRIS) Database. U.S. Environmental Protection Agency.
- EPA, 2005b. National Center for Environmental Assessment (NCEA). U.S. Environmental Protection Agency. <http://www.epa.gov/ncea/>

- Gilbert, Richard O., 1987. *Statistical Methods for Environmental Pollution Monitoring*. Van Nostrand Reinhold, New York.
- Montgomery Watson, 1995. Letter to Mr. Steve Mitchell, Unocal Corporate Environmental and Remediation Technology, "Reconnaissance Evaluation of the Areal Extent of Former Inactive Waste Site 6C at the Unocal San Francisco Refinery (SFR), Rodeo, California." December 5.
- Montgomery Watson, 1997. Results of Additional Investigation and Remediation Plan Inactive Waste Site 6C, Tosco Refining Company, San Francisco Area Refineries, Rodeo Refinery, Rodeo, California. August 1.
- Montgomery Watson, 1998. Addendum to Inactive Waste Site 6C Report – "Results of Additional Investigation and Remediation Plan, August 1, 1997." Tosco Refining Company, San Francisco Refinery at Rodeo. January 7.
- MWH, 2003. Phase I Closure Work Plan, Bulk/Container Storage Unit, San Francisco Refinery, Rodeo, California. ConocoPhillips Company. August 29.
- MWH, 2004a. Letter to Mr. Stephan Rosen, ConocoPhillips Company, Response to Comments- December 11, 2003 and February 11, 2004 Letters, Phase I Closure Work Plan, Bulk/Container Storage Unit, San Francisco Refinery, Rodeo, California. ConocoPhillips Company. February 27.
- MWH, 2004b. Letter to Mr. Dean Wright, DTSC, Waiver Request for Soil Sampling Beneath Concrete Containment Pads, Phase I Closure Process, Bulk/Container Storage Unit, San Francisco Refinery, Rodeo, California. ConocoPhillips Company. August 4.
- MWH, 2004c. Closure Report, Bulk/Container Storage Unit, San Francisco Refinery, Rodeo, California. ConocoPhillips Company. September 30.
- United States Geological Survey (USGS), 1999. *A Retrospective Analysis of the Occurrence of Arsenic in Ground-Water Resources of the United States and Limitations in Drinking Water supply Characterizations*. Water-Resources Investigations Report 99-4279.
- Woodward-Clyde Consultants, 1993. *Corrective Measures Study*, Unocal, San Francisco Refinery, Rodeo, California. December 15.

TABLE 1

**REVISED PROJECT SCHEDULE
BULK/CONTAINER STORAGE UNIT CLOSURE PROJECT
SAN FRANCISCO REFINERY, RODEO, CALIFORNIA**

Activity	Duration	Implemented Schedule		Comment
		Start Date	End Date	
Original Submittal of Phase I Closure Work Plan	-	-	29-Aug-03	
DTSC Comment / ConocoPhillips Response-to-Comments	-	01-Sep-03	27-Feb-04	DTSC comments on Phase I Work Plan received 11-Dec-03.
DTSC Review and Formal Acceptance of Phase I Closure Work Plan	-	01-Mar-04	26-Apr-04	DTSC Conditional Approval letter dated 26-Apr-04.
Develop Alternative Waste Storage Yard / Clean-out BCSU	2 months	27-Apr-04	10-Jun-04	~ 6 weeks as opposed to the plan of 8 weeks.
Phase I Field Closure Activities	2 months	11-Jun-04	20-Aug-04	Started ~2 weeks ahead of schedule.
<i>Decontaminate BCSU by Pressure Washing</i>		Mon 14-Jun	Mon 21-Jun	Cleaning of BCSU started on Monday morning @ ~ 9AM. Finished on Mon 21-Jun.
<i>Collect Wipe/Chip Samples, & Background Samples in Outcrops</i>		Tue 15-Jun	Fri 25-Jun	Completed mostly Jun 15 thru Jun 21. Some background soil samples collected Jun 29-30.
<i>Collect Soil, Soil Vapor, & Groundwater Samples, & Background Samples from Boreholes</i>		Mon 28-Jun	Wed 7-Jul	Soil, soil vapor, and groundwater work completed 28-Jun thru 7-Jul.
<i>Collect Sump Samples</i>		Wed 14-Jul	Wed 14-Jul	
<i>Data Analysis</i>		Mon 5-Jul	13-Aug-04	Data analysis started week of Jul 5, after collection of last field samples.
<i>Prepare Chemistry Results Technical Memorandum</i>		09-Aug-04	19-Aug-04	
<i>Hold Ph I Results Review Meeting / Discuss PH II Closure Process and Report.</i>		-	20-Aug-04	Meeting occurred on Friday, 20-Aug.
Prepare Closure Report		23-Aug-04	30-Sep-04	
DTSC Review		01-Oct-04	05-Aug-05	Comments letter from DTSC dated August 5, 2005
Prepare <i>Revised</i> Closure Report with Risk Assessment		14-Aug-05	28-Oct-05	DTSC Letter received by ConocoPhillips on Aug 14
DTSC Review / Approval of Closure	TBD			

TBD - To Be Determined

TABLE 2

SUMMARY OF GROUNDWATER CHEMISTRY DATA
 BULK/CONTAINER STORAGE UNIT CLOSURE PROJECT
 SAN FRANCISCO REFINERY, RODEO, CALIFORNIA

Well	Date	TPH-d (µg/L)	Benzene (µg/L)	Toluene (µg/L)	Ethyl- benzene (µg/L)	Total Xylenes (µg/L)	PAHs (µg/L)	PCBs (µg/L)	Le (µg)
MW-137	08/01/97	1,200	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	2-methylnaphthalene (10) all other compounds ND (5.0 - 10)	ND (0.50 - 2.0)	7
	02/27/98	2,500	ND (0.5)	ND (0.5)	ND (0.5)	11.0	--	ND (0.50 - 2.0)	ND
	05/23/98	1,900	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	--	ND (0.50 - 2.0)	ND
	08/13/98	920	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	--	ND (0.50 - 2.0)	ND
	10/27/98	1,200	ND (0.5)	1.7	ND (0.5)	3.0	--	ND (0.50 - 2.0)	ND
	05/17/99	3,600	ND (0.5)	0.94	ND (0.5)	1.48	--	ND (0.50 - 2.0)	ND
	11/04/99	1,100	ND (0.5)	ND (0.5)	ND (0.5)	0.55	--	ND (0.50 - 2.0)	ND
	05/18/00	770	ND (0.5)	ND (0.5)	ND (0.5)	0.6	--	ND (0.50 - 2.0)	ND
	11/02/00	660	ND (0.5)	ND (0.5)	ND (0.5)	0.6	--	ND (0.50 - 2.0)	ND
	05/25/01	980	ND (0.5)	ND (0.5)	ND (0.5)	0.6	--	ND (0.50 - 2.0)	ND
	11/02/01	1,900	ND (0.5)	ND (0.5)	ND (0.5)	ND (1.0)	--	ND (0.50 - 2.0)	ND
	06/04/02	760	ND (0.5)	ND (0.5)	ND (0.5)	0.7	--	ND (0.50 - 2.0)	3
	10/11/02	730	ND (0.5)	ND (0.5)	ND (0.5)	0.7	--	ND (0.50 - 2.0)	ND
	06/03/03	1,500	ND (0.5)	ND (0.5)	ND (0.5)	1.0	--	ND (0.50 - 2.0)	3
	10/08/03	570	ND (0.5)	ND (0.5)	ND (0.5)	0.8	--	ND (0.50 - 2.0)	ND
	06/01/04	1,200	ND (0.5)	ND (0.5)	ND (0.5)	1.0	--	ND (0.47 - 0.94)	ND
	10/15/04	1,200	ND (0.5)	ND (0.5)	ND (0.5)	0.8	--	ND (0.52 - 1.0)	ND
	05/26/05	1,200	ND (0.5)	ND (0.5)	ND (0.5)	1.5	--	ND (0.5 - 0.99)	ND
MW-139	08/01/97	ND (50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (5.0 - 10))	ND (0.50 - 2.0)	ND
	03/02/98	ND (50)	ND (0.50)	ND (0.5)	ND (0.5)	ND (0.50)	--	ND (0.50 - 2.0)	ND
	05/25/98	63	ND (0.50)	ND (0.5)	ND (0.5)	ND (1.0)	--	ND (0.50 - 2.0)	ND
	08/13/98	ND (50)	ND (0.50)	ND (0.5)	ND (0.5)	ND (1.0)	--	ND (0.50 - 2.0)	ND
	10/27/98	ND (50)	ND (0.50)	ND (0.5)	ND (0.5)	ND (1.0)	--	ND (0.50 - 2.0)	ND
	05/17/99	150	ND (0.50)	ND (0.5)	ND (0.5)	ND (1.0)	--	ND (0.50 - 2.0)	ND
	11/03/99	ND (50)	ND (0.50)	ND (0.5)	ND (0.5)	ND (1.0)	--	ND (0.50 - 2.0)	ND
	05/22/00	ND (50)	--	ND (0.5)	ND (0.5)	ND (1.0)	--	ND (0.50 - 2.0)	ND
	11/02/00	ND (50)	ND (0.50)	ND (0.5)	ND (0.5)	ND (1.0)	--	ND (0.50 - 2.0)	ND

TABLE 2

SUMMARY OF GROUNDWATER CHEMISTRY DATA
 BULK/CONTAINER STORAGE UNIT CLOSURE PROJECT
 SAN FRANCISCO REFINERY, RODEO, CALIFORNIA

Well	Date	TPH-d (µg/L)	Benzene (µg/L)	Toluene (µg/L)	Ethyl- benzene (µg/L)	Total Xylenes (µg/L)	PAHs (µg/L)	PCBs (µg/L)	Le (µg)
MW-139	05/25/01	ND (50)	ND (0.50)	ND (0.5)	ND (0.5)	ND (1.0)	--	ND (0.50 - 2.0)	ND
(Continued)	11/02/01	98	ND (0.50)	ND (0.5)	ND (0.5)	ND (1.0)	--	ND (0.50 - 2.0)	ND
	06/05/02	ND (50)	ND (0.50)	ND (0.5)	ND (0.5)	ND (1.0)	--	ND (0.50 - 2.0)	0.
	06/05/02	ND (50)	ND (0.50)	ND (0.5)	ND (0.5)	ND (1.0)	--	ND (0.50 - 2.0)	ND
	10/11/02	ND (50)	ND (0.50)	ND (0.5)	ND (0.5)	ND (1.0)	--	ND (0.50 - 2.0)	ND
	06/03/03	ND (50)	ND (0.50)	ND (0.5)	ND (0.5)	ND (1.0)	--	ND (0.50 - 2.0)	ND
	06/03/03	ND (50)	ND (0.50)	ND (0.5)	ND (0.5)	ND (1.0)	--	ND (0.50 - 2.0)	ND
	10/08/03	ND (50)	ND (0.50)	ND (0.5)	ND (0.5)	ND (1.0)	--	ND (0.50 - 2.0)	ND
	06/01/04	ND (50)	ND (0.50)	ND (0.5)	ND (0.5)	ND (1.0)	--	ND (0.47 - 0.94)	ND
	10/15/04	ND (50)	ND (0.5)	ND (0.5)	ND (0.5)	ND (1.0)	--	ND (0.49 - 0.98)	ND
	05/26/05	ND (50)	ND (0.5)	ND (0.5)	ND (0.5)	ND (1.0)	--	ND (0.5 - 0.99)	ND
MW-211	08/01/97	ND (50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (5.0 - 10))	ND (0.50 - 2.0)	ND
	03/02/98	ND (50)	ND (0.50)	ND (0.5)	ND (0.5)	ND (0.5)	--	ND (0.50 - 2.0)	ND
	05/23/98	ND (50)	ND (0.50)	ND (0.5)	ND (0.5)	ND (0.5)	--	ND (0.50 - 2.0)	ND
	08/13/98	ND (50)	ND (0.50)	ND (0.5)	ND (0.5)	ND (0.5)	--	ND (0.50 - 2.0)	ND
	10/27/98	ND (50)	ND (0.50)	ND (0.5)	ND (0.5)	ND (0.5)	--	ND (0.50 - 2.0)	ND
	05/17/99	340	ND (0.50)	ND (0.5)	ND (0.5)	ND (0.5)	--	ND (0.50 - 2.0)	ND
	11/04/99	ND (50)	ND (0.50)	ND (0.5)	ND (0.5)	ND (0.5)	--	ND (0.50 - 2.0)	ND
	05/19/00	ND (50)	--	ND (0.5)	ND (0.5)	ND (0.5)	--	ND (0.50 - 2.0)	ND
	11/03/00	ND (50)	ND (0.50)	ND (0.5)	ND (0.5)	ND (0.5)	--	ND (0.50 - 2.0)	ND
	05/25/01	ND (50)	ND (0.50)	ND (0.5)	ND (0.5)	ND (1.0)	--	ND (0.50 - 2.0)	ND
	11/05/01	ND (50)	ND (0.50)	ND (0.5)	ND (0.5)	ND (1.0)	--	ND (0.50 - 2.0)	ND
	06/04/02	ND (50)	ND (0.50)	ND (0.5)	ND (0.5)	ND (1.0)	--	ND (0.50 - 2.0)	ND
	10/15/02	ND (50)	ND (0.50)	ND (0.5)	ND (0.5)	ND (1.0)	--	ND (0.50 - 2.0)	ND
	06/03/03	ND (50)	ND (0.50)	ND (0.5)	ND (0.5)	0.6	--	ND (0.50 - 2.0)	ND
	10/08/03	ND (50)	ND (0.50)	ND (0.5)	ND (0.5)	ND (1.0)	--	ND (0.50 - 2.0)	ND
	06/01/04	ND (50)	ND (0.50)	ND (0.5)	ND (0.5)	ND (1.0)	--	ND (0.47 - 0.94)	ND
	10/15/04	ND (50)	ND (0.5)	ND (0.5)	ND (0.5)	ND (1.0)	--	ND (0.5 - 1.0)	ND
	05/26/05	ND (50)	ND (0.5)	ND (0.5)	ND (0.5)	ND (1.0)	--	ND (0.48 - 0.95)	ND

TABLE 2

SUMMARY OF GROUNDWATER CHEMISTRY DATA
 BULK/CONTAINER STORAGE UNIT CLOSURE PROJECT
 SAN FRANCISCO REFINERY, RODEO, CALIFORNIA

Well	Date	TPH-d (µg/L)	Benzene (µg/L)	Toluene (µg/L)	Ethyl- benzene (µg/L)	Total Xylenes (µg/L)	PAHs (µg/L)	PCBs (µg/L)	Le (µg)
MW-6B2	08/01/97	ND (50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (5.0 - 10))	ND (0.50 - 2.0)	ND
	05/21/98	ND (50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	--	ND (0.50 - 2.0)	ND
	08/12/98	ND (50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	--	ND (0.50 - 2.0)	ND
	10/22/98	ND (50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	--	ND (0.50 - 2.0)	ND
	05/12/99	ND (50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	--	ND (0.50 - 2.0)	ND
	11/02/99	ND (50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	--	ND (0.50 - 2.0)	ND
	05/18/00	ND (50)	--	ND (0.50)	ND (0.50)	ND (0.50)	--	ND (0.50 - 2.0)	ND
	11/07/00	ND (50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	--	ND (0.50 - 2.0)	ND
	05/24/01	ND (50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (1.0)	--	ND (0.50 - 2.0)	ND
	11/02/01	ND (50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (1.0)	--	ND (0.50 - 2.0)	ND
	05/31/02	ND (50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (1.0)	--	ND (0.50 - 2.0)	ND
	10/15/02	ND (50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (1.0)	--	ND (0.50 - 2.0)	ND
	05/30/03	ND (50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (1.0)	--	ND (0.50 - 2.0)	ND
	10/09/03	ND (50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (1.0)	--	ND (0.50 - 2.0)	ND
	05/26/04	ND (50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (1.0)	--	ND (0.49 - 0.97)	ND
10/15/04	ND (50)	ND (0.5)	ND (0.5)	ND (0.5)	ND (1.0)	--	ND (0.48 - 0.96)	ND	
05/26/05	ND (50)	ND (0.5)	ND (0.5)	ND (0.5)	ND (1.0)	--	ND (0.5 - 0.99)	ND	
<i>Analytical Method</i>		<i>3510 / 8015m</i>	<i>5030/ 8020 & 8260B</i>	<i>5030/ 8020 & 8260B</i>	<i>5030/ 8020 & 8260B</i>	<i>5030/ 8020 & 8260B</i>	<i>8270C</i>	<i>8082</i>	<i>74</i>

TPH -d - total petroleum hydrocarbons as diesel

mg/L- milligrams per liter

ND - Not detected equal to or greater than method reporting limit shown in parenthesis.

PAHs - polynuclear aromatic hydrocarbons

µg/L - micrograms per liter

PCBs - polychlorinated biphenols. PCBs tested include PCB 1016, 1221, 1232, 1242, 1248, 1254, and 1260.

(- -) - Samples not analyzed

TABLE 3
 ASPHALT CHIP SAMPLE CHEMISTRY DATA
 BULK CONTAINER STORAGE UNIT CLOSURE
 SAN FRANCISCO REFINERY, RODEO, CALIFORNIA
 Page 1 of 3

EPA Test Method	Screening Standards		Sample Name						
	Residential PRG ⁽¹⁾	Industrial PRG	ASPH -1	ASPH -2	ASPH -3	ASPH -4	ASPH -5	ASPH -6	
Sample Location:			Area C	Area C	Area C	Area C	Area C	Area B (Upper Terrace)	
Field Observations of Sample Site:			---	New Asphalt (Resurfaced in 2004)	Slight staining	---	---	---	
Chemistry Results:									
pH	9045C	-	-	7.4	8.7	7.8	7.6	7.9	8.5
Volatile Organic Compounds (µg/kg)	8260B								
Detections only. All other compounds not detected at reporting limits of 4.4 to 91 µg/kg									
Acetone		1,600,000	6,000,000	<19	220	<19	<20	25 J	<18
Methylene Chloride		9,100	21,000	<19	29	<19	<20	<20	<18
2-Butanone		-	-	<9.4	52	<9.4	<9.8	<10	<9.1
2-Hexanone		-	-	<9.4	9.1	<9.4	<9.8	<10	<9.1
Metals (mg/kg)									
Antimony	6010B	31	410	<2.1	<2.7	<2.5	<2.0	<2.4	<2.9
Arsenic	6010B	22 / 0.39 ⁽²⁾	260 / 1.6	0.33	<0.22	<0.21	0.65	0.30	0.60
Barium	6010B	5,400	67,000	7.6	15	11	6.5	10	18
Beryllium	6010B	150	1,900	0.17	0.44	0.13	0.21	0.34	0.23
Cadmium	6010B	1.7	7.4	<0.18	<0.22	<0.21	<0.17	<0.20	<0.25
Chromium (total)	6010B	210	450	11	12	15	11	8.7	13
Cobalt	6010B	900	1,900	8.9	17	6.5	8.3	15	10
Copper	6010B	3,100	41,000	19	37	13	23	33	30
Lead	6010B	150	750	0.78	1.4	0.41	0.64	0.81	11
Mercury	7471	23	310	0.15	11	0.14	0.24	0.28	0.21
Molybdenum	6010B	390	5,100	<0.71	<0.89	<0.83	<0.68	<0.80	<0.98
Nickel	6010B	1,600	20,000	17	24	15	17	22	17
Selenium	6010B	390	5,100	<0.18	<0.22	<0.21	<0.17	1.4	1.7
Silver	6010B	390	5,100	<0.18	<0.22	<0.21	<0.17	<0.20	<0.25
Thallium	6010B	5.2	67	<0.18	<0.22	<0.21	<0.17	<0.20	<0.25
Vanadium	6010B	550	7,200	49	130	33	42	110	100
Zinc	6010B	23,000	100,000	21	55	8.6	9.5	44 J	45

Notes:

- Sam ples collected between 16-June-04 and 21-June-04 and chem ically tested at Curtis & Tom pkins, Ltd., Berkeley, California
- All sam ples collected from the 0 to 1 inch below ground surface interval
- ASPH -8/8D, ASPH -13/13D, ASPH -18/18D = Chem istry results for prim ary and duplicate sam ples
- 1. EPA Region IX Prelim inary Remedial Goals Table (01-0 ct-02). Soil PRG s, not directly applicable to asphalt, but presented here as a conservative reference criterion
- 2. Noncancer endpoint / cancer endpoint
- J = Result is estim ated
- = Typical BCSU asphalt: circa 1989, good condition, no appazent staining
- = No standard for com pound
- = Concentration exceeds residential PRG

TABLE 3
 ASPHALT CHIP SAMPLE CHEMISTRY DATA
 BULK CONTAINER STORAGE UNIT CLOSURE
 SAN FRANCISCO REFINERY, RODEO, CALIFORNIA
 Page 2 of 3

	EPA Test Method	Screening Standards		Sample Name						
		Residential PRG ⁽¹⁾	Industrial PRG	ASPH -7	ASPH -8 /8D	ASPH -9	ASPH -10	ASPH -11	ASPH -12	ASPH -13 /13D
Sample Location:				Area B (Upper Tenace)	Area B (Upper Tenace)	Area B (Upper Tenace)	Area B (Upper Tenace)	Area B (Lower Tenace)	Area B (Lower Tenace)	Area B (Lower Tenace)
Field Observations of Sample Site:				---	---	---	Slight staining	Slight Staining	---	---
Chemistry Results:										
pH	9045C	-	-	6.8	8.1 /8.5	8.3	8.1	7.1	7.9	7.4 /7.0
Volatile Organic Compounds (µg/Kg)	8260B									
Detections only. All other compounds not detected at reporting limits of 4.4 to 91 µg/Kg)										
Acetone		1,600,000	6,000,000	<19	26 J /19	<19	23	<19	24 J	<20 /<19
Methylene Chloride		9,100	21,000	<19	<20 /<19	<19	<19	<19	<19	<20 /<19
2-Butanone		-	-	<9.3	<10 /<9.4	<9.6	<9.6	<9.6	<9.3	<9.8 /<9.6
2-Hexanone		-	-	<9.3	<10 /<9.4	<9.6	<9.6	<9.6	<9.3	<9.8 /<9.6
Metals (mg/Kg)										
Antimony	6010B	31	410	<2.5	<3.2 /<2.7	<3.0	<2.6	<2.4	<2.4	<3.1 /<2.5
Arsenic	6010B	22 /0.39 ⁽²⁾	260 /1.6	2.7	0.55 J /0.84	0.34	0.50	0.51	1.1	0.32 J /0.82
Barium	6010B	5,400	67,000	64	17 /17	11	23	15	14	29 J /21
Beryllium	6010B	150	1,900	0.18	0.3 /0.27	<0.10	0.13	0.33	0.38	0.45 /0.42
Cadmium	6010B	1.7	7.4	<0.21	<0.26 /<0.23	<0.25	<0.22	<0.20	<0.20	<0.26 /<0.21
Chromium (total)	6010B	210	450	24	12 /11	5.1	6.6	10	9.6	9.9 /10
Cobalt	6010B	900	1,900	6.5	17 /16	1.4	3.3	12	13	18 /15
Copper	6010B	3,100	41,000	14	34 /29	11	20	230	28	44 /41
Lead	6010B	150	750	3.7	1.3 /1.1	2.8	4.7	5.2	1.2	1.2 J /2.3
Mercury	7471	23	310	0.064	0.073 /0.065	0.093	1.3	1.5	0.072	0.28 J /0.10
Molybdenum	6010B	390	5,100	2.6	<1.1 /<0.91	<1.0	3.6	2.2	<0.81	<1.0 /0.84
Nickel	6010B	1,600	20,000	35	26 /23	8.7	10	16	23	26 /32
Selenium	6010B	390	5,100	0.66	0.89 J /0.64	<0.25	0.42	1.4	0.93	0.39 J /24
Silver	6010B	390	5,100	<0.21	<0.26 /<0.23	<0.25	<0.22	<0.20	<0.20	<0.26 /<0.21
Thallium	6010B	5.2	67	<0.21	<0.26 /<0.23	<0.25	<0.22	<0.20	<0.20	<0.26 /<0.21
Vanadium	6010B	550	7,200	32	130 /120	17	22	91	120	130 /110
Zinc	6010B	23,000	100,000	33	51 /49	13	47	60	43 J	56 /51

Notes:

- Samples collected between 16-June-04 and 21-June-04 and chemically tested at Curtis & Tompkins, Ltd., Berkeley, California
- All samples collected from the 0 to 1 inch below ground surface interval
- ASPH -8/8D, ASPH -13/13D, ASPH -18/18D = Chemistry results for primary and duplicate samples
- 1. EPA Region IX Preliminary Remedial Goals Table (01-Oct-02). Soil PRGs, not directly applicable to asphalt, but presented here as a conservative reference criterion
- 2. N on cancer endpoint / cancer endpoint
- J = Result is estimated
- --- = Typical BCSU asphalt: circa 1989, good condition, no apparent staining
- - = No standard for compound
- = Concentration exceeds residential PRG

TABLE 3
 ASPHALT CHIP SAMPLE CHEMISTRY DATA
 BULK CONTAINER STORAGE UNIT CLOSURE
 SAN FRANCISCO REFINERY, RODEO, CALIFORNIA
 Page 3 of 3

	EPA Test Method	Screening Standards		Sample Name					
		Residential PRG ⁽¹⁾	Industrial PRG	ASPH -14	ASPH -15	ASPH -16	ASPH -17	ASPH -18 /18D	ASPH -19
Sample Location:				Area B (Lower Tenace)	Area C	Area B (Lower Tenace)	Area B (Lower Tenace)	Area B (Lower Tenace)	Area B (Lower Tenace)
Field Observations of Sample Site:				—	—	—	Slight staining	New Asphalt (Resurfaced in 2004)	Slight staining
Chemistry Results:									
pH	9045C	-	-	6.0	5.9	7.8	7.0	8.9 / 8.9	8.7
Volatile Organic Compounds (µg/Kg)	8260B								
<small>(Detections only. All other compounds not detected at reporting limits of 4.4 to 91 µg/Kg)</small>									
Acetone		1,600,000	6,000,000	<20	<19	<19	<18	370 / 290	23
Methylene Chloride		9,100	21,000	<20	<19	<19	<18	<19 / <20	<20
2-Butanone		-	-	<9.8	<9.6	<9.4	<8.8	46 J / 63 J	10
2-Hexanone		-	-	<9.8	<9.6	<9.4	<8.8	<9.6 / <10	<9.8
Metals (mg/Kg)									
Antimony	6010B	31	410	<2.7	<2.6	<2.7	<2.9	<2.8 / <2.7	<3.0
Arsenic	6010B	22 / 0.39 ⁽²⁾	260 / 1.6	3.5	1.1	<0.23	1.0	1.4 / 1.3	<0.25
Barium	6010B	5,400	67,000	87	21	34	20	34 / 38	7.9
Beryllium	6010B	150	1,900	0.25	0.24	0.33	0.22	0.40 / 0.39	<0.10
Cadmium	6010B	1.7	7.4	<0.22	<0.22	<0.23	<0.25	<0.23 / <0.23	<0.25
Chromium (total)	6010B	210	450	34	24	11	10	16 / 14	5.6
Cobalt	6010B	900	1,900	7.1	15	13	6.7	19 / 18	1.6
Copper	6010B	3,100	41,000	19	50	56	62	44 / 39	9.5
Lead	6010B	150	750	5.0	2.4	1.6	7.4	1.7 / 1.5	1.1
Mercury	7471	23	310	<0.020	0.19	0.081	0.42	0.97 J / 0.61	<0.016
Molybdenum	6010B	390	5,100	<0.89	<0.88	1.5	21	<0.93 / <0.91	<1.0
Nickel	6010B	1,600	20,000	49	32	28	43	36 / 32	7.7
Selenium	6010B	390	5,100	<0.22	<0.22	0.71	0.96	<0.23 / <0.23	<0.25
Silver	6010B	390	5,100	<0.22	0.83	<0.23	<0.25	<0.23 / <0.23	<0.25
Thallium	6010B	5.2	67	<0.22	<0.22	<0.23	0.26	<0.23 / <0.23	<0.25
Vanadium	6010B	550	7,200	38	82	100	54	120 / 120	17
Zinc	6010B	23,000	100,000	51	28 J	66	67	50 / 47 J	17

Notes:

- Samples collected between 16-June-04 and 21-June-04 and chemically tested at Curtis & Tompkins, Ltd., Berkeley, California
- All samples collected from the 0 to 1 inch below ground surface interval
- ASPH -8/8D, ASPH -13/13D, ASPH -18/18D = Chemistry results for primary and duplicate samples
- 1. EPA Region IX Preliminary Remedial Goals Table (01-Oct-02). Soil PRGs, not directly applicable to asphalt, but presented here as a conservative reference criterion
- 2. Noncancer endpoint / cancer endpoint
- J = Result is estimated
- — = Typical BCSU asphalt: circa 1989, good condition, no apparent staining
- - = No standard for compound
- = Concentration exceeds residential PRG

TABLE 4
BACKGROUND ASPHALT CHIP SAMPLE CHEMISTRY DATA
BULK CONTAINER STORAGE UNIT CLOSURE
SAN FRANCISCO REFINERY, RODEO, CALIFORNIA
Page 1 of 2

	EPA Test Method	Screening Standards		Sample Name				
		Residential PRG ⁽¹⁾	Industrial PRG	ASPCKG -1 /1D	ASPCKG -2	ASPCKG -3	ASPCKG -4	ASPCKG -5
Sample Location:				Top of Curbing North of BCSU	Top of Curbing Area B (Lower Tenace)	Top of Curbing Area B (Lower Tenace)	Top of Curbing Area C	Top of Curbing Area C
Field Observations of Sample Site:				—	—	—	—	—
Chemistry Results:								
pH	9045C	-	-	6.4 /6.7	7.8	7.4	7.1	6.8
Volatile Organic Compounds (µg/kg) (Detections only. All other compounds not detected at reporting limits of 4.5 to 50 µg/kg)	8260B							
Acetone		1,600,000	6,000,000	<19 /<19	<19	19	23	<20
Methylene Chloride		9,100	21,000	28 J /57	25	34	27	29
2-Butanone		-	-	<9.3 /<9.3	<9.6	<9.1	<9.6	<9.8
2-Hexanone		-	-	<9.3 /<9.3	<9.6	<9.1	<9.6	<9.8
Metals (mg/kg)								
Antimony	6010B	31	410	<3.0 /<3.2	<2.5	<2.2	<2.1	<3.1
Arsenic	6010B	22 /0.39 ⁽²⁾	260 /1.6	1.9 /2.0	1.2	1.4	3.0	3.7
Barium	6010B	5,400	67,000	56 J /78	9.2	11	49	58
Beryllium	6010B	150	1,900	<0.099 /0.20	0.18	0.18	0.13	0.18
Cadmium	6010B	1.7	7.4	<0.25 /<0.27	0.76	0.41	<0.18	<0.26
Chromium (total)	6010B	210	450	23 /29	13	9.7	17	24
Cobalt	6010B	900	1,900	5.0 J /7.4	16	14	5.0	6.3
Copper	6010B	3,100	41,000	14 J /31	27	31	11	13
Lead	6010B	150	750	2.4 J /4.9	1.2	2.3	3.2	4.1
Mercury	7471	23	310	0.023 /<0.017	0.036	<0.018	0.019	0.054
Molybdenum	6010B	390	5,100	<0.99 /<1.1	<0.84	<0.73	<0.71	<1.0
Nickel	6010B	1,600	20,000	41 J /60	27	23	30	39
Selenium	6010B	390	5,100	0.71 J /0.40	0.64	1.7	0.48	0.68
Silver	6010B	390	5,100	<0.25 /<0.27	<0.21	<0.18	<0.18	<0.26
Thallium	6010B	5.2	67	<0.25 /<0.27	<0.21	<0.18	<0.18	<0.26
Vanadium	6010B	550	7,200	32 J /42	110	97	17	23
Zinc	6010B	23,000	100,000	21 J /33	51	150	27	39

Notes:

Samples collected 15-June-04 and chemically tested at Curtis & Tompkins, Ltd., Berkeley, California

ASPCKG -1 /1D = Chemistry results for primary and duplicate samples

1. EPA Region IX Preliminary Remedial Goals Table (01-0 ct-02). Soil PRGs, not directly applicable to asphalt, but presented here as a conservative reference criterion

2. Noncancer endpoint /cancer endpoint

J = Result is estimated

— = Typical BCSU asphalt: circa 1989, good condition, no apparent staining

- = No standard for compound

= Concentration exceeds residential PRG

TABLE 4
 BACKGROUND ASPHALT CHIP SAMPLE CHEMISTRY DATA
 BULK CONTAINER STORAGE UNIT CLOSURE
 SAN FRANCISCO REFINERY, RODEO, CALIFORNIA
 Page 2 of 2

EPA Test Method	Screening Standards		Sample Name							
	Residential PRG ⁽¹⁾	Industrial PRG	ASPCKG -6	ASPCKG -7	ASPCKG -8	ASPCKG -9	ASPCKG -10	ASPCKG -11	ASPCKG -12	
Sample Location:			Road Surface Near Tank 107 Beam	Top of Curbing West of Area B (Lower Tenace)	Top of Curbing West of Area B (Lower Tenace)	Top of Curbing West of Area B (Lower Tenace)	Top of Curbing Area B (Lower Tenace)	Surface Pavement West of Area B (Lower Tenace)	Surface Pavement West of Area B (Lower Tenace)	Surface Pavement West of Area B (Lower Tenace)
Field Observations of Sample Site:			---	---	---	---	---	---	---	---
Chemistry Results:										
pH	9045C	-	-	7.0	6.7	6.5	6.6	7.4	7.0	7.6
Volatile Organic Compounds (µg/kg) (Detections only. All other compounds not detected at reporting limits of 4.5 to 50 µg/kg)	8260B									
Acetone		1,600,000	6,000,000	<19	39	31	<19	64	51	48
Methylene Chloride		9,100	21,000	24	28	27	35	28	33	26
2-Butanone		-	-	<9.3	12	<10	<9.3	15	14	11
2-Hexanone		-	-	<9.3	<10	<10	<9.3	<9.3	<9.6	<8.9
Metals (mg/kg)										
Antimony	6010B	31	410	<2.8	<2.5	<2.3	<3.0	<2.8	<2.7	<2.9
Arsenic	6010B	22 / 0.39 ⁽²⁾	260 / 1.6	0.35	0.84	0.75	2.0	1.1	0.75	2.2
Barium	6010B	5,400	67,000	18	6.4	7.3	48	13	14	14
Beryllium	6010B	150	1,900	0.20	0.20	0.20	0.11	0.19	0.18	0.19
Cadmium	6010B	1.7	7.4	0.46	0.31	0.37	<0.25	0.27	0.36	0.24
Chromium (total)	6010B	210	450	10	7.9	8.7	21	8.9	10	10
Cobalt	6010B	900	1,900	18	13	13	4.2	12	14	15
Copper	6010B	3,100	41,000	38	25	27	12	26	25	25
Lead	6010B	150	750	3.0	0.77	0.79	3.2	0.76	0.91	1.0
Mercury	7471	23	310	0.097	0.041	0.13	0.049	0.058	0.092	0.093
Molybdenum	6010B	390	5,100	<0.92	<0.83	<0.76	<0.99	<0.93	<0.88	<0.96
Nickel	6010B	1,600	20,000	23	17	18	37	21	21	23
Selenium	6010B	390	5,100	0.77	0.58	0.60	0.41	0.76	0.65	0.84
Silver	6010B	390	5,100	<0.23	<0.21	<0.19	<0.25	<0.23	<0.22	<0.24
Thallium	6010B	5.2	67	<0.23	<0.21	<0.19	<0.25	<0.23	<0.22	<0.24
Vanadium	6010B	550	7,200	110	86	94	22	81	95	89
Zinc	6010B	23,000	100,000	51	36	42	18	33	44	39

Notes:
 Samples collected 15-June-04 and chemically tested at Curtis & Tompkins, Ltd., Berkeley, California
 ASPCKG-1 / 1D = Chemistry results for primary and duplicate samples
 1. EPA Region IX Preliminary Remedial Goals Table (01-Oct-02). Soil PRGs, not directly applicable to asphalt, but presented here as a conservative reference criterion
 2. Noncancer endpoint / cancer endpoint
 J = Result is estimated
 --- = Typical BCSU asphalt: circa 1989, good condition, no apparent staining
 - = No standard for compound
 = Concentration exceeds residential PRG

TABLE 5
 CONCRETE CHIP SAMPLE CHEMISTRY DATA
 BULK CONTAINER STORAGE UNIT CLOSURE
 SAN FRANCISCO REFINERY, RODEO, CALIFORNIA
 Page 1 of 4

EPA Test Method	Screening Standards		Concrete 1	Concrete 2	Concrete 3		Concrete 4		
	Residential PRG ⁽¹⁾	Industrial PRG	CON-1	CON-2 / 2D	CON-3	CON-3 2.5-4.5	CON-4	CON-4 1.0-2.5	
Sample Location:			Area B (Upper Tenace) upper 1.0" of pad	Area B (Upper Tenace) upper 1.0" of pad	Area B (Upper Tenace) upper 1.0" of trench	Area B (Upper Tenace) 2.5-4.5" below surface of trench	Area C (Loading Dock) upper 1.0" of pad	Area C (Loading Dock) 1.0-2.5" below surface of pad	
Field Observations of Sample Site:			—	—	—	—	—	—	
Chemistry Results:									
Total Petroleum Hydrocarbons (mg/Kg)	8015B								
Diesel C10-C24		500 ⁽²⁾	500	28 HY	2.0 JHY / 92 HYZ	48 HYZ	4.2 HY	220 HY	<1.0
Motor Oil C24-C36		500 ⁽²⁾	1,000	55	6.6 J / 180	43	7.6	550 Z	<5.0
Volatile Organic Compounds (µg/Kg)	8260B								
Detections only. All other compounds not detected at reporting limits of 4.3 to 50 µg/Kg)									
Acetone		1,600,000	6,000,000	<20 UJ	<19 UJ / <19 UJ	21 J	<19 UJ	<18 UJ	<20 UJ
para-Isopropyl Toluene		-	-	<4.9 UJ	<4.8 UJ / <4.8 UJ	16 J	<4.6 UJ	<4.5 UJ	<5.0 UJ
Semi-Volatile Organic Compounds (µg/Kg)	8270C								
(Includes 7 carcinogenic and 9 toxic PAHs. All other compounds not detected at reporting limits of 66 to 1,700 µg/Kg)									
Benzo (a) anthracene		620	2,100	<67	<67 / <66	<66	<66	<67	<66
Chrysene		62,000	210,000	<67	98 J / 170	<66	<66	<67	<66
Benzo (b) fluoranthene		620	2,100	150	160 / 170	140	<66	140	<66
Benzo (k) fluoranthene		6,200	21,000	140	140 / 140	140	<66	140	<66
Benzo (a) pyrene		62	210	<67	<67 / <66	<66	<66	<67	<66
Indeno (1,2,3-cd) pyrene		620	2,100	<67	<67 / <66	<66	<66	<67	<66
Dibenz (a,h) anthracene		62	210	<67	<67 / <66	<66	<66	<67	<66
Naphthalene		56,000	190,000	<67	<67 / <66	<66	<66	<67	<66
Acenaphthylene		0.00	0.00	<67	<67 / <66	<66	<66	<67	<66
Acenaphthene		3,700,000	29,000,000	<67	<67 / <66	<66	<66	<67	<66
Fluorene		2,700,000	26,000,000	<67	<67 / <66	<66	<66	<67	<66
Phenanthrene		-	-	<67	<67 / 75	<66	<66	<67	<66
Anthracene		22,000,000	100,000,000	<67	<67 / <66	<66	<66	<67	<66
Fluoranthene		2,300,000	22,000,000	<67	<67 / <66	<66	<66	<67	<66
Pyrene		2,300,000	29,000,000	<67	<67 / 86	<66	<66	<67	<66
Benzo (g,h,i) perylene		-	-	<67	<67 / <66	<66	<66	<67	<66
Polychlorinated Biphenyls (µg/Kg)	8082								
Detections only. All other compounds not detected at reporting limits of 9.5 to 19 µg/Kg)									
Aroclor-1260		220	740	—	—	—	—	—	—

TABLE 5
 CONCRETE CHIP SAMPLE CHEMISTRY DATA
 BULK CONTAINER STORAGE UNIT CLOSURE
 SAN FRANCISCO REFINERY, RODEO, CALIFORNIA
 Page 2 of 4

EPA Test Method	Screening Standards		Concrete 1	Concrete 2	Concrete 3		Concrete 4		
	Residential PRG ⁽¹⁾	Industrial PRG	CON-1	CON-2 /2D	CON-3	CON-3 2.5-4.5	CON-4	CON-4 1.0-2.5	
Sample Location:			Area B (Upper Tenace) upper 1.0" of pad	Area B (Upper Tenace) upper 1.0" of pad	Area B (Upper Tenace) upper 1.0" of trench	Area B (Upper Tenace) 2.5-4.5" below surface of trench	Area C (Loading Dock) upper 1.0" of pad	Area C (Loading Dock) 1.0-2.5" below surface of pad	
Field Observations of Sample Site:			---	---	---	---	---	---	
Chemistry Results:									
Metals (mg/kg)									
Antimony	6010B	31	410	<3.3	<2.9 /<3.1	<2.5	<3.2	<3.1	<2.4
Arsenic	6010B	22 /0.39 ^(b)	260 /1.6	3.9	3.9 /4.4	4.4	4.1	3.4	3.5
Barium	6010B	5,400	67,000	240	190 /240	250	250	360	380
Beryllium	6010B	150	1,900	0.29	0.29 /0.35	0.23	0.23	0.43	0.36
Cadmium	6010B	1.7	7.4	0.33	0.29 /0.36	0.29	<0.27	0.44	0.41
Chromium (total)	6010B	210	450	49	47 /57	61	58	39	33
Cobalt	6010B	900	1,900	11	12 J /16	12	7.8	7.8	6.2
Copper	6010B	3,100	41,000	37	32 J /47	48	42	18	16
Lead	6010B	150	750	5.0	4.2 /5.3	8.0	5.4	3.6	3.5
Mercury	7471	23	310	0.057	0.035 J /0.025	0.19	0.78	0.021	<0.20
Molybdenum	6010B	390	5,100	4.7	3.3 J /4.7	6.3	3.7	1.9	1.6
Nickel	6010B	1,600	20,000	49	47 /59	69	58	57	48
Selenium	6010B	390	5,100	0.39	0.44 /<0.26	0.73	1.2	<0.26	0.6
Silver	6010B	390	5,100	0.59	0.52 /<0.26	0.88	0.67	<0.26	<0.20
Thallium	6010B	5.2	67	<0.27	<0.25 /<0.26	<0.21	<0.27	<0.26	1.0
Vanadium	6010B	550	7,200	64	65 /81	230	68	98	65
Zinc	6010B	23,000	100,000	40	36 J /60	110	43	39 J	35 J

Notes:

- Sam ples collected between 16-June-04 and 21-June-04 and chem ically tested at Curtis & Tom pkins, Ltd., Berkeley, California
- Sam ples collected from the 0-1" interval, w ith the exception of the 4 sam ples w ith alternate depths indicated in their sam ple nam e
- CON -2/2D , CON 6-6D , CON 9-9D = Chem istry results for prim ary and duplicate sam ple
- 1. EPA Region IX Prelim inary Remedial Goals Table (01-0 ct-02) . Soil PRG s, not directly applicable to concrete, but presented here as a conservative reference criterion
- 2. California Regional Water Quality Control Board - Environmental Screening Levels for Shallow Soils w here groundw ater is not a current or potential source of drinking w ater. Since there is not a PRG for TPH concentrations, an ESL for soil, although not directly applicable to concrete, is presented as a conservative reference criterion.
- 3. N oncancer endpoint / cancer endpoint
- H = Heavier hydrocarbon contributed to the quantitation
- J = Result is estim ated
- L = Lighter hydrocarbon contributed to the quantitation
- UJ - The result is not detected; how ever, the reporting lim it value is qualified as estim ated
- Y = Exhibits chrom atographic pattern w hich does not resem ble standard
- Z = Exhibits unknown single peak or peaks
- = Nom al BCSU concrete: circa 1989, good condition, no staining
- = Not analyzed. Not applicable
- = No standard for com pound
- " = inches
- = Concentration exceeds screening criteria

TABLE 5
 CONCRETE CHIP SAMPLE CHEMISTRY DATA
 BULK CONTAINER STORAGE UNIT CLOSURE
 SAN FRANCISCO REFINERY, RODEO, CALIFORNIA
 Page 3 of 4

EPA Test Method	Screening Standards		Concrete 5	Concrete 6		Concrete 7	Concrete 8		Concrete 9	Concrete 10	
	Residential PRG ⁽¹⁾	Industrial PRG	CON-5	CON-6 /6D	CON-6 1.5-2.0	CON-7	CON-8	CON-8 1.0-2.5	CON-9 /9D	CON-10	
Sample Location:			Area C (Loading Dock) upper 1.0" of pad	Area B (Lower Tenace) upper 1.0" of pad	Area B (Lower Tenace) 1.5-2.0" below surface of pad	Area B (Lower Tenace) upper 1.0" of pad	Area B (Lower Tenace) upper 1.0" of trench	Area B (Lower Tenace) 1.0-2.5" below surface of trench	Area B (Lower Tenace) upper 1.0" of pad	Area B (Lower Tenace) upper 1.0" of pad	
Field Observations of Sample Site:			—	—	—	—	—	—	—	—	
Chemistry Results:											
Total Petroleum Hydrocarbons (mg/kg)	8015B										
Diesel C10-C24		500 ⁽²⁾	500	2.4 HY	1.0 Y /<1.0	<1.0	16 HYZ	71 HY	<1.0	<1.0 /<1.0	<0.99
Motor Oil C24-C36		500 ⁽²⁾	1,000	7.7 Z	<5.0 /<5.0	<5.0	14	49 L	<5.0	<5.0 /<5.0	<5.0
Volatile Organic Compounds (µg/kg)	8260B										
(Only detections only. All other compounds not detected at reporting limits of 4.3 to 50 µg/kg)											
Acetone		1,600,000	6,000,000	<20 UJ	<20 UJ /<20 UJ	<19 UJ	<17 UJ	65 J	69 J	<18 UJ /<19 UJ	<19 UJ
para-Isopropyl Toluene		-	-	<4.7 UJ	<5.0 UJ /<4.9 UJ	<4.6 UJ	<4.3 UJ	<4.4 UJ	<4.7 UJ	<4.5 UJ /<4.7 UJ	<4.6 UJ
Semi-Volatile Organic Compounds (µg/kg)	8270C										
(Includes 7 carcinogenic and 9 toxic PAHs. All other compounds not detected at reporting limits of 66 to 1,700 µg/kg)											
Benzo (a)anthracene		620	2,100	<66	<67 /<67	<67	<67	<66	<66	<66 /<67	<67
Chrysene		62,000	210,000	<66	<67 /<67	<67	<67	<66	<66	<66 /<67	<67
Benzo (b) fluoranthene		620	2,100	<66	<67 /<67	<67	<67	140	<66	<66 /<67	<67
Benzo (k) fluoranthene		6,200	21,000	<66	<67 /<67	<67	<67	140	<66	<66 /<67	<67
Benzo (a) pyrene		62	210	<66	<67 /<67	<67	<67	<66	<66	<66 /<67	<67
Indeno (1,2,3-cd) pyrene		620	2,100	<66	<67 /<67	<67	<67	<66	<66	<66 /<67	<67
Dibenz (a,h) anthracene		62	210	<66	<67 /<67	<67	<67	<66	<66	<66 /<67	<67
Naphthalene		56,000	190,000	<66	<67 /<67	<67	<67	<66	<66	<66 /<67	<67
Acenaphthylene		0.00	0.00	<66	<67 /<67	<67	<67	<66	<66	<66 /<67	<67
Acenaphthene		3,700,000	29,000,000	<66	<67 /<67	<67	<67	<66	<66	<66 /<67	<67
Fluorene		2,700,000	26,000,000	<66	<67 /<67	<67	<67	<66	<66	<66 /<67	<67
Phenanthrene		-	-	<66	<67 /<67	<67	<67	<66	<66	<66 /<67	<67
Anthracene		22,000,000	100,000,000	<66	<67 /<67	<67	<67	<66	<66	<66 /<67	<67
Fluoranthene		2,300,000	22,000,000	<66	<67 /<67	<67	<67	<66	<66	<66 /<67	<67
Pyrene		2,300,000	29,000,000	<66	<67 /<67	<67	<67	<66	<66	<66 /<67	<67
Benzo (g,h,i) perylene		-	-	<66	<67 /<67	<67	<67	<66	<66	<66 /<67	<67
Polychlorinated Biphenyls (µg/kg)	8082										
(Only detections only. All other compounds not detected at reporting limits of 9.5 to 19 µg/kg)											
Aroclor-1260		220	740	—	48 J /<9.6 UJ	<9.5 UJ	—	—	—	—	

TABLE 5
 CONCRETE CHIP SAMPLE CHEMISTRY DATA
 BULK CONTAINER STORAGE UNIT CLOSURE
 SAN FRANCISCO REFINERY, RODEO, CALIFORNIA
 Page 4 of 4

EPA Test Method	Screening Standards		Concrete 5	Concrete 6		Concrete 7	Concrete 8		Concrete 9	Concrete 10	
	Residential PRG ⁽¹⁾	Industrial PRG	CON-5	CON-6 /6D	CON-6 1.5-2.0	CON-7	CON-8	CON-8 1.0-2.5	CON-9 /9D	CON-10	
Sample Location:			Area C (Loading Dock) upper 1.0" of pad	Area B (Lower Tenace) upper 1.0" of pad	Area B (Lower Tenace) 1.5-2.0" below surface of pad	Area B (Lower Tenace) upper 1.0" of pad	Area B (Lower Tenace) upper 1.0" of trench	Area B (Lower Tenace) 1.0-2.5" below surface of trench	Area B (Lower Tenace) upper 1.0" of pad	Area B (Lower Tenace) upper 1.0" of pad	
Field Observations of Sample Site:			—	—	—	—	—	—	—	—	
Chemistry Results:											
Metals (mg/kg)											
Antimony	6010B	31	410	<3.1	<2.9 /<2.7	<3.2	<2.5	<2.5	<3.0	<3.1 /<3.2	<3.0
Arsenic	6010B	22 /0.39 ⁽³⁾	260 /1.6	3.9	4.9 /3.9	4.6	7.6	6.0	7.2	7.7 /7.8	7.0
Barium	6010B	5,400	67,000	320	88 /96	94	130	120	140	140 /130	120
Beryllium	6010B	150	1,900	0.50	0.23 /0.19	0.26	0.26	0.26	0.37	0.24 /0.27	0.24
Cadmium	6010B	1.7	7.4	0.42	0.46 /0.41	<0.27	0.30	0.76	0.35	0.32 /0.32	0.28
Chromium (total)	6010B	210	450	40	27 /23	29	30	27	30	36 /38	25
Cobalt	6010B	900	1,900	8.1	6.4 /6.1	7.2	6.1	6.3	6.0	6.5 /6.8	6.8
Copper	6010B	3,100	41,000	28	17 /16	18	12	140	18	17 /15	14
Lead	6010B	150	750	4.1	3.4 /3.3	3.7	6.5	7.8	9.0	8.0 /8.7	6.5
Mercury	7471	23	310	<0.018	<0.019 /0.034	<0.018	<0.020	0.084	<0.020	0.022 /0.021	0.023
Molybdenum	6010B	390	5,100	1.8	<0.95 /<0.91	<1.1	<0.84	1.1	<0.99	<1.0 /<1.1	<0.99
Nickel	6010B	1,600	20,000	60	29 /29	31	30	120	37	38 /46	33
Selenium	6010B	390	5,100	<0.26	0.71 /0.79	<0.27	0.91	1.1	0.41	0.79 /0.68	0.87
Silver	6010B	390	5,100	<0.26	<0.24 /<0.23	<0.27	<0.21	<0.21	<0.25	<0.26 /<0.27	<0.25
Thallium	6010B	5.2	67	<0.26	<0.24 /<0.23	<0.27	<0.21	<0.21	<0.25	<0.26 /<0.27	<0.25
Vanadium	6010B	550	7,200	150	28 /25	29	31	92	35	31 /31	30
Zinc	6010B	23,000	100,000	42 J	71 /65	73	41 J	250	55	42 J /42 J	39 J

Notes:

Samples collected between 16-June-04 and 21-June-04 and chemically tested at Curtis & Tompkins, Ltd., Berkeley, California
 Samples collected from the 0-1" interval, with the exception of the 4 samples with alternate depths indicated in their sample name

CON-2/2D, CON-6-6D, CON-9-9D = Chemistry results for primary and duplicate sample

1. EPA Region IX Preliminary Remedial Goals Table (01-Oct-02). Soil PRGs, not directly applicable to concrete, but presented here as a conservative reference criterion

2. California Regional Water Quality Control Board - Environmental Screening Levels for Shallow Soils where groundwater is not a current or potential source of drinking water. Since there is not a PRG for TPH concentrations, an ESL for soil, although not directly applicable to concrete, is presented as a conservative reference criterion.

3. Noncancer endpoint / cancer endpoint

H = Heavier hydrocarbon contributed to the quantitation

J = Result is estimated

L = Lighter hydrocarbon contributed to the quantitation

UJ - The result is not detected; however, the reporting limit value is qualified as estimated

Y = Exhibits chromatographic pattern which does not resemble standard

Z = Exhibits unknown single peak or peaks

— = Normal BCSU concrete: circa 1989, good condition, no staining

— = Not analyzed. Not applicable

- = No standard for compound

" = inches

■ = Concentration exceeds screening criteria

TABLE 6
BACKGROUND CONCRETE CHIP SAMPLE CHEMISTRY DATA
BULK CONTAINER STORAGE UNIT CLOSURE
SAN FRANCISCO REFINERY, RODEO, CALIFORNIA
Page 1 of 2

	EPA Test Method	Screening Standards		Sample Name				
		Residential PRG ⁽¹⁾	Industrial PRG	CONBCKG -1	CONBCKG -2	CONBCKG -3	CONBCKG -4	CONBCKG -5
Sample Location:				1999 BCSU closure background site Area A Raised Curb (Lower Terrace)	1999 BCSU closure background site Area A Raised Curb (Lower Terrace)	1999 BCSU closure background site Area A Raised Curb (Lower Terrace)	1999 BCSU closure background site Area A Raised Curb (Upper Terrace)	1999 BCSU closure background site Area A Raised Curb (Upper Terrace)
Field Observations of Sample Site:				---	---	---	---	---
Chemistry Results:								
Total Petroleum Hydrocarbons (mg/kg)	8015B							
Diesel C10-C24		500 ⁽²⁾	500	---	---	---	---	---
Motor Oil C24-C36		500 ⁽²⁾	1,000	---	---	---	---	---
Volatile Organic Compounds (ug/kg)	8260B							
(All compounds not detected at reporting limits of 4.4 to 47 ug/kg)								
All Compounds		-	-	---	---	---	---	---
Semi-Volatile Organic Compounds (ug/kg)	8270C							
(All other compounds not detected at reporting limits of 66 to 1,700 ug/kg)								
Toxic and Carcinogenic PAHs		62-22,000,000	210-100,000,000	---	---	---	---	---
Metals (mg/kg)								
Antimony	6010B	31	410	<2.9	<2.9	<3.0	<3.0	<2.9
Arsenic	6010B	22 / 0.39 ⁽³⁾	260 / 1.6	6.1	3.9	3.4	4.5	4.0
Barium	6010B	5,400	67,000	110	100	91	91	75
Beryllium	6010B	150	1,900	0.33	0.18	0.17	0.17	0.14
Cadmium	6010B	1.7	7.4	0.74	0.42	0.45	0.36	0.38
Chromium (total)	6010B	210	450	31	23	21	19	22
Cobalt	6010B	900	1,900	6.4	7.5	8.6	6.7	5.0
Copper	6010B	3,100	41,000	23	20	21	9.5	13
Lead	6010B	150	750	4.1	7.9	9.5	9.3	6.1
Mercury	7471	23	310	<0.040	0.091	0.046	<0.040	<0.040
Molybdenum	6010B	390	5,100	<0.97	0.98	<1.0	<1.0	<0.98
Nickel	6010B	1,600	20,000	36	27	28	24	23
Selenium	6010B	390	5,100	<0.24	<0.25	<0.25	<0.25	<0.25
Silver	6010B	390	5,100	<0.49	<0.49	<0.50	<0.50	<0.49
Thallium	6010B	5.2	67	0.64	<0.25	<0.25	<0.25	<0.25
Vanadium	6010B	550	7,200	32	29	27	20	30
Zinc	6010B	23,000	100,000	75	94	59	32	56

Notes:

Samples collected between 16-June-04 and 21-June-04 and chemically tested at Curtis & Tompkins, Ltd., Berkeley, California

1. EPA Region IX Preliminary Remedial Goals Table (01-Oct-02). Soil PRGs, not directly applicable to concrete, but presented here as a conservative reference criterion.

2. California Regional Water Quality Control Board - Environmental Screening Levels for Shallow Soils where groundwater is not a current or potential source of drinking water. Since there is not a PRG for TPH concentrations, an ESL for soil, although not directly applicable to concrete, is presented as a conservative reference criterion.

3. Noncancer endpoint / cancer endpoint

H = Heavier hydrocarbon contributed to the quantitation

J = Result is estimated

UJ = The result is not detected; however, the reporting limit value is qualified as estimated

Y = Exhibits chromatographic pattern which does not resemble standard

ND = Not Detected

--- = Nonal BCSU concrete: circa 1989, good condition, no staining

--- = Not Analyzed, Not Applicable

--- = No standard for compound

 = Concentration exceeds residential PRG

TABLE 6
 BACKGROUND CONCRETE CHIP SAMPLE CHEMISTRY DATA
 BULK CONTAINER STORAGE UNIT CLOSURE
 SAN FRANCISCO REFINERY, RODEO, CALIFORNIA
 Page 2 of 2

EPA Test Method	Screening Standards		Sample Name					
	Residential PRG ⁽¹⁾	Industrial PRG	CONBCKG -6	CONBCKG -7	CONBCKG -8	CONBCKG -9	CONBCKG -10	
Sample Location:			Area B Raised Curb (Lower Tenace)	Area B Raised Curb (Upper Tenace)	Area B Raised Curb (Lower Tenace)	Area B Raised Curb (Upper Tenace)	Area B Raised Curb (Upper Tenace)	
Field Observations of Sample Site:			---	---	---	---	---	
Chemistry Results:								
Total Petroleum Hydrocarbons (m g/K g)	8015B							
Diesel C10-C24		500 ⁽²⁾	500	<1.0	---	2.2 H Y	---	
Motor Oil C24-C36		500 ⁽²⁾	1,000	<5.0	---	<5.0	---	
Volatile Organic Compounds (µg/K g)	8260B							
(All compounds not detected at reporting limits of 4.4 to 47 µg/K g)								
All Compounds		-	-	ND UJ	---	ND UJ	---	
Semi-Volatile Organic Compounds (µg/K g)	8270C							
(All other compounds not detected at reporting limits of 66 to 1,700 µg/K g)								
Toxic and Carcinogenic PAHs		62-22,000,000	210-100,000,000	<66	---	<67	---	
Metals (m g/K g)								
Antimony	6010B	31	410	<2.7	<3.1	<3.1	<2.9	<2.7
Arsenic	6010B	22 / 0.39 ⁽³⁾	260 / 1.6	6.1	2.8	7.1	5.8	4.5
Barium	6010B	5,400	67,000	190	150	130	180	290
Beryllium	6010B	150	1,900	0.26	0.22	0.26	0.25	0.27
Cadmium	6010B	1.7	7.4	0.54	<0.26	0.49	<0.24	0.62
Chromium (total)	6010B	210	450	33	34	28	57	64
Cobalt	6010B	900	1,900	7.4	8.7	6.0	8.0	9.2
Copper	6010B	3,100	41,000	18	24	20	55	58
Lead	6010B	150	750	6.6	3.5	6.9	8.5	5.7
Mercury	7471	23	310	0.023	0.027	0.027	0.053	0.073
Molybdenum	6010B	390	5,100	0.93	2.0	<1.0	4.7	5.0
Nickel	6010B	1,600	20,000	41	37	33	49	60
Selenium	6010B	390	5,100	1.0	0.57	0.93	0.37	<0.23
Silver	6010B	390	5,100	<0.22	<0.26	<0.26	<0.24	0.64
Thallium	6010B	5.2	67	<0.22	<0.26	<0.26	<0.24	<0.23
Vanadium	6010B	550	7,200	46	37	32	48	85
Zinc	6010B	23,000	100,000	51	25	42 J	32	49

Notes:

- Samples collected between 16-June-04 and 21-June-04 and chemically tested at Curtis & Tompkins, Ltd., Berkeley, California
- 1. EPA Region IX Preliminary Remedial Goals Table (01-Oct-02). Soil PRGs, not directly applicable to concrete, but presented here as a conservative reference criterion
- 2. California Regional Water Quality Control Board - Environmental Screening Levels for Shallow Soils where groundwater is not a current or potential source of drinking water. Since there is not a PRG for TPH concentrations, an ESL for soil, although not directly applicable to concrete, is presented as a conservative reference criterion.
- 3. Noncancer endpoint / cancer endpoint
- H = Heavier hydrocarbon contributed to the quantitation
- J = Result is estimated
- UJ = The result is not detected; however, the reporting limit value is qualified as estimated
- Y = Exhibits chromatographic pattern which does not resemble standard
- ND = Not Detected
- = Nominal BCSU concrete: circa 1989, good condition, no staining
- = Not Analyzed, Not Applicable
- = No standard for compound
- = Concentration exceeds residential PRG

TABLE 7
W IPE SAM PLE CHEM ISTRY DATA
BULK CONTAINER STORAGE UNIT CLOSURE
SAN FRANCISCO REFINERY, RODEO, CALIFORNIA
Page 1 of 2

Sam ple Nam e	EPA TestM ethod	W P-1	W P-2	W P-3	W P-4	W P-5	W P-6	W P-7	W P-8	W P-9	W P-10	W P-11	W P-12
Sam ple Location:		Tank A	Tank A	Tank B	Tank B	Tank C	Tank C	Piping to Tank A	Piping to Tank A	Piping to Tank B	Piping to Tank B	Piping to Tank C	Piping to Tank C
Field Observations of Sam ple Site:		HDPE	HDPE	HDPE	HDPE	HDPE	HDPE	Painted Steel Pipe Slight Rusting					
Chem istry Results:													
Total Petroleum Hydrocarbons (µg/100cm ²)	8015B												
Diesel C10-C24		<2,500	<2,500	<2,500	<2,500	<2,500	<2,500	<2,500	<2,500	<2,500	<2,500	<2,500	<2,500
Motor Oil C24-C36		<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500
Semi-Volatile Organic Compounds (µg/100cm ²)	8270C												
(All other compounds not detected at reporting limits of 50 to 500 µg/100cm ²)													
Toxic and Carcinogenic PAHs		<50	<50	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
Polychlorinated Biphenyls (µg/100cm ²)	8082												
(Reporting limits from 2.5 to 5 µg/100cm ²)													
All Compounds		--	--	--	--	--	--	--	--	--	--	--	--
M etals (µg/100cm ²)													
Antimony	6010B	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
Arsenic	6010B	<1.0 UJ	<0.85 UJ	<0.26 UJ	<0.26 UJ	<0.41 UJ	<0.89 UJ	<0.33 UJ	<0.37 UJ	<0.34 UJ	<0.33 UJ	<0.29 UJ	<0.28 UJ
Barium	6010B	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.59	0.82	<0.50	<0.50	<0.50
Beryllium	6010B	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Cadmium	6010B	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25
Chromium (total)	6010B	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Cobalt	6010B	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Copper	6010B	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	1.2	<0.50	0.74
Lead	6010B	1.7	0.22	0.31	<0.15	0.18	0.18	0.43	0.51	1.3	0.72	1.6	0.20
Mercury	7470	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Molybdenum	6010B	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Nickel	6010B	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Selenium	6010B	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25
Silver	6010B	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25
Thallium	6010B	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25
Vanadium	6010B	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.60	0.71	<0.50	<0.50	<0.50
Zinc	6010B	65 J	<16 UJ	<8.3 UJ	<6.7 UJ	<8.0 UJ	69 J	<8.9 UJ	<9.3 UJ	<8.4 UJ	<10 UJ	<12 UJ	<7.9 UJ

Notes:

Sam ples collected between 21-June-04 and 25-June-04 and chem ically tested at Curtis & Tom pkins, Ltd., Berkeley, California
W P-16/16D and W P-17/17D = Chem istry results for prim ary and duplicate sam ple
PAH = Polycyclic Arom atic Hydrocarbons
HDPE = High Density Polyethylene
J = Result is estim ated
UJ - The result is not detected; how ever, the reporting lim it value is qualified as estim ated
Y = Exhibits chrom atographic pattern w hich does not resem ble standard
-- = Not analyzed, not applicable
ND = Not detected

TABLE 7
 W IPE SAM PLE CHEM ISTRY DATA
 BULK CONTAINER STORAGE UNIT CLOSURE
 SAN FRANCISCO REFINERY, RODEO, CALIFORNIA
 Page 2 of 2

Sam ple Nam e	EPA TestM ethod	W P-13	W P-14	W P-15	W P-16 /16D	W P-17 /17D	W P-18	W P-19
Sam ple Location :		Stairway Structure	Stairway Structure	SewerDrop InletGrate Area C	Grate LowerTenace Collection Trench	Grate UpperTenace Collection Trench	SewerDrop Inlet Grate Area InletGrate Area B LowerTenace	SewerDrop InletGrate Area B LowerTenace
Field Observations of Sam ple Site:		Galvanized Steel Clean	Galvanized Steel	Steel Corroded, Stained	Steel Corroded, Rusty	Steel Stained	Steel Slight Staining	Steel Rusty
Chem istry Results:								
Total Petroleum Hydrocarbons (µg/100cm ²)	8015B							
DiethylC10-C24		<2,500	<2,500	<2,500	<2,500	<2,500	<2,500	<2,500
MonoaromaticC24-C36		<500	<500	<500	<500	<500	840Y	<500
Semi-Volatile Organic Compounds (µg/100cm ²)	8270C							
(All other compounds not detected at reporting limits of 50 to 500 µg/100cm ²)								
Toxic and Carcinogenic PAHs		<50	<100	<100	<50	<100	<50	<50
Polychlorinated Biphenyls (µg/100cm ²)	8082							
All Compounds		--	--	--	ND	--	--	--
(Reporting limits from 2.5 to 5 µg/100cm ²)								
Metals (µg/100cm ²)								
Antimony	6010B	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
Arsenic	6010B	0.48	<0.33 UJ	<0.85 UJ	<0.81 UJ / <0.25	<0.39 UJ / <0.65 UJ	<0.25	<0.25
Barium	6010B	0.52	<5.0	<0.50	<0.50	5.6 J / 14	0.55	0.67
Beryllium	6010B	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Cadmium	6010B	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25
Chromium (total)	6010B	<0.50	<0.50	<0.50	<0.50	0.86 J / 2.2	<0.50	0.60
Cobalt	6010B	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Copper	6010B	<0.50	<0.50	<0.50	<0.50	2.1 J / 4.7	1.0	2.2
Lead	6010B	5.1	0.52	0.22	0.18 J / 0.27	1.2 J / 3.1	0.39	1.1
Mercury	7470	<0.010	<0.010	<0.010	<0.010	0.022 / <0.010	<0.010	0.073
Molybdenum	6010B	<1.0	<1.0	<1.0	<1.0	<1.0 / 1.0	<1.0	<1.0
Nickel	6010B	<1.0	<1.0	<1.0	<1.0	2.6 J / 5.9	<1.0	<1.0
Selenium	6010B	<0.25	<0.25	<0.25	<0.25 / 0.84	<0.25 / 0.55	0.34	1.6
Silver	6010B	<0.25	<0.25	<0.25	<0.25	<0.25 / 0.32	<0.25	2.0
Thallium	6010B	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25
Vanadium	6010B	0.67	3.6	1.0	3.0 J / 5.2	16 J / 48	<0.50	2.5
Zinc	6010B	87	150 J	<46 UJ	68 J / 83 J	130 J / 470 J	<26 UJ	140 J

Notes:

Sam ples collected between 21-June-04 and 25-June-04 and chem ically tested at Curtis & Tom pk
 W P-16/16D and W P-17/17D = Chem istry results for prim ary and duplicate sam ple
 PAH = Polycyclic Aromatic Hydrocarbons
 HDPE = High Density Polyethylene
 J = Result is estimated
 UJ = The result is not detected, how ever, the reporting lim it value is qualified as estimated
 Y = Exhibits chromatographic pattern w hich does not resemble standard
 -- = Not analyzed, not applicable
 ND = Not detected

TABLE 8
 W IPE BACKGROUND SAM PLE CHEM ISTRY DATA
 BULK CONTAINER STORAGE UNIT CLOSURE
 SAN FRANCISCO REFINERY ,RODEO ,CALIFORNIA
 Page 1 of 1

Sam ple Nam e	EPA TestM ethod	W PBCKG -1	W PBCKG -2	W PBLANK -1
Sam ple Location :		24" diam eter, painted steel hydrocarbon conveyance line (across street from BCSU)	2" diam eter, galvanized line (across street from BCSU)	—
Chem istry Results:				
Total Petroleum Hydrocarbons ($\mu\text{g}/100\text{cm}^2$)	8015B			
Diesel C10-C24		<2,500	<2,500	<2,500
Motor Oil C24-C36		<500	<500	<500
Sem i-Volatile Organic Com pounds ($\mu\text{g}/100\text{cm}^2$) (All other com pounds not detected at reporting lim its of 100 to 500 $\mu\text{g}/100\text{cm}^2$)	8270C			
Toxic and Carcinogenic PAH s		<100	<100	<100
M etals ($\mu\text{g}/100\text{cm}^2$)				
Antim ony	6010B	<3.0	<3.0	<3.0
Arsenic	6010B	<0.38 UJ	<0.80 UJ	1.1
Barium	6010B	1.0	0.72	<0.50
Beryllium	6010B	<0.10	<0.10	<0.10
Cadm ium	6010B	<0.25	<0.25	<0.25
Chrom ium (total)	6010B	<0.50	0.67	<0.50
Cobalt	6010B	<1.0	<1.0	<1.0
Copper	6010B	<0.50	1.1	<0.50
Lead	6010B	1.7	0.42	<0.15
M ercury	7470	<0.010	<0.010	<0.010
M olybdenum	6010B	<1.0	<1.0	<1.0
Nickel	6010B	<1.0	<1.0	<1.0
Selenium	6010B	<0.25	<0.25	<0.25
Silver	6010B	<0.25	<0.25	<0.25
Thallium	6010B	<0.25	<0.25	<0.25
Vanadium	6010B	<0.50	0.57	<0.50
Zinc	6010B	<8.4 UJ	120 J	52

Notes:

Samples collected 21-June-04 and chem ically tested at Curtis & Tom pkins, Ltd., Berkeley, California

PAH = Polycyclic Arom atic Hydrocarbons

J = Result is estim ated

UJ - The result is not detected; how ever, the reporting lim it value is qualified as estim ated

— = Not Applicable

TABLE 9
 SUBSURFACE SOIL SAMPLE CHEMISTRY DATA
 BULK CONTAINER STORAGE UNIT CLOSURE
 SAN FRANCISCO REFINERY, RODEO, CALIFORNIA
 Page 1 of 4

EPA Test Method	Screening Standards			SoilBoring 1		SoilBoring 2			SoilBoring 6		
	Residential PRG ⁽¹⁾	Industrial PRG	Typical Values (California) ⁽²⁾	BCSU SB-1-1'	BCSU SB-1-3'	BCSU SB-2-1'	BCSU SB-2-3'	BCSU SB-2-8' ⁽⁶⁾	BCSU SB-6-1'	BCSU SB-6-8' ⁽⁶⁾	
Sample Location:				Area B (Upper Tenace) 0.5-1.0' bgs	Area B (Upper Tenace) 2.5-3.0' bgs	Area B (Upper Tenace) 0.5-1.0' bgs	Area B (Upper Tenace) 2.5-3.0' bgs	Area B (Upper Tenace) 7.5-8.0' bgs	Area B (Lower Tenace) 0.5-1.0' bgs	Area B (Lower Tenace) 7.5-8.0' bgs	
Interpreted Lithologic Unit of Sample: ⁽³⁾				Fill	Bedrock (Tptl)	Fill	Bedrock (Tptl)	Bedrock (Tptl)	Fill	Bedrock (Tptl)	
Chemistry Results:											
pH	9045C	-	-	-	8.0	7.2	7.9	7.7	7.6 J	8.4	7.7 J
Total Petroleum Hydrocarbons (mg/kg)	8015B										
Diesel C10-C24		500 ⁽⁴⁾	500	-	15 H Y	<1.4	160 H Y	44 H Y	<1.4	3.8 JH Y	<1.3
Motor Oil C24-C36		500 ⁽⁴⁾	1,000	-	62	<6.8	260 L	130	<6.8	36 JL	<6.5
Volatile Organic Compounds (µg/kg) (Detections only. All other compounds not detected at reporting limits of 5.0 to 1,400 µg/kg)	8260B										
Acetone		1,600,000	6,000,000	-	<34	<30	<27	<37	<29	<29	<33
Semi-Volatile Organic Compounds (µg/kg) (Includes detections and the 7 carcinogenic and 9 toxic PAHs. All other compounds not detected at reporting limits of 72 to 370,000 µg/kg)	8270C										
2-Methylnaphthalene		-	-	-	<88	<91	<160	<87	<91	<70	<86
Benzo (a) anthracene		620	2,100	-	<88	<91	<160	<87	<91	<70	<86
Chrysene		62,000	210,000	-	<88	<91	<160	<87	<91	<70	<86
Benzo (b) fluoranthene		620	2,100	-	190	<91	360	190	<91	<70	<86
Benzo (k) fluoranthene		6,200	21,000	-	180	<91	<160	180	<91	<70	<86
Benzo (a) pyrene		62	210	-	<88	<91	<160	<87	<91	<70	<86
Indeno (1,2,3-cd) pyrene		620	2,100	-	<88	<91	<160	<87	<91	<70	<86
Dibenz (a,h) anthracene		62	210	-	<88	<91	<160	<87	<91	<70	<86
Naphthalene		56,000	190,000	-	<88	<91	<160	<87	<91	<70	<86
Acenaphthylene		0.00	0.00	-	<88	<91	<160	<87	<91	<70	<86
Acenaphthene		3,700,000	29,000,000	-	<88	<91	<160	<87	<91	<70	<86
Fluorene		2,700,000	26,000,000	-	<88	<91	<160	<87	<91	<70	<86
Phenanthrene		-	-	-	<88	<91	<160	<87	<91	<70	<86
Anthracene		22,000,000	100,000,000	-	<88	<91	<160	<87	<91	<70	<86
Fluoranthene		2,300,000	22,000,000	-	<88	<91	<160	<87	<91	<70	<86
Pyrene		2,300,000	29,000,000	-	<88	<91	<160	<87	<91	<70	<86
Benzo (g,h,i) perylene		-	-	-	<88	<91	<160	<87	<91	<70	<86

TABLE 9
 SUBSURFACE SOIL SAMPLE CHEMISTRY DATA
 BULK CONTAINER STORAGE UNIT CLOSURE
 SAN FRANCISCO REFINERY, RODEO, CALIFORNIA
 Page 2 of 4

	Screening Standards				SoilBoring 1		SoilBoring 2			SoilBoring 6	
	EPA Test Method	Residential PRG ⁽¹⁾	Industrial PRG	Typical Values (California) ⁽²⁾	BCSU SB-1-1'	BCSU SB-1-3'	BCSU SB-2-1'	BCSU SB-2-3'	BCSU SB-2-8' ⁽⁶⁾	BCSU SB-6-1'	BCSU SB-6-8' ⁽⁶⁾
Sample Location:					Area B (Upper Tenace) 0.5-1.0'bgs	Area B (Upper Tenace) 2.5-3.0'bgs	Area B (Upper Tenace) 0.5-1.0'bgs	Area B (Upper Tenace) 2.5-3.0'bgs	Area B (Upper Tenace) 7.5-8.0'bgs	Area B (Lower Tenace) 0.5-1.0'bgs	Area B (Lower Tenace) 7.5-8.0'bgs
Interpreted Lithologic Unit of Sample: ⁽³⁾					Fill	Bedrock (Tptl)	Fill	Bedrock (Tptl)	Bedrock (Tptl)	Fill	Bedrock (Tptl)
Chemistry Results:											
Metals (m g/K g)											
Antimony	6010B	31	410	0.15-1.95	5.3	<4.3	<3.2	<3.5	<3.2	<2.6	<4.2
Arsenic	6010B	22 / 0.39 ⁽⁵⁾	260 / 1.6	0.6-11.0	1.0	4.8	2.1	0.83	1.8	0.85	0.67
Barium	6010B	5,400	67,000	133-1,400	17	160	160	22	64	150	84
Beryllium	6010B	150	1,900	0.25-2.70	<0.14	0.60	0.41	0.58	1.9	0.42	0.36
Cadmium	6010B	1.7	7.4	0.05-1.70	<0.36	<0.36	<0.27	<0.29	<0.27	<0.22	<0.35
Chromium (total)	6010B	210	450	23-1,579	22	5.8	16	2.7	17	6.5	2.0
Cobalt	6010B	900	1,900	2.7-46.9	30	4.3	8.7	1.6	3.6	4.8	6.5
Copper	6010B	3,100	41,000	9.7-96.4	70	20	14	5.6	10	17	30
Lead	6010B	150	750	12.4-97.1	1.1	50	150	2.9	8.5	6.9	5.0
Mercury	7471	23	310	0.10-0.90	5.3	0.054	0.095	0.047	0.027	0.27	<0.025
Molybdenum	6010B	390	5,100	0.1-9.6	<1.4	<1.4	<1.1	<1.2	<1.1	<0.86	<1.4
Nickel	6010B	1,600	20,000	9-509	27	7.8	15	2.2	3.6	6.1	3.1
Selenium	6010B	390	5,100	0.015-0.430	2.1	0.50	<0.27	<0.29	<0.27	<0.22	<0.35
Silver	6010B	390	5,100	0.10-8.30	<0.36	<0.36	<0.27	<0.29	<0.27	<0.22	<0.35
Thallium	6010B	5.2	67	0.17-1.10	0.39	<0.36	<0.27	<0.29	<0.27	<0.22	<0.35
Vanadium	6010B	550	7,200	39-288	230	30	44	5.8	36	22	13
Zinc	6010B	23,000	100,000	88-236	96	37	36	11	34	20	40

Notes:

- Samples collected 28-June-04 through 2-July-04 and chemically tested at Curtis & Tompkins, Ltd., Berkeley, California
 Tptl = Lower Pinole Tuff. This unit consists of coarse and fine, pumice and lithic andesitic tuff which is interbedded with thin sandstones and siltstones
 1. EPA Region IX Preliminary Remedial Goals Table (01-Oct-02)
 2. Kearney Foundation of Soil Science - Background Concentrations of Trace and Major Elements in California Soils
 3. From interpretation of field geologist and soil boring logs
 4. California Regional Water Quality Control Board - Environmental Screening Levels for Shallow Soils where groundwater is not a current or potential source of drinking water. Since there is not a PRG for TPH concentrations, an ESL is presented as a reference.
 5. Noncancer endpoint / cancer endpoint
 6. Low surrogate recovery
 bgs = Below Ground Surface
 PAH = Polycyclic Aromatic Hydrocarbons
 H = Heavier hydrocarbon contributed to the quantization
 J = Result is estimated
 L = Lighter hydrocarbon contributed to the quantization
 Y = Exhibits chromatographic pattern which does not resemble standard
 -- = Not analyzed. Not applicable
 - = No standard for compound
 ' = feet
 = Concentration exceeds screening standard

TABLE 9
SUBSURFACE SOIL SAMPLE CHEMISTRY DATA
BULK CONTAINER STORAGE UNIT CLOSURE
SAN FRANCISCO REFINERY, RODEO, CALIFORNIA
Page 3 of 4

EPA Test Method	Screening Standards			SoilBoring 7			SoilBoring 8		Soil Borings Representative of IW S-6C Waste Deposits					
	Residential PRG ⁽¹⁾	Industrial PRG	Typical Values (California) ⁽²⁾	BCSU SB-7-1'	BCSU SB-7-2'	BCSU SB-7-8' ⁽⁶⁾	BCSU SB-8-1'	BCSU SB-8-7.5'	BCSU SB-3-1'	BCSU SB-3-8'	BCSU SB-4-1'	BCSU SB-4-9'	BCSU SB-5-1'	BCSU SB-5-8'
Sample Location:				Area B (Lower Tenace) 0.5-1.0' bgs	Area B (Lower Tenace) 1.5-2.0' bgs	Area B (Lower Tenace) 7.5-8.0' bgs	Area B (Lower Tenace) 0.5-1.0' bgs	Area B (Lower Tenace) 7.0-7.5' bgs	Area C 0.5-1.0' bgs	Area C 7.5-8.0' bgs	Area C 0.5-1.0' bgs	Area C 8.5-9.0' bgs	Area C 0.5-1.0' bgs	Area C 7.5-8.0' bgs
Interpreted Lithologic Unit of Sample: ⁽³⁾				Fill	Bedrock (Tptl)	Bedrock (Tptl)	Fill	Bedrock (Tptl)	IW S-6C Fill	IW S-6C Fill	IW S-6C Fill	IW S-6C Fill	IW S-6C Fill	Colluvium
Chemistry Results:														
pH	9045C	-	-	8.3	8.4	10.9 J	8.2	6.6	10.8	7.3	8.2	7.9	7.8	5.4
Total Petroleum Hydrocarbons (mg/kg)	8015B													
Diesel C10-C24		500 ⁽⁴⁾	500	1.8 H Y	2.5 H Y	1.7 H Y	13 H Y	<1.3	150 H	56 H Y	170 H Y	500 H	13 H Y	8,100 JH Y
Motor Oil C24-C36		500 ⁽⁴⁾	1,000	16 H	21 H	6.8	33	<6.6	1,000	180	1,600	610 L	71	43,000 JL
Volatile Organic Compounds (µg/kg)	8260B													
Detections only. All other compounds not detected at reporting limits of 5.0 to 1,400 µg/kg)														
Acetone		1,600,000	6,000,000	<27	<32	<32	<25	<33	<28	<28	<28	50	<23	<560
Semi-Volatile Organic Compounds (µg/kg)	8270C													
(Includes detections and the 7 carcinogenic and 9 toxic PAHs. All other compounds not detected at reporting limits of 72 to 370,000 µg/kg)														
2-Methylnaphthalene		-	-	<71	<81	<88	<83	<89	<72	2,700	<150	680	<380	<15,000
Benzo (a) anthracene		620	2,100	<71	<81	<88	<83	<89	<72	2,700	<150	670	<380	<15,000
Chrysene		62,000	210,000	<71	<81	<88	<83	<89	110	5,000	<150	1,100	<380	<15,000
Benzo (b) fluoanthene		620	2,100	<71	<81	150	180	<89	<72	2,600	390	760	870	<15,000
Benzo (k) fluoanthene		6,200	21,000	<71	<81	<88	170	<89	<72	1,500	340	460	820	<15,000
Benzo (a) pyrene		62	210	<71	<81	<88	<83	<89	<72	3,500	<150	860	<380	<15,000
Indeno (1,2,3-cd) pyrene		620	2,100	<71	<81	<88	<83	<89	<72	560	<150	<180	<380	<15,000
Dibenz (a,h) anthracene		62	210	<71	<81	<88	<83	<89	<72	1,000	<150	240	<380	<15,000
Naphthalene		56,000	190,000	<71	<81	<88	<83	<89	<72	1,200	<150	300	<380	<15,000
Acenaphthylene		0.00	0.00	<71	<81	<88	<83	<89	<72	<400	<150	<180	<380	<15,000
Acenaphthene		3,700,000	29,000,000	<71	<81	<88	<83	<89	<72	<400	<150	<180	<380	<15,000
Fluorene		2,700,000	26,000,000	<71	<81	<88	<83	<89	<72	<400	<150	<180	<380	<15,000
Phenanthrene		-	-	<71	<81	<88	<83	<89	<72	980	<150	240	<380	<15,000
Anthracene		22,000,000	100,000,000	<71	<81	<88	<83	<89	<72	450	<150	<180	<380	<15,000
Fluoanthene		2,300,000	22,000,000	<71	<81	<88	<83	<89	<72	<400	<150	<180	<380	<15,000
Pyrene		2,300,000	29,000,000	<71	<81	<88	<83	<89	<72	1,100	<150	300	<380	<15,000
Benzo (g,h,i) perylene		-	-	<71	<81	<88	<83	<89	<72	1,200	<150	260	<380	<15,000

TABLE 9
 SUBSURFACE SOIL SAMPLE CHEMISTRY DATA
 BULK CONTAINER STORAGE UNIT CLOSURE
 SAN FRANCISCO REFINERY, RODEO, CALIFORNIA
 Page 4 of 4

EPA Test Method	Screening Standards			SoilBoring 7			SoilBoring 8		Soil Borings Representative of IW S-6C Waste Deposits						
	Residential PRG ⁽¹⁾	Industrial PRG	Typical Values (California) ⁽²⁾	BCSU SB-7-1'	BCSU SB-7-2'	BCSU SB-7-8' ⁽⁶⁾	BCSU SB-8-1'	BCSU SB-8-7.5'	SoilBoring 3		SoilBoring 4		SoilBoring 5		
				Area B (Lower Tenace) 0.5-1.0'bgs	Area B (Lower Tenace) 1.5-2.0'bgs	Area B (Lower Tenace) 7.5-8.0'bgs	Area B (Lower Tenace) 0.5-1.0'bgs	Area B (Lower Tenace) 7.0-7.5'bgs	Area C 0.5-1.0'bgs	Area C 7.5-8.0'bgs	Area C 0.5-1.0'bgs	Area C 8.5-9.0'bgs	Area C 0.5-1.0'bgs	Area C 7.5-8.0'bgs	
Sample Location:				Area B (Lower Tenace) 0.5-1.0'bgs	Area B (Lower Tenace) 1.5-2.0'bgs	Area B (Lower Tenace) 7.5-8.0'bgs	Area B (Lower Tenace) 0.5-1.0'bgs	Area B (Lower Tenace) 7.0-7.5'bgs	Area C 0.5-1.0'bgs	Area C 7.5-8.0'bgs	Area C 0.5-1.0'bgs	Area C 8.5-9.0'bgs	Area C 0.5-1.0'bgs	Area C 7.5-8.0'bgs	
Interpreted Lithologic Unit of Sample: ⁽³⁾				Fill	Bedrock (Tptl)	Bedrock (Tptl)	Fill	Bedrock (Tptl)	IW S-6C Fill	IW S-6C Fill	IW S-6C Fill	IW S-6C Fill	IW S-6C Fill	Colluvium	
Chemistry Results:															
Metals (mg/kg)															
Antimony	6010B	31	410	0.15-1.95	3.2	<3.7	<3.5	<3.8	<3.7	<3.0	<4.0	<3.1	<3.6	<3.2	<3.4
Arsenic	6010B	22 / 0.39 ⁽⁵⁾	260 / 1.6	0.6-11.0	1.4	1.2	2.8	1.4	0.55	1.9	0.89	3.3	2.9	<0.26	31
Barium	6010B	5,400	67,000	133-1,400	28	81	140 J	92	43	74	30	110	190	<0.53	170
Beryllium	6010B	150	1,900	0.25-2.70	<0.11	0.38	0.44	0.60	0.62	0.51	<0.13	0.45	0.67	0.32	0.59
Cadmium	6010B	1.7	7.4	0.05-1.70	<0.27	<0.31	0.57	<0.32	<0.31	<0.25	<0.33	<0.26	<0.30	<0.26	<0.28
Chromium (total)	6010B	210	450	23-1,579	17	52	24	14	4.7	7.8	3.2	23	14	<0.53	13
Cobalt	6010B	900	1,900	2.7-46.9	26	4.6	6.1	6.0	2.0	4.6	4.9	8.0	9.7	<1.1	7.2
Copper	6010B	3,100	41,000	9.7-96.4	56	14	65	11	6.1	11	2.9	22	34	<0.53	36
Lead	6010B	150	750	12.4-97.1	1.3	3.6	4.0	6.4	3.6	19	20	24	1,400	<0.16	1,200
Mercury	7471	23	310	0.10-0.90	5.0	0.39	0.082	0.25	0.032	0.71	0.029	0.63	0.048	0.030	0.33
Molybdenum	6010B	390	5,100	0.1-9.6	<1.1	<1.2	1.3	<1.3	<1.2	<0.99	<1.3	<1.0	4.2	<1.1	3.6
Nickel	6010B	1,600	20,000	9-509	21	6.2	20	12	4.2	8.3	170	26	20	<1.1	18
Selenium	6010B	390	5,100	0.015-0.430	0.42	0.34	<0.29	<0.32	<0.31	<0.25	<0.33	<0.26	<0.30	<0.26	0.36
Silver	6010B	390	5,100	0.10-8.30	<0.27	<0.31	<0.29	<0.32	<0.31	<0.25	<0.33	<0.26	<0.30	<0.26	<0.28
Thallium	6010B	5.2	67	0.17-1.10	<0.27	<0.31	<0.29	<0.32	<0.31	<0.25	<0.33	<0.26	<0.30	<0.26	<0.28
Vanadium	6010B	550	7,200	39-288	180	28	27	39	17	24	160	35	40	<0.53	37
Zinc	6010B	23,000	100,000	88-236	78	22	80 J	33	21	27	11	43	66	<1.1	60

Notes:
 Samples collected 28-June-04 through 2-July-04 and chemically tested at Curtis & Tompkins, Ltd., Berkeley, California
 Tptl = Lower Pine Tuff. This unit consists of coarse and fine, pumice and lithic andesitic tuff which is interbedded with thin sandstones and siltstones
 1. EPA Region IX Preliminary Remedial Goals Table (01-Oct-02)
 2. Kearney Foundation of Soil Science - Background Concentrations of Trace and Major Elements in California Soils
 3. From interpretation of field geologist and soil boring logs
 4. California Regional Water Quality Control Board - Environmental Screening Levels for Shallow Soils where groundwater is not a current or potential source of drinking water. Since there is no PRG for TPH concentrations, an ESL is presented as a reference.
 5. Noncancer endpoint/cancer endpoint
 6. Low surrogate recovery
 bgs = Below Ground Surface
 PAH = Polycyclic Aromatic Hydrocarbons
 H = Heavier hydrocarbon contributed to the quantitation
 J = Result is estimated
 L = Lighter hydrocarbon contributed to the quantitation
 Y = Exhibits chromatographic pattern which does not resemble standard
 -- = Not analyzed. Not applicable
 - = No standard for compound
 ' = feet
 = Concentration exceeds screening standard

TABLE 10
BACKGROUND SUBSURFACE SOIL SAMPLE CHEMISTRY DATA
BULK CONTAINER STORAGE UNIT CLOSURE
SAN FRANCISCO REFINERY, RODEO, CALIFORNIA
Page 1 of 3

	EPA Test Method	Screening Standards			Sample Name						
		Residential PRG ⁽¹⁾	Industrial PRG	Typical Values (California) ⁽²⁾	SOILBCKG -1	SOILBCKG -2	SOILBCKG -3	SOILBCKG -4	SOILBCKG -5	SOILBCKG -6	SOILBCKG -7
Sample Location:					Tank 106 Bem Cut	Tank 180 Bem Cut	Surface Outcrop				
Interpreted Lithologic Unit of Sample: ⁽³⁾					Tptl	Tptl	Tptl	Tptl	Tptl	Tptl	Tptl
Chemistry Results:											
Metals (mg/kg)											
Antimony	6010B	31	410	0.15-1.95	<2.8	<3.0	<2.5	<3.6	<3.6	<3.7	<2.6
Arsenic	6010B	22 / 0.39 ⁽⁴⁾	260 / 1.6	0.6-11.0	<0.23	<0.25	0.59	0.48	1.7	0.65	0.89
Barium	6010B	5,400	67,000	133-1,400	52	32	96	110	210	70	200
Beryllium	6010B	150	1,900	0.25-2.70	0.64	0.66	0.47	0.55	0.82	1.1	0.64
Cadmium	6010B	1.7	7.4	0.05-1.70	<0.23	<0.25	<0.21	<0.30	<0.30	<0.31	<0.22
Chromium (total)	6010B	210	450	23-1,579	2.4	1.7	6.5	4.6	7.2	1.7	4.9
Cobalt	6010B	900	1,900	2.7-46.9	3.6	1.6	3.8	2.6	3.0	3.9	4.3
Copper	6010B	3,100	41,000	9.7-96.4	16	5.4	14	17	6.9	6.6	18
Lead	6010B	150	750	12.4-97.1	4.4	5.0	2.9	2.8	3.4	5.2	4.9
Mercury	7471	23	310	0.10-0.90	0.052	0.045	0.062	0.021	<0.028	<0.027	<0.025
Molybdenum	6010B	390	5,100	0.1-9.6	<0.93	<1.0	<0.82	<1.2	<1.2	<1.2	<0.86
Nickel	6010B	1,600	20,000	9-509	2.9	2.5	5.5	4.3	5.2	3.0	6.5
Selenium	6010B	390	5,100	0.015-0.430	<0.23	<0.25	<0.21	<0.30	0.47	<0.31	<0.22
Silver	6010B	390	5,100	0.10-8.30	<0.23	<0.25	<0.21	<0.30	<0.30	<0.31	<0.22
Thallium	6010B	5.2	67	0.17-1.10	<0.23	<0.25	<0.21	<0.30	0.40	<0.31	0.34
Vanadium	6010B	550	7,200	39-288	15	6.7	19	15	18	3.1	21
Zinc	6010B	23,000	100,000	88-236	19	14	23	15	22	15	19

Notes:

Samples collected between 17-June-04 and 29-June-04 and chemically tested at Curtis & Tompkins, Ltd., Berkeley, California

Tptl = Lower Pinole Tuff. This unit consists of coarse and fine, pumice and lithic andesitic tuff which is interbedded with thin sandstones and siltstones

Tnss-4 = Neroly Formation Unit Tnss-4. This unit consists of gray, predominantly medium-grained andesitic sandstones in which sand grains typically show a blue authigenic clay coating

1. EPA Region IX Preliminary Remedial Goals Table (01-Oct-02)

2. Kearney Foundation of Soil Science - Background Concentrations of Trace and Major Elements in California Soils

3. From interpretation of field geologist and soil boring logs

4. Noncancer endpoint / cancer endpoint

= Concentration exceeds residential PRG

TABLE 10
BACKGROUND SUBSURFACE SOIL SAMPLE CHEMISTRY DATA
BULK CONTAINER STORAGE UNIT CLOSURE
SAN FRANCISCO REFINERY, RODEO, CALIFORNIA
Page 2 of 3

	EPA Test Method	Screening Standards			Sample Name						
		Residential PRG ⁽¹⁾	Industrial PRG	Typical Values (California) ⁽²⁾	SOILBCKG -8	SOILBCKG -9	SOILBCKG -10	SOILBCKG -11	SOILBCKG -12	SOILBCKG -13	SOILBCKG -14
Sample Location:					Surface Outcrop	Surface Outcrop	Surface Outcrop	Beam -Cut for Tank 180	Beam -Cut for Tank 180	Beam -Cut for Tank 107	Surface Outcrop
Interpreted Lithologic Unit of Sample: ⁽³⁾					Tptl	Tptl	Tptl	Tnss-4	Tnss-4	Tnss-4	Tnss-4
Chemistry Results:											
Metals (mg/kg)											
Antimony	6010B	31	410	0.15-1.95	<3.2	<3.2	<3.8	<2.9	<3.0	<3.1	<3.3
Arsenic	6010B	22 / 0.39 ⁽⁴⁾	260 / 1.6	0.6-11.0	0.73	1.1	0.91	10	1.1	0.88	1.0
Barium	6010B	5,400	67,000	133-1,400	120	36	94	240	63	35	25
Beryllium	6010B	150	1,900	0.25-2.70	0.39	0.84	0.38	0.70	0.47	0.26	0.31
Cadmium	6010B	1.7	7.4	0.05-1.70	<0.27	<0.27	<0.32	<0.24	<0.25	<0.26	<0.27
Chromium (total)	6010B	210	450	23-1,579	2.3	4.1	1.9	15	9.3	8.3	7.5
Cobalt	6010B	900	1,900	2.7-46.9	2.6	2.9	2.1	12	6.7	7.2	9.1
Copper	6010B	3,100	41,000	9.7-96.4	12	8.0	13	15	8.7	9.6	12
Lead	6010B	150	750	12.4-97.1	2.8	4.4	3.8	5.9	4.2	3.5	3.8
Mercury	7471	23	310	0.10-0.90	<0.025	0.044	<0.025	0.10	0.12	0.26	0.19
Molybdenum	6010B	390	5,100	0.1-9.6	<1.1	<1.1	<1.3	<0.97	<0.99	<1.0	<1.1
Nickel	6010B	1,600	20,000	9-509	2.9	5.6	2.6	17	8.9	8.9	12
Selenium	6010B	390	5,100	0.015-0.430	<0.27	0.37	<0.32	<0.24	<0.25	0.47	<0.27
Silver	6010B	390	5,100	0.10-8.30	<0.27	<0.27	<0.32	<0.24	<0.25	<0.26	<0.27
Thallium	6010B	5.2	67	0.17-1.10	<0.27	<0.27	<0.32	0.42	<0.25	<0.26	<0.27
Vanadium	6010B	550	7,200	39-288	10	20	13	50	47	50	52
Zinc	6010B	23,000	100,000	88-236	13	33	22	43	36	35	44

Notes:

Samples collected between 17-June-04 and 29-June-04 and chemically tested at Curtis & Tompkins, Ltd., Berkeley, California

Tptl = Lower Pinole Tuff. This unit consists of coarse and fine, pumice and lithic andesitic tuff which is interbedded with thin sandstones and siltstones

Tnss-4 = Neroly Formation Unit Tnss-4. This unit consists of gray, predominantly medium-grained andesitic sandstones in which sand grains typically show a blue authigenic clay coating

1. EPA Region IX Preliminary Remedial Goals Table (01-Oct-02)

2. Kearney Foundation of Soil Science - Background Concentrations of Trace and Major Elements in California Soils

3. From interpretation of field geologist and soil boring logs

4. Noncancer endpoint / cancer endpoint

= Concentration exceeds residential PRG

TABLE 10
BACKGROUND SUBSURFACE SOIL SAMPLE CHEMISTRY DATA
BULK CONTAINER STORAGE UNIT CLOSURE
SAN FRANCISCO REFINERY, RODEO, CALIFORNIA
Page 3 of 3

	EPA Test Method	Screening Standards			Sample Name					
		Residential PRG ⁽¹⁾	Industrial PRG	Typical Values (California) ⁽²⁾	SO ILBCKG -15	SO ILBCKG -16	SO ILBCKG -17	SO ILBCKG -18	SO ILBCKG -19	SO ILBCKG -20
Sample Location:					Surface Outcrop					
Interpreted Lithologic Unit of Sample: ⁽³⁾					Tnss-4	Tnss-4	Tnss-4	Tnss-4	Tnss-4	Tnss-4
Chemistry Results:										
Metals (mg/kg)										
Antimony	6010B	31	410	0.15-1.95	<3.1	<2.9	<2.7	<2.4	<3.0	<2.9
Arsenic	6010B	22 / 0.39 ⁽⁴⁾	260 / 1.6	0.6-11.0	1.6	9.7	2.0	2.1	1.4	1.8
Barium	6010B	5,400	67,000	133-1,400	68	120	51	61	60	43
Beryllium	6010B	150	1,900	0.25-2.70	0.34	0.51	0.37	0.41	0.33	0.46
Cadmium	6010B	1.7	7.4	0.05-1.70	<0.26	<0.24	<0.23	<0.20	<0.25	<0.24
Chromium (total)	6010B	210	450	23-1,579	9.9	22	12	15	8.7	9.9
Cobalt	6010B	900	1,900	2.7-46.9	8.9	2.7	7.2	11	8.4	7.5
Copper	6010B	3,100	41,000	9.7-96.4	7.1	15	8.7	11	12	12
Lead	6010B	150	750	12.4-97.1	3.4	6.3	4.1	4.7	3.3	4.0
Mercury	7471	23	310	0.10-0.90	0.35	0.19	<0.023	<0.025	<0.022	<0.020
Molybdenum	6010B	390	5,100	0.1-9.6	<1.0	<0.96	<0.91	<0.81	<1.0	<0.96
Nickel	6010B	1,600	20,000	9-509	11	15	12	12	9.2	10
Selenium	6010B	390	5,100	0.015-0.430	<0.26	<0.24	0.43	0.50	0.33	0.43
Silver	6010B	390	5,100	0.10-8.30	<0.26	<0.24	<0.23	<0.20	<0.25	<0.24
Thallium	6010B	5.2	67	0.17-1.10	<0.26	<0.24	<0.23	<0.20	<0.25	<0.24
Vanadium	6010B	550	7,200	39-288	57	30	52	74	75	57
Zinc	6010B	23,000	100,000	88-236	36	47	36	44	40	38

Notes:

Samples collected between 17-June-04 and 29-June-04 and chemically tested at Curtis & Tompkins, Ltd., Berkeley, California

Tpt1 = Lower Pinehole Tuff. This unit consists of coarse and fine, pumice and lithic andesitic tuff which is interbedded with thin sandstones and siltstones

Tnss-4 = Neely Formation Unit Tnss-4. This unit consists of gray, predominantly medium-grained andesitic sandstones in which sand grains typically show a blue authigenic clay coating

1. EPA Region IX Preliminary Remedial Goals Table (01-0 ct-02)

2. Keamey Foundation of Soil Science - Background Concentrations of Trace and Major Elements in California Soils

3. From interpretation of field geologist and soil boring logs

4. Noncancer endpoint / cancer endpoint

= Concentration exceeds residential PRG

TABLE 11
GROUNDWATER SAMPLE CHEMISTRY DATA
BULK CONTAINER STORAGE UNIT CLOSURE
SAN FRANCISCO REFINERY, RODEO, CALIFORNIA
Page 1 of 1

	EPA Test Method	Screening Standard	Sample Name	
		Tap Water PRG ⁽¹⁾	BCSU SB-3W /3W-RE ⁽⁴⁾	BCSU SB-7W
Sample Location:			Area C	Area B (Lower Terrace)
Chemistry Results:				
pH	9040B	-	7.1	7.9
Total Petroleum Hydrocarbons (µg/L)	8015B			
Diesel C10-C24		640 ⁽²⁾	<50	<50
Motor Oil C24-C36		640 ⁽²⁾	<300	<300
Volatile Organic Compounds (µg/L)	8260B			
Detections only. All other compounds not detected at reporting limits of 5.0 to 50 µg/L)				
Acetone		610	85	<20
2-Butanone		1,900	20	<10
Semi-Volatile Organic Compounds (µg/L)	8270C			
All other compounds not detected at reporting limits of 9.4 to 63 µg/L)				
Toxic and Carcinogenic PAHs		0.0092-1,800	<9.4 / <13	<12
Metals (µg/L)				
Antimony	6020	14	<1.0	1.4
Arsenic	6020	0.045 ⁽³⁾	7.0	8.4
Barium	6020	2,600	350	36
Beryllium	6020	73	<1.0	<1.0
Cadmium	6020	0.18	<1.0	<1.0
Chromium (total)	6020	55,000	3.1	27
Cobalt	6020	750	9.5	<1.0
Copper	6020	1,500	4.5	1.6
Lead	6020	15	4.2	1.3
Mercury	7470	11	<0.20	0.27
Molybdenum	6020	180	87	59
Nickel	6020	730	18 J	1.6 J
Selenium	6020	180	2.4	7.3
Silver	6020	180	<1.0	<1.0
Thallium	6020	2.4	<1.0	<1.0
Vanadium	6020	260	15	32
Zinc	6020	11,000	7.5 J	6.1 J

Notes:

Sam ples collected between 30-June-04 and 7-July-04 and chem ically tested at Curtis & Tom pkins, Ltd., Berkeley, California

1. EPA Region IX Preliminary Remedial Goals Table (01-0 ct-02)

2. California Regional Water Quality Control Board - Groundwater Environmental Screening Levels for Shallow Soils where groundwater is not a current or potential source of drinking water. Since no there is no PRG for TPH concentrations, and ESL is presented as a reference

3. Cancer endpoint

4. Due to low surrogate recovery, sam ple was reanalyzed for Semi-Volatile Organic Compounds as BCSU-3W-RE

PAH = Polycyclic Aromatic Hydrocar

J = Result is estimated

- = No standard for compound

■ = Concentration exceeds tap water PRG

TABLE 12
 SOIL VAPOR SAMPLE CHEMISTRY DATA
 BULK CONTAINER STORAGE UNIT CLOSURE
 SAN FRANCISCO REFINERY, RODEO, CALIFORNIA
 Page 1 of 1

EPA Test Method	Screening Standards		Sample of Soil Vapor Beneath BC SU	Sample Representative of Soil Vapor Within IWS-6C Fill			FB 063004 ⁽³⁾
	Residential ESL ⁽¹⁾	Industrial ESL	BCSU SB-8A /8AD	BCSU SB-3A /3AD	BCSU SB-4A	BCSU SB-5A	
Sample Location:			Area B (Lower Terrace) 7.0' bgs	Area C 8.0' bgs	Area C 9.0' bgs	Area C 8.0' bgs	--
Interpreted Lithologic Unit of Sample: ⁽²⁾			Bedrock (Tptl)	Fill	Fill	Colluvium	--
Chemistry Results:							
Volatile Organic Compounds (µg/l)	TO-14A						
(Detections only. All other compounds not detected at reporting limits of 0.0014 to 260 µg/l)							
Ethanol		-	<8.4 R /<8.4 R	<22 R /<45 R	<0.084	0.015	<0.0042
Acetone		73	11 JR /36 R	<28 R /57 R	0.12 J	0.34 J	0.097
2-Propanol*		-	640 JR /1,300 R	2,400 R /1,900 R	1.4 J	1 J	0.61
Carbon Disulfide		-	<3.5 R /<3.5 R	<9.3 R /<19 R	<0.035	0.0063	<0.0018
Hexane		-	<3.9 R /<3.9 R	<10 R /<21 R	0.086	0.27	<0.002
2-Butanone		210	<3.3 R /<3.3 R	<8.8 R /<18 R	<0.033	0.019	<0.0017
Tetrahydrofuran		-	<3.3 R /<3.3 R	11 JR /<18 R	0.065	<0.0017	<0.0017
Cyclohexane		-	<3.8 R /<3.8 R	<10 R /<21 R	1.1	0.17	<0.0019
Benzene		0.084	<3.6 R /<3.6 R	<9.6 R /<19 R	<0.036	0.0054	<0.0018
Heptane		-	<4.6 R /<4.6 R	<12 R /<24 R	<0.046	0.095	<0.0023
4-Methyl-2-pentanone		17	<4.6 R /<4.6 R	<12 R /<24 R	<0.046	0.055	<0.0023
Toluene		83	<4.2 R /<4.2 R	<11 R /<22 R	<0.042	0.12	<0.0021
Ethylbenzene		2.2	<4.8 R /<4.8 R	<13 R /<26 R	<0.048	0.018	<0.0024
Xylenes (Total)		21	<9.6 R /<9.6 R	<26 R /<52 R	<0.096	0.056	<0.0048
1,1,2,2-Tetrachloroethane		0.042	<7.7 R /<7.7 R	<20 R /<41 R	0.47	<0.0039	<0.0039

Notes:

Samples collected between 30-June-2004 and chemically tested at AirToxics, Ltd., Folsom, California

Tptl = Lower Pliocene Tuff. This unit consists of coarse and fine, pumice and lithic andesitic tuff which is interbedded with thin sandstones and siltstones

1. California Regional Water Quality Control Board - Table E: Environmental Screening Levels for Shallow Soil Gas (July 2003).

A depth of three meters is used to delineate between shallow and deep soils.

2. From interpretation of field geologist and soil boring logs

3. Field Blank

J = Result is estimated

bgs = Below Ground Surface

' = Feet

-- = Not Analyzed, Not Applicable

-- = No standard for compound

0.47 = Concentration exceeds residential ESL

* = 2-Propanol, also known as isopropyl alcohol, was used as the leak test tracer compound during sample collection.

R = Sample rejected due to exceeding the tracer compound leak detection requirement of 10 µg/l as outlined in the Department of Toxic Substances Control and Regional Water Quality Control Board Los Angeles Region

Active Soil Gas Investigation Advisory Letter dated January 28, 2003.

TABLE 13
WASH WATER AND SUM P SAMPLE CHEMISTRY DATA
BULK CONTAINER STORAGE UNIT CLOSURE
SAN FRANCISCO REFINERY, RODEO, CALIFORNIA
Page 1 of 1

	EPA Test Method	Screening Standard		Sample Name	
		Tap Water PRG ⁽¹⁾	WASH WATER	SUM P-1	SUM P-2
Chemistry Results:					
pH	9040B	-	-	8.5	9.3
Total Petroleum Hydrocarbons (µg/L)	8015B				
Diesel C10-C24		640 ⁽²⁾	410 H Y	190 Y	210 Y
Motor Oil C24-C36		640 ⁽²⁾	1,800 L	300	<300
Volatile Organic Compounds (µg/L) (All compounds not detected at reporting limits of 5.0 to 20 µg/L)	8260B				
All Compounds		-	ND	ND	ND
Semi-Volatile Organic Compounds (µg/L) (Includes detections and the 7 carcinogenic and 9 toxic PAHs. All other compounds not detected at reporting limits of 9.5 to 50 µg/L)	8270C				
Diethylphthalate		360,000	13	<9.5	<9.5 / <10
Toxic and Carcinogenic PAHs		0.0092-1,800	<9.5	<9.5	<9.5 / <10
Metals (µg/L)					
Antimony	6020	14	1.3	81	90
Arsenic	6020	0.045 ⁽³⁾	2.4	7.1	24
Barium	6020	2,600	35	20	6.1
Beryllium	6020	73	<1.0	<1.0	<1.0
Cadmium	6020	0.18	<1.0	<1.0	<1.0
Chromium (total)	6020	55,000	5.3	<1.0	1.2
Cobalt	6020	750	6.8	<1.0	1.7
Copper	6020	1,500	19	<1.0	2.1
Lead	6020	15	13	<1.0	<1.0
Mercury	7470	11	0.31	<1.0	0.45
Molybdenum	6020	180	6.8	43	240
Nickel	6020	730	14	2.1	11
Selenium	6020	180	<1.0	<1.0	1.4
Silver	6020	180	<1.0	<1.0	<1.0
Thallium	6020	2.4	<1.0	<1.0	<1.0
Vanadium	6020	260	1,900	39	110
Zinc	6020	11,000	170	<1.0	3.9

Notes:

Samples collected between 18-June-04 and 14-July-04 and chemically tested at Curtis & Tompkins, Ltd., Berkeley, California

1. EPA Region IX Preliminary Remedial Goals Table (01-Oct-02)

2. California Regional Water Quality Control Board - Groundwater Environmental Screening Levels for Shallow Soils where groundwater is not a current or potential source of drinking water. Since there is no PRG for TPH concentrations, and ESL is presented as a reference

3. Cancer endpoint

H = Heavier hydrocarbon contributed to the quantitation

L = Lighter hydrocarbon contributed to the quantitation

Y = Exhibits chromatographic pattern which does not resemble standard

ND = Not detected

-- = Not Analyzed, Not Applicable

- = No standard for compound

■ = Concentration exceeds tap water PRG

TABLE 14
IDENTIFIED CHEMICALS OF POTENTIAL CONCERN
BULK/CONTAINER STORAGE UNIT CLOSURE
SAN FRANCISCO REFINERY, RODEO, CALIFORNIA
Page 1 of 1

Soil	Soil Vapor	Groundwater
Shallow (0 to 3 feet bgs)	1,1,2,2-Tetrachloroethane	Antimony
Antimony	2-Butanone (MEK)	Arsenic
Mercury	2-Propanol	Barium
Benzo(a)anthracene	4-Methyl-2-pentanone (MIBK)	Chromium
Benzo(a)pyrene	Acetone	Cobalt
Benzo(b)fluoranthene	Benzene	Copper
Benzo(k)fluoranthene	Carbon Disulfide	Lead
Chrysene	Cyclohexane	Mercury
Dibenz(a,h)anthracene	Ethanol	Molybdenum
Diesel C10-C24	Ethylbenzene	Nickel
Indeno(1,2,3-cd)pyrene	Heptane	Selenium
Motor Oil C24-C36	Hexane	Vanadium
	Tetrahydrofuran	Zinc
Deep Subsurface (> 3 feet bgs)	Toluene	2-Butanone (MEK)
Cadmium	Xylenes (Total)	Acetone
Molybdenum		
2-Methylnaphthalene		
Acetone		
Anthracene		
Benzo(a)anthracene		
Benzo(a)pyrene		
Benzo(b)fluoranthene		
Benzo(g,h,i)perylene		
Benzo(k)fluoranthene		
Chrysene		
Dibenz(a,h)anthracene		
Diesel C10-C24		
Indeno(1,2,3-cd)pyrene		
Motor Oil C24-C36		
Naphthalene		
Phenanthrene		
Pyrene		

Notes:

bgs (below ground surface)

MEK - Methyl ethyl ketone.

MIBK - Methyl isobutyl ketone.

TABLE 15
SCREENING CRITERIA FOR CANCER RISK AND NONCANCER HAZARD CALCULATIONS
BULK/CONTAINER STORAGE UNIT CLOSURE
SAN FRANCISCO REFINERY, RODEO, CALIFORNIA
Page 1 of 2

Constituent	Carcinogenic Screening Criteria	
	Residential	Industrial
Soil COPCs ^a		
Benzo(a)pyrene TEQ ^b	0.038	0.13
Cadmium	1.7	7.5
Soil Vapor COPCs ^c		
1,1,2,2-Tetrachloroethane	na	na
Benzene	36.2	122
Ethylbenzene	na	na
Groundwater COPCs ^d		
Arsenic	0.045	na
Constituent	Noncarcinogenic Screening Criteria	
	Residential	Industrial
Soil COPCs ^a		
2-Methylnaphthalene	na	na
Acetone	na	na
Anthracene	na	na
Antimony	30	380
Benzo(g,h,i)perylene	na	na
Cadmium	1.7	7.5
Diesel C10-C24	na	na
Mercury	18	180
Motor Oil C24-C36	na	na
Molybdenum	380	4,800
Naphthalene	na	na
Phenanthrene	na	na
Pyrene	na	na
Soil Vapor COPCs ^c		
1,1,2,2-Tetrachloroethane	na	na
2-Butanone (MEK)	na	na
2-Propanol	na	na
4-Methyl-2-pentanone (MIBK)	na	na
Acetone	na	na
Benzene	36.2	122
Carbon Disulfide	na	na
Cyclohexane	na	na
Ethanol	na	na
Ethylbenzene	na	na
Heptane	na	na
Hexane	na	na
Tetrahydrofuran	na	na
Toluene	135,000	378,000
Xylenes (Total)	315,000	879,000

TABLE 15
SCREENING CRITERIA FOR CANCER RISK AND NONCANCER HAZARD CALCULATIONS
BULK/CONTAINER STORAGE UNIT CLOSURE
SAN FRANCISCO REFINERY, RODEO, CALIFORNIA
Page 2 of 2

Constituent	Noncarcinogenic Screening Criteria	
	Residential	Industrial
Groundwater COPCs ^d		
2-Butanone (MEK)	1,900	na
Acetone	610	na
Antimony	15	na
Barium	2,600	na
Chromium	55,000	na
Cobalt	730	na
Copper	1,500	na
Lead	na	na
Mercury	11	na
Molybdenum	180	na
Nickel	730	na
Selenium	180	na
Vanadium	260	na
Zinc	11,000	na

Notes:

- ^a Criteria obtained from Cal-EPA soil CHHSLs for residential and industrial receptors, Table 1 (January 2005). Concentrations reported in mg/kg (milligrams per kilogram).
- ^b Refer to Section 5.3.1.2 for calculation of the benzo(a)pyrene TEQ.
- ^c Criteria obtained from Cal-EPA shallow soil gas CHHSLs, Table 2 (January 2005). Concentrations are reported in ug/m³ (Micrograms per cubic meter).
- ^d Taken from USEPA Region 9, tap water criteria presented in ug/L (micrograms per liter).
- COPC - Chemical of potential concern.
MEK - Methyl ethyl ketone.
MIBK - Methyl isobutyl ketone.
na - Not applicable.
TEQ - Toxicity equivalent concentration

TABLE 16
SCREENING CANCER RISK AND NONCANCER HAZARD CALCULATIONS FOR SHALLOW SOIL - ALL DATA
BULK/CONTAINER STORAGE UNIT CLOSURE
SAN FRANCISCO REFINERY, RODEO, CALIFORNIA
 Page 1 of 1

	Soil			Cal-EPA		Residential Screening		Industrial Screening	
	Concentration (mg/kg)			Residential	Industrial	Soil EPC vs	Residential	Soil EPC vs	Industrial
	Maximum	95% UCL	EPC ^b	CHHSL (mg/kg)	CHHSL (mg/kg)	Residential CHHSL	Cancer Risk	Industrial CHHSL	Cancer Risk
Polynuclear Aromatic Hydrocarbons									
Benzo(a)pyrene TEQ ^a	4.6	0.25	0.25	0.038	0.13	6.6	6.6E-06	1.9	1.9E-06
						Cumulative Risk:	7E-06	Cumulative Risk:	2E-06
	Soil			Cal-EPA		Residential Screening		Industrial Screening	
	Concentration (mg/kg)			Residential	Industrial	Soil EPC vs	Residential	Soil EPC vs	Industrial
	Maximum	95% UCL	EPC ^b	CHHSL (mg/kg)	CHHSL (mg/kg)	Residential CHHSL	Noncancer HQ	Industrial CHHSL	Noncancer HQ
Inorganics									
Antimony	5.3	2.8	2.8	30	380	0.093	0.093	0.0073	0.0073
Mercury	5.3	18	5.3	18	180	0.29	0.29	0.029	0.029
Total Petroleum Hydrocarbons									
Diesel C10-C24	170	91	91	na	na	na	na	na	na
Motor Oil C24-C36	1,600	578	578	na	na	na	na	na	na
						Cumulative HI:	0.4	Cumulative HI:	0.04

Notes:

^a Refer to Table 4 for calculation of the benzo(a)pyrene TEQ.

^b Exposure point concentration (EPC) is the lower of the maximum soil concentration or the 95% UCL.

CHHSL - California Human Health Screening Level.

HI - Hazard index.

HQ - Hazard Quotient.

mg/kg - Milligrams per kilogram.

na - Not available.

TEQ - Toxicity equivalent concentration

UCL - Upper confidence limit.

TABLE 17
SCREENING CANCER RISK AND NONCANCER HAZARD CALCULATIONS FOR DEEP SOIL - ALL DATA
BULK/CONTAINER STORAGE UNIT CLOSURE
SAN FRANCISCO REFINERY, RODEO, CALIFORNIA
 Page 1 of 1

	Soil			Cal-EPA		Residential Screening		Industrial Screening	
	Concentration (mg/kg)			Residential	Industrial	Soil EPC vs	Residential	Soil EPC vs	Industrial
	Maximum	95% UCL	EPC ^b	CHHSL (mg/kg)	CHHSL (mg/kg)	Residential CHHSL	Cancer Risk	Industrial CHHSL	Cancer Risk
Inorganics									
Cadmium	0.57	0.35	0.35	1.7	7.5	0.20	2.0E-07	0.046	4.6E-08
Polynuclear Aromatic Hydrocarbons									
Benzo(a)pyrene TEQ ^a	4.6	8.4	4.6	0.038	0.13	122	1.2E-04	36	3.6E-05
						Cumulative Risk:	1E-04	Cumulative Risk:	4E-05
	Soil			Cal-EPA		Residential Screening		Industrial Screening	
	Concentration (mg/kg)			Residential	Industrial	Soil EPC vs	Residential	Soil EPC vs	Industrial
	Maximum	95% UCL	EPC ^b	CHHSL (mg/kg)	CHHSL (mg/kg)	Residential CHHSL	Noncancer HQ	Industrial CHHSL	Noncancer HQ
Inorganics									
Cadmium	0.57	0.35	0.35	1.7	7.5	0.20	0.20	0.046	0.046
Molybdenum	4.2	5.2	4.2	380	4,800	0.011	0.011	0.00088	0.00088
Volatile Organic Compounds									
Acetone	0.05	0.041	0.041	na	na	na	na	na	na
Polynuclear Aromatic Hydrocarbons									
2-Methylnaphthalene	2.7	1,970	2.7	na	na	na	na	na	na
Anthracene	0.45	3.1	0.45	na	na	na	na	na	na
Benzo(g,h,i)perylene	0.56	3.1	0.56	na	na	na	na	na	na
Naphthalene	1.2	3.1	1.2	na	na	na	na	na	na
Phenanthrene	0.98	3.2	0.98	na	na	na	na	na	na
Pyrene	1.1	3.3	1.1	na	na	na	na	na	na
Total Petroleum Hydrocarbons									
Diesel C10-C24	8,100	3,710	3,710	na	na	na	na	na	na
Motor Oil C24-C36	43,000	43,000	43,000	na	na	na	na	na	na
						Cumulative HI:	0.2	Cumulative HI:	0.05

Notes:

^a Refer to Table 4 for calculation of the benzo(a)pyrene TEQ.

^b Exposure point concentration (EPC) is the lower of the maximum soil concentration or the 95% UCL

CHHSL - California Human Health Screening Level.

HI - Hazard index.

HQ - Hazard Quotient.

mg/kg - Milligrams per kilogram.

na - Not available.

TEQ - Toxicity equivalent concentration

UCL - Upper confidence limit.

TABLE 18
SCREENING CANCER RISK AND NONCANCER HAZARD CALCULATIONS FOR SOIL VAPOR
BULK/CONTAINER STORAGE UNIT CLOSURE
SAN FRANCISCO REFINERY, RODEO, CALIFORNIA
 Page 1 of 1

	Soil Vapor			Cal-EPA		Residential Screening		Industrial Screening		
	Concentration (ug/m ³)			Residential	Industrial	Soil Vapor EPC vs	Residential	Soil Vapor EPC vs	Industrial	
	Maximum	95% UCL	EPC ^a	CHHSL (ug/m ³)	CHHSL (ug/m ³)	Residential CHHSL	Cancer Risk	Industrial CHHSL	Cancer Risk	
Volatile Organic Compounds										
1,1,2,2-Tetrachloroethane	470	na	470	na	na	na	na	na	na	
Benzene	5.4	na	5.4	36	122	0.15	1.5E-07	0.044	4.4E-08	
Ethylbenzene	18	na	18	na	na	na	na	na	na	
							Cumulative Risk:	1E-07	Cumulative Risk:	4E-08
	Soil Vapor			Cal-EPA		Residential Screening		Industrial Screening		
	Concentration (ug/m ³)			Residential	Industrial	Soil Vapor EPC vs	Residential	Soil Vapor EPC vs	Industrial	
	Maximum	95% UCL	EPC ^a	CHHSL (ug/m ³)	CHHSL (ug/m ³)	Residential CHHSL	Noncancer HQ	Industrial CHHSL	Noncancer HQ	
Volatile Organic Compounds										
1,1,2,2-Tetrachloroethane	470	na	470	na	na	na	na	na	na	
2-Butanone (MEK)	19	na	19	na	na	na	na	na	na	
2-Propanol	2,150,000	na	2,150,000	na	na	na	na	na	na	
4-Methyl-2-pentanone (MIBK)	55	na	55	na	na	na	na	na	na	
Acetone	23,500	na	23,500	na	na	na	na	na	na	
Benzene	5.4	na	5.4	36	122	0.15	0.15	0.044	0.044	
Carbon Disulfide	6.3	na	6.3	na	na	na	na	na	na	
Cyclohexane	1,100	na	1,100	na	na	na	na	na	na	
Ethanol	4,200	na	4,200	na	na	na	na	na	na	
Ethylbenzene	18	na	18	na	na	na	na	na	na	
Heptane	95	na	95	na	na	na	na	na	na	
Hexane	270	na	270	na	na	na	na	na	na	
Tetrahydrofuran	10,000	na	10,000	na	na	na	na	na	na	
Toluene	120	na	120	135,000	378,000	0.00089	0.00089	0.00032	0.00032	
Xylenes (Total)	56	na	56	315,000	879,000	0.00018	0.00018	0.000064	0.000064	
							Cumulative HI:	0.2	Cumulative HI:	0.04

Notes:

^a Exposure point concentration (EPC) is the lower of the maximum soil concentration or the 95% UCL

CHHSL - California Human Health Screening Level.

na - Not available.

HI - Hazard index.

nc - Not calculated, too few samples to calculate a 95% UCL.

HQ - Hazard Quotient.

UCL - Upper confidence limit.

MEK - Methyl ethyl ketone.

ug/m³ - Microgram per cubic meter.

MIBK - Methyl isobutyl ketone.

TABLE 19
SCREENING CANCER RISK AND NONCANCER HAZARD CALCULATIONS FOR GROUNDWATER
BULK/CONTAINER STORAGE UNIT CLOSURE
SAN FRANCISCO REFINERY, RODEO, CALIFORNIA
 Page 1 of 1

	Groundwater Concentration (ug/L)			USEPA Region IX		Residential Screening		Industrial Screening	
	Maximum	95% UCL	EPC ^a	Residential	Industrial	Groundwater EPC vs	Residential	Groundwater EPC vs	Industrial
				PRG (ug/L)	PRG (ug/L)	Residential PRG	Cancer Risk	Industrial PRG	Cancer Risk
Inorganics									
Arsenic	8.4	nc	8.4	0.045	na	187	1.9E-04	na	nc
						Cumulative Risk:	2E-04	Cumulative Risk:	0E+00
	Groundwater Concentration (ug/L)			USEPA Region IX		Residential Screening		Industrial Screening	
	Maximum	95% UCL	EPC ^a	Residential	Industrial	Groundwater EPC vs	Residential	Groundwater EPC vs	Industrial
				PRG (ug/L)	PRG (ug/L)	Residential PRG	Noncancer HQ	Industrial PRG	Noncancer HQ
Inorganics									
Antimony	1.4	nc	1.4	15	na	0.093	0.093	na	nc
Barium	350	nc	350	2,600	na	0.13	0.13	na	nc
Chromium	27	nc	27	55,000	na	0.00049	0.00049	na	nc
Cobalt	10	nc	10	730	na	0.013	0.013	na	nc
Copper	4.5	nc	4.5	1,500	na	0.0030	0.0030	na	nc
Lead ^b	4.2	nc	4.2	na	na	na	na	na	nc
Mercury	0.27	nc	0.3	11	na	0.025	0.025	na	nc
Molybdenum	87	nc	87	180	na	0.48	0.48	na	nc
Nickel	18	nc	18	730	na	0.025	0.025	na	nc
Selenium	7.3	nc	7.3	180	na	0.041	0.041	na	nc
Vanadium	32	nc	32	260	na	0.12	0.12	na	nc
Zinc	7.5	nc	7.5	11,000	na	0.00068	0.00068	na	nc
Volatile Organic Compounds									
2-Butanone (MEK)	20	nc	20	1,900	na	0.011	0.011	na	nc
Acetone	85	nc	85	610	na	0.14	0.14	na	nc
						Cumulative HI:	1	Cumulative HI:	0

Notes:

^a Exposure point concentration (EPC) is the lower of the maximum soil concentration or the 95% UCL.

^b Consistent with DTSC, lead was evaluated using the California Lead Risk Assessment spreadsheet.

CHHSL - California Human Health Screening Level.

HI - Hazard index.

HQ - Hazard Quotient.

MEK - Methyl ethyl ketone.

na - Not available.

nc - Not calculated, too few samples to calculate a 95% UCL.

UCL - Upper confidence limit.

ug/L - Microgram per liter.

TABLE 20
HUMAN HEALTH EXPOSURE PARAMETERS
BULK/CONTAINER STORAGE UNIT CLOSURE
SAN FRANCISCO REFINERY, RODEO, CALIFORNIA
Page 1 of 1

Parameter	Units	Site Worker		Hypothetical Resident				
		Symbol	Value	Adult		Child		
				Symbol	Value	Symbol	Value	
General								
Body weight	kg	BW_a	70	BW_a	70	BW_c	15	
Averaging time								
	carcinogens	days	ATcarc_a	25,550	ATcarc_a	25,550	ATcarc_c	25,550
	noncarcinogens	days	ATnoncarc_a	9,125	ATnoncarc_a	2,190	ATnoncarc_c	2,190
Exposure Duration	yrs		ED_a	25	ED_a	24	ED_c	6
Inhalation rate	m ³ /day		InhR_a	20	InhR_a	20	InhR_c	10
Ingestion of soil/dust								
Soil ingestion rate	mg/day		IRsoil_a	100	IRsoil_a	100	IRsoil_c	200
Exposure frequency	day/yr		EFsi_a	225	EFsi_a	350	EFsi_c	350
Dermal contact with soil/dust								
Dermal surface area	cm ² /event		SAsoil_a	3,300	SAsoil_a	5,700	SAsoil_c	2,800
Skin adherence factor	mg/cm ²		AF_a	0.2	AF_a	0.07	AF_c	0.2
Skin absorption factor	unitless		ABS	chemical specific	ABS	chemical specific	ABS	chemical specific
Exposure frequency	day/yr		EFsd_a	225	EFsd_a	350	EFsd_c	350
Inhalation of particulates associated with soil/dust								
Particulate Emission Factor	m ³ /kg		PEF	1.30E+09	PEF	1.30E+09	PEF	1.30E+09
Exposure frequency	day/yr		EFsinh_a	250	EFsinh_a	350	EFsinh_c	350

Sources:

USEPA (2004b; 2002c; 1997a,b; 1991b; 1989) and Cal-EPA (1999).

Notes:

cm²/event - Squared centimeters per event.

cm/hr - Centimeters per hour.

day/yr - Days per year

g/day - Grams per day.

kg - Kilogram.

L/day - Liters per day.

m³/kg - Cubic meters per kilogram.

mg/cm² - Milligrams per cubic centimeter.

TABLE 21
HUMAN HEALTH TOXICITY VALUES
BULK/CONTAINER STORAGE UNIT CLOSURE
SAN FRANCISCO REFINERY, RODEO, CALIFORNIA
Page 1 of 1

Chemical of Potential Concern	Cancer Slope Factor - CSF (mg/kg-d) ⁻¹			Reference dose - RfD (mg/kg-d)		
	Oral	Dermal	Inhalation	Oral	Dermal	Inhalation
Inorganics						
Antimony	na	na	na	4.0E-04 I	4.0E-04 R	4.0E-04 R
Cadmium	na	na	6.3E+00 I	5.0E-04 I	5.0E-04 R	5.0E-04 R
Mercury	na	na	na	3.0E-04 I	3.0E-04 R	8.0E-06 I ^q
Molybdenum						
Polycyclic Aromatic Hydrocarbons						
Benzo(a)pyrene TEQ	7.3E+00 I	7.3E+00 R	7.3E+00 N	na	na	na
Petroleum Hydrocarbons						
Diesel C10-C24, Aliphatic	na	na	na	1.0E-01 ^a	na	2.9E-01 ^a
Diesel C10-C24, Aromatic	na	na	na	4.0E-02 ^a	na	5.7E-01 ^a
Gasoline C24-C26, Aliphatic	na	na	na	2.0E+00 ^a	na	na
Gasoline C24-C26, Aromatic	na	na	na	3.0E-02 ^a	na	na

Notes:

COPC - Chemical of Potential Concern.

CSF - Cancer slope factor.

mg/kg-d - milligram per kilogram per day

na - Not Applicable.

RfD - Reference Dose.

Source Data:

I Integrated Risk Information System (IRIS) Database (USEPA, 2005a).

H Health Effects Assessment Summary Tables (HEAST) (USEPA, 1995).

N National Center for Environmental Assessment (NCEA) (USEPA, 2005b).

R Route Extrapolation.

^a Source: ADEC Guidance for Cleanup of Petroleum contaminated Sites (ADEC, 2000).

TABLE 22
SUMMARY OF BASELINE HUMAN HEALTH RISK ASSESSMENT RESULTS - SHALLOW SOIL
BULK/CONTAINER STORAGE UNIT CLOSURE
SAN FRANCISCO REFINERY, RODEO, CALIFORNIA
Page 1 of 1

Depth/Constituent	Cancer Risk and Noncancer Hazard Estimate			
	Residential Scenario		Industrial Scenario	
	ILCR	HI	ILCR	HI
All Data^a	4E-06	na	1E-06	na
All COPCs except PHCs:	na	0.1	na	0.02
PHCs:	na	0.2	na	0.01
Revised Data^b	2E-06	na	5E-07	na
All COPCs except PHCs:	na	0.2	na	0.02
PHCs:	na	0.1	na	0.01

Notes:

a - All Data refers to combined data for soils associated with both the BCSU and Inactive Waste Site 6C.

b - Revised Data refers to data for soils associated with only the BCSU proper.

COPC - Chemical of potential concern.

HI - Hazard index.

ILCR -Incremental lifetime cancer risk.

na - Not applicable.

PHC - Petroleum hydrocarbons.

"All Data" scenario = BCSU and IWS-6C soil samples

"Revised Data" scenario = BCSU soil samples only

TABLE 23
SUMMARY OF BASELINE HUMAN HEALTH RISK ASSESSMENT RESULTS - DEEP SOIL
BULK/CONTAINER STORAGE UNIT CLOSURE
SAN FRANCISCO REFINERY, RODEO, CALIFORNIA
Page 1 of 1

Depth/Constituent	Cancer Risk and Noncancer Hazard Estimate			
	Residential Scenario		Industrial Scenario	
	ILCR	HI	ILCR	HI
All Data^a	7E-05	na	2E-05	na
All COPCs except PHCs:	na	0.04	na	0.002
PHCs:	na	16	na	0.8
Revised Data^b	1E-06	na	4E-07	na
All COPCs except PHCs:	na	0.03	na	0.001
PHCs:	na	0.003	na	0.0002

Notes:

a - All Data refers to combined data for soils associated with both the BCSU and Inactive Waste Site 6C.

b - Revised Data refers to data for soils associated with only the BCSU proper.

COPC - Chemical of potential concern.

HI - Hazard index.

ILCR -Incremental lifetime cancer risk.

na - Not applicable.

PHC - Petroleum hydrocarbons.

"All Data" scenario = BCSU and IWS-6C soil samples

"Revised Data" scenario = BCSU soil samples only

TABLE 24
SUMMARY OF BASELINE HUMAN HEALTH RISK ASSESSMENT RESULTS - SOIL VAPOR
BULK/CONTAINER STORAGE UNIT CLOSURE
SAN FRANCISCO REFINERY, RODEO, CALIFORNIA
Page 1 of 1

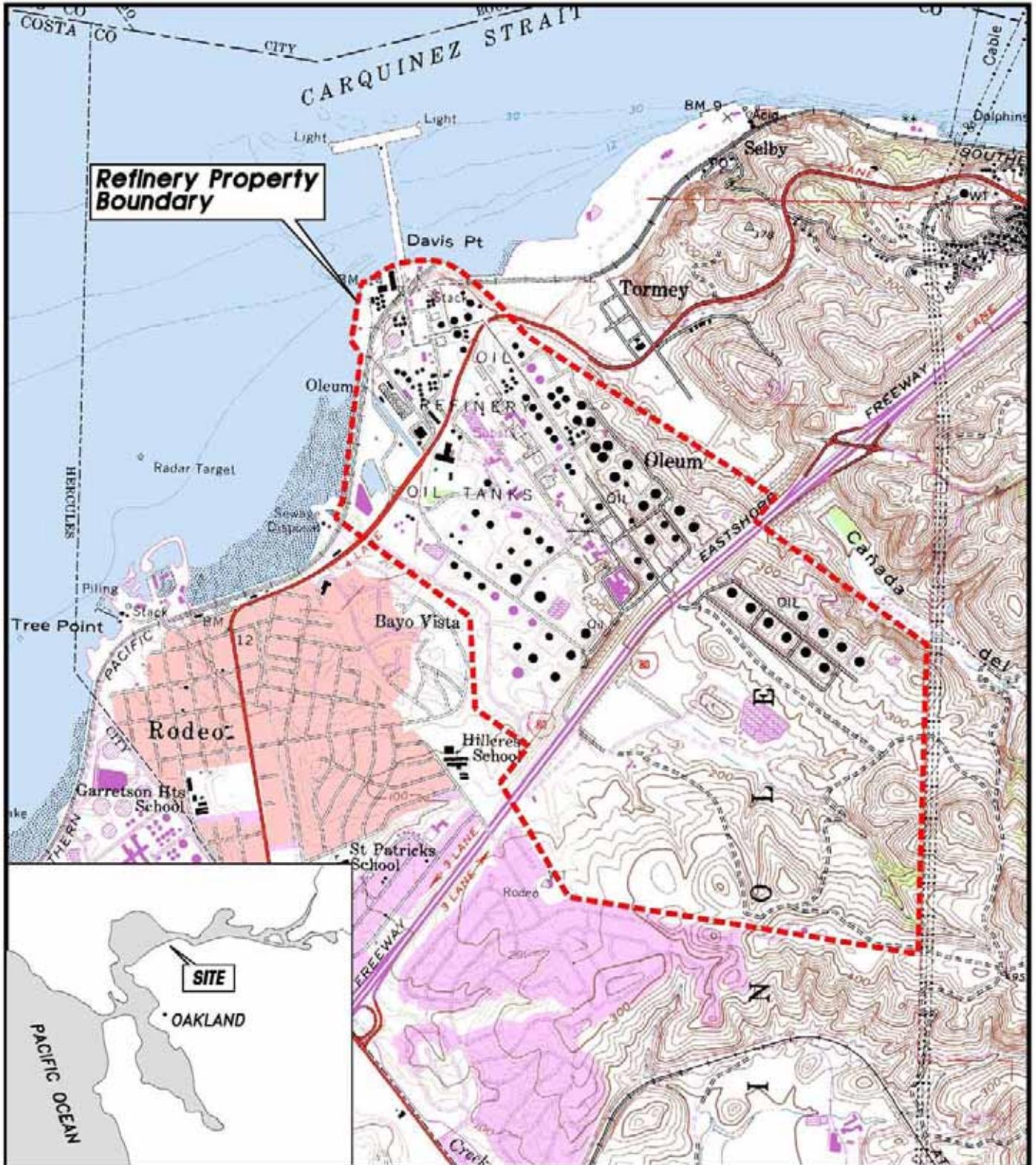
Constituent	Cancer Risk and Noncancer Hazard Estimate			
	Hypothetical Future Resident		Site Worker	
	ILCR	HI	ILCR	HI
1,1,2,2-Tetrachloroethane	5.3E-06	0.0020	3.2E-06	0.0015
2-Butanone (MEK)	NA	0.0000092	NA	0.0000065
2-Propanol	Not in J&E Model		Not in J&E Model	
4-Methyl-2-pentanone (MIBK)	NA	0.00033	NA	0.00023
Acetone	NA	0.035	NA	0.025
Carbon Disulfide	NA	0.0000040	NA	0.0000028
Cyclohexane	Not in J&E Model		Not in J&E Model	
Ethanol	Not in J&E Model		Not in J&E Model	
Ethylbenzene	4.0E-09	0.0000043	2.4E-09	0.0000030
Heptane	Not in J&E Model		Not in J&E Model	
Hexane	NA	0.000021	NA	0.000015
Tetrahydrofuran	Not in J&E Model		Not in J&E Model	
Cumulative ILCR/HI:	5E-06	0.04	3E-06	0.03

Notes:

HI - Hazard index.

ILCR -Incremental lifetime cancer risk.

NA - Not applicable.



Refinery Property Boundary



SOURCE: U.S.G.S. 7.5' QUAD SHEET
BENICIA & MARE ISLAND, CA
PHOTOREVISED 1980

SCALE:



SITE LOCATION MAP

CLIENT:

CONOCOPHILLIPS
SAN FRANCISCO REFINERY

DATE:

10/8/02

LOCATION:

RODEO, CALIFORNIA

FIGURE:

1

JOB No. --- FILE No. --- INDSTR\INDUSTRIAL\CAD_ML\EBK\RCDEO_REFINERY\CONTAINER_STORAGE_UNIT_CLOSURE\FIG 2 site plan 8 03



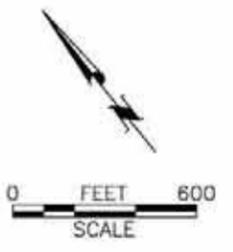
San Pablo Bay

San Pablo Bay

Lower Tank Farm Area

Bulk/Container Storage Unit

Interstate 80

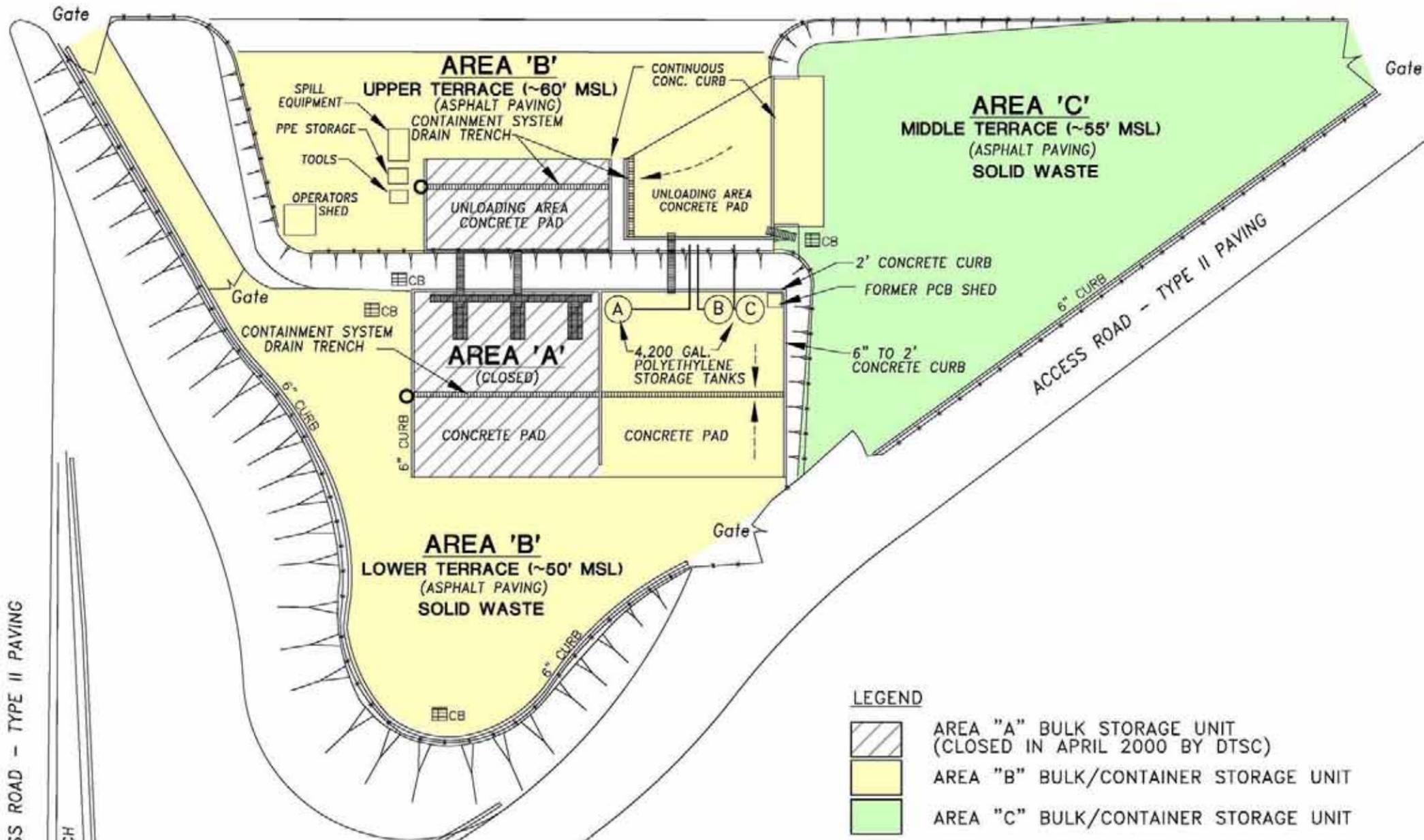


CONOCOPHILLIPS COMPANY
 SAN FRANCISCO REFINERY, RODEO, CA
 BULK/CONTAINER STORAGE UNIT CLOSURE PROJECT
**BULK/CONTAINER STORAGE UNIT
 LOCATION**

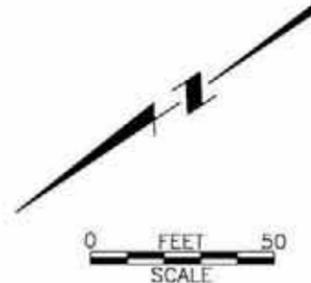
FIGURE 2

C:\INDSVR\INDUSTRIAL\CAD\MUJERKE\RODEO_REFINERY\CONTAINER_STORAGE_UNIT_CLOSURE\PHASE 1 FIG 1

MAIN ACCESS ROAD - TYPE II PAVING



MAIN ACCESS ROAD - TYPE II PAVING
 DRAINAGE TRENCH



- LEGEND**
- AREA "A" BULK STORAGE UNIT (CLOSED IN APRIL 2000 BY DTSC)
 - AREA "B" BULK/CONTAINER STORAGE UNIT
 - AREA "C" BULK/CONTAINER STORAGE UNIT
 - 6" SECURITY FENCE W/ACCESS GATES
 - CATCH BASIN
 - SLOPE OF CONCRETE CONTAINMENT PAD
 - STEEL SUPERSTRUCTURES AND STAIRWAYS
 - ABOVEGROUND POLYETHYLENE STORAGE TANKS WITH ASSOCIATED PIPING
 - LINER SYSTEM COLLECTION SUMP
 - MSL FEET MEAN SEA LEVEL

MWH
 CONOCOPHILLIPS COMPANY
 SAN FRANCISCO REFINERY, RODEO, CA
 BULK/CONTAINER STORAGE UNIT CLOSURE PROJECT
**BULK/CONTAINER STORAGE UNIT
 WASTE STORAGE/HANDLING FACILITIES**
 FIGURE 3

INDSVR\INDUSTRIAL\CAD_M\UERKE\REDO\REFINERY\CON STOR UNIT CLOSURE\inactive_waste_site_6c
FILE No. ---
JOB No. ---

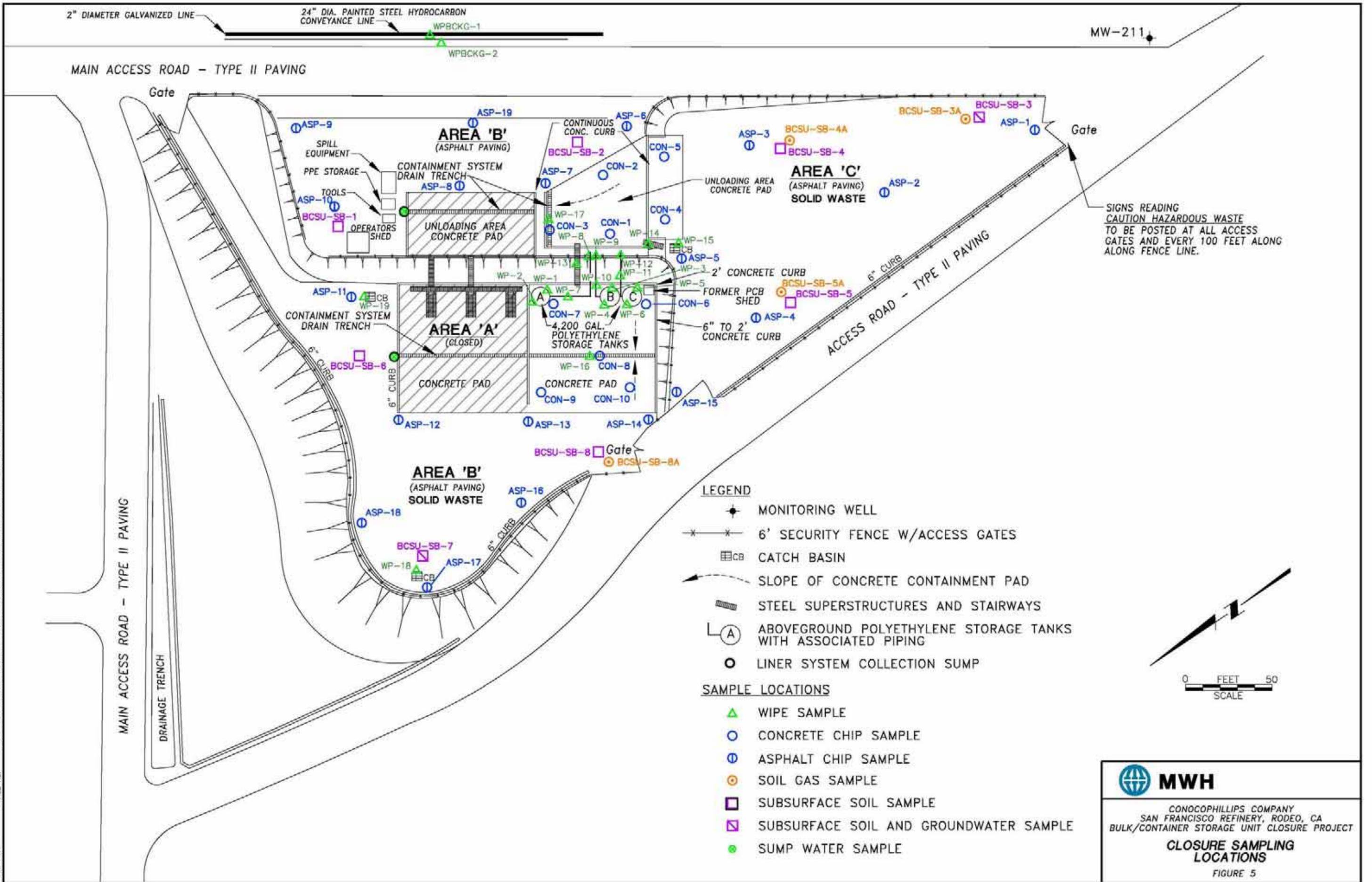


Legend

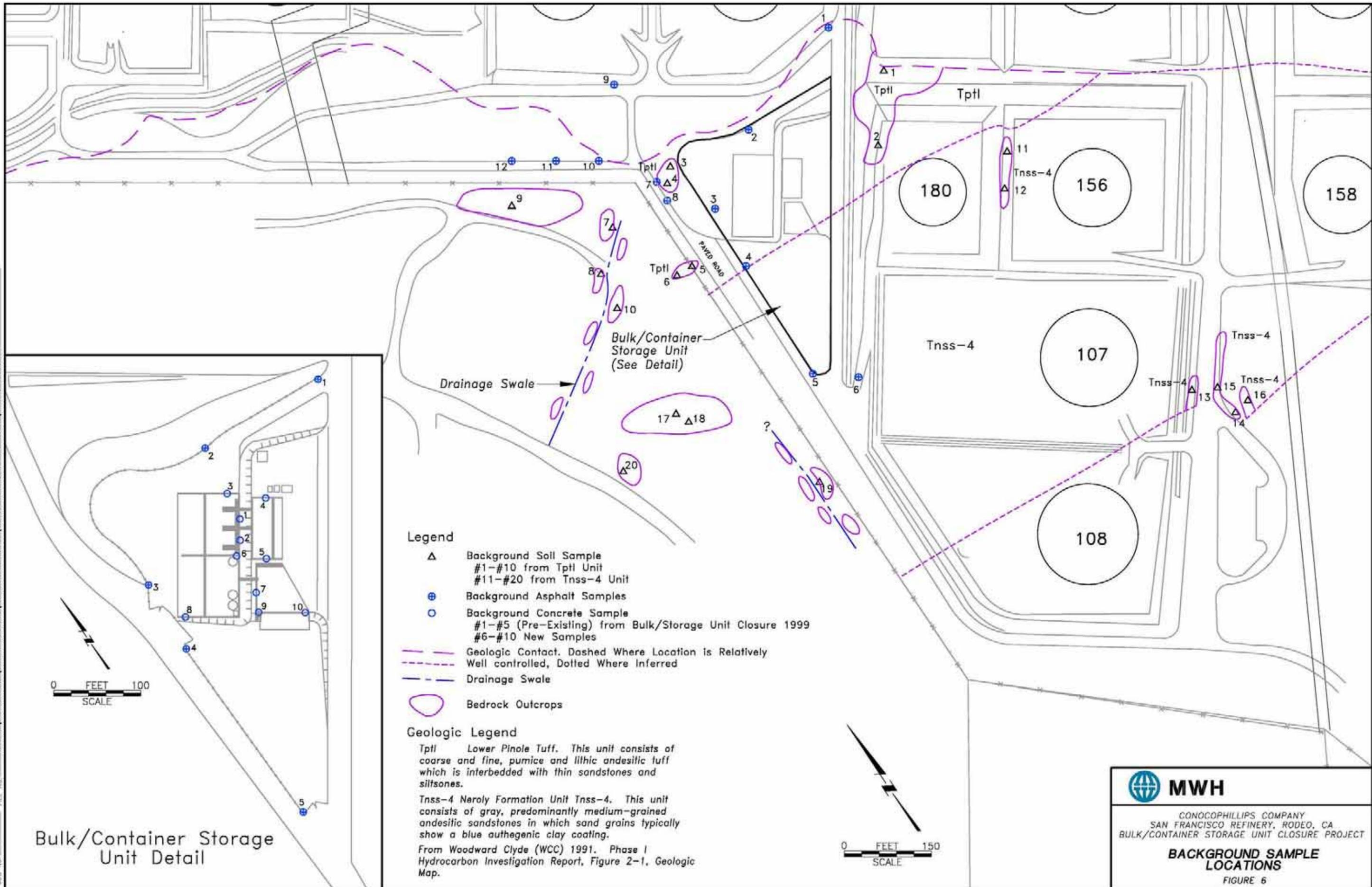
■ IWS-6C Monitoring Wells

 **MWH**
CONOCOPHILLIPS COMPANY
SAN FRANCISCO REFINERY, RODEO, CA
BULK/CONTAINER STORAGE UNIT CLOSURE PROJECT
**BCSU RELATIVE TO THE
"SOUTHEAST AREA" AND IWS-6C**
FIGURE 4

C:\INDSVR\INDUSTRIAL\CAD\MUJERKE\RODEO REFINERY\CONTAINER STORAGE UNIT CLOSURE\PHASE 1 FIG. 2



INDSVR\INDUSTRIAL\CAD_MLUEBKE\REDEO_REFINERY\CON STOR UNIT CLOSURE\PHASE I FIG 3



Bulk/Container Storage Unit Detail

Legend

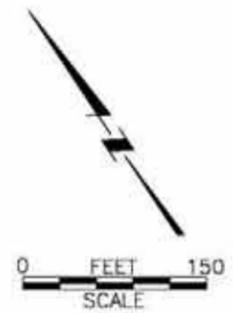
- △ Background Soil Sample
#1-#10 from Tptl Unit
#11-#20 from Tnss-4 Unit
- ⊕ Background Asphalt Samples
- Background Concrete Sample
#1-#5 (Pre-Existing) from Bulk/Storage Unit Closure 1999
#6-#10 New Samples
- Geologic Contact. Dashed Where Location is Relatively Well controlled, Dotted Where Inferred
- - - Drainage Swale
- Bedrock Outcrops

Geologic Legend

Tptl Lower Pinole Tuff. This unit consists of coarse and fine, pumice and lithic andesilic tuff which is interbedded with thin sandstones and siltstones.

Tnss-4 Neroly Formation Unit Tnss-4. This unit consists of gray, predominantly medium-grained andesilic sandstones in which sand grains typically show a blue authogenic clay coating.

From Woodward Clyde (WCC) 1991. Phase I Hydrocarbon Investigation Report, Figure 2-1, Geologic Map.

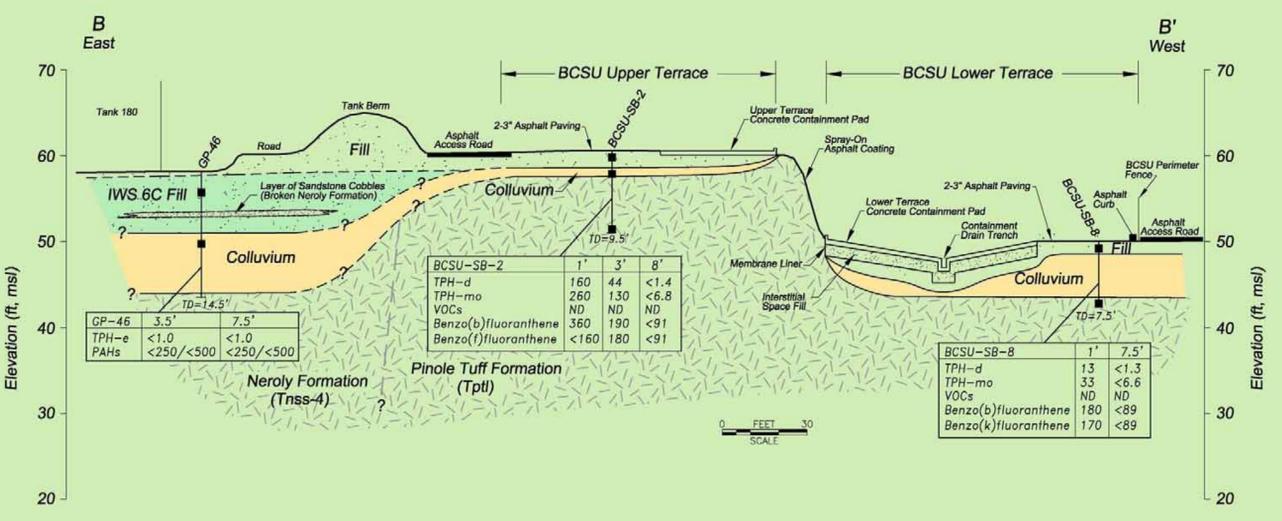
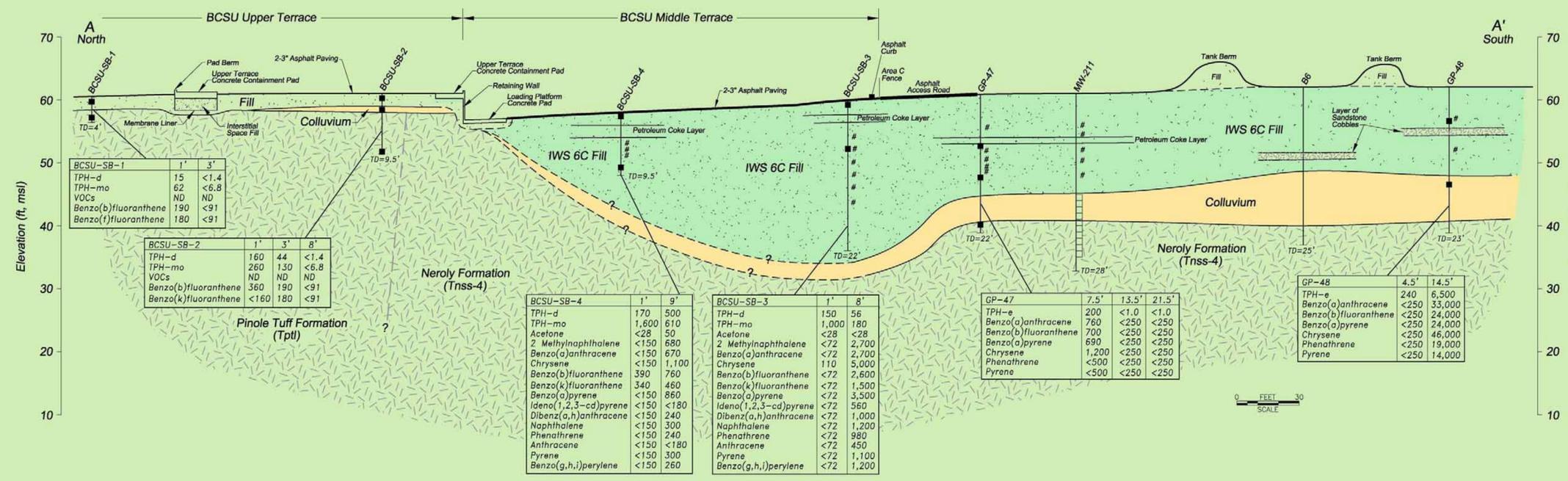


MWH

CONOCOPHILLIPS COMPANY
SAN FRANCISCO REFINERY, RODEO, CA
BULK/CONTAINER STORAGE UNIT CLOSURE PROJECT

BACKGROUND SAMPLE LOCATIONS

FIGURE 6



LEGEND

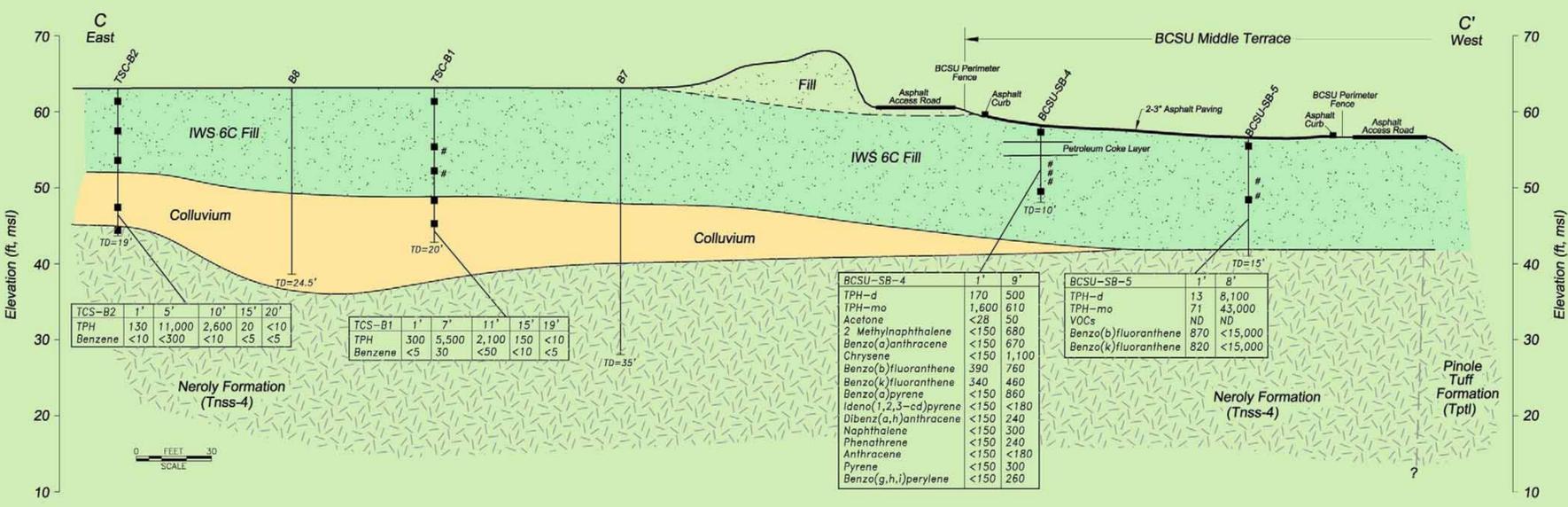
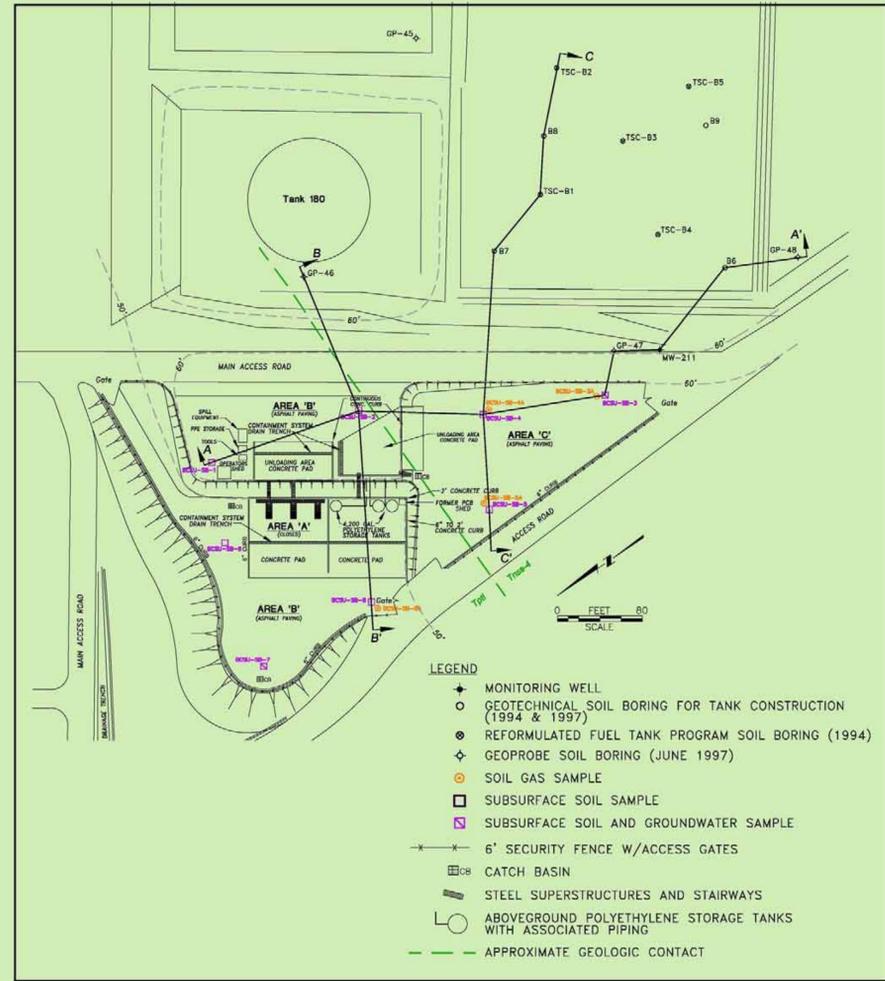
IWS 6C INACTIVE WASTE SITE SITE 6C
 TPH-e EXTRACTABLE TOTAL PETROLEUM HYDROCARBONS IN mg/kg, EPA METHOD 8015M
 TPH TOTAL PETROLEUM HYDROCARBONS IN mg/kg, EPA METHOD 8015M
 TPH-d TPH as DIESEL IN mg/kg, EPA METHOD 8015M
 TPH-mo TPH as MOTOR OIL IN mg/kg, EPA METHOD 8015M
 Benzene BENZENE IN ug/kg, EPA METHOD 8020
 PAHs POLY AROMATIC HYDROCARBONS IN ug/kg, EPA METHOD 8270
 VOCs VOLATILE ORGANIC COMPOUNDS IN ug/kg, EPA METHOD 8260
 (ALL COMPOUNDS NOT DETECTED AT REPORTING LIMITS UNLESS INDICATED)

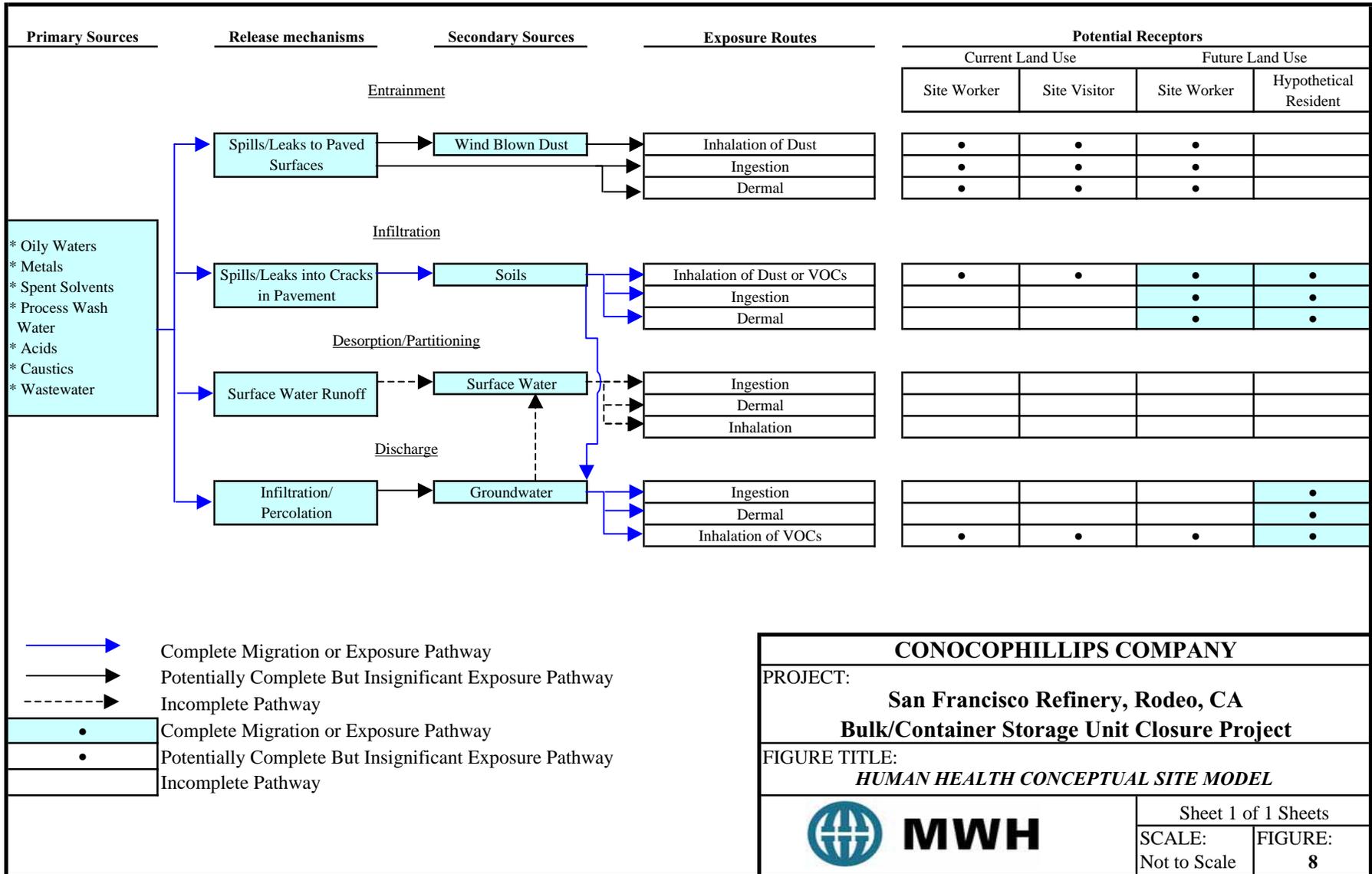
SOIL BORING/MONITORING WELL

SOIL SAMPLE LOCATION
 AREA OF PETROLEUM COKE CONGLOMERATIONS IN FILL MATRIX
 MONITORING WELL SCREENED INTERVAL
 TD=10' TOTAL DEPTH IN FEET
 GEOLOGIC CONTACT
 SOIL BORING
 GP-46 3.5' SAMPLE INTERVAL LOCATION
 TPH-e <1.0 CHEMISTRY RESULT
 ANALYTE

GEOLOGIC LEGEND

Tptl LOWER PINOLE TUFF. THIS UNIT CONSISTS OF COARSE AND FINE, PUMICE AND LITHIC ANDESITIC TUFF WHICH IS INTERBEDDED WITH THIN SANDSTONES AND SILTSTONES.
 Tnss-4 NEROLY FORMATION UNIT TNSS-4. THIS UNIT CONSISTS OF GRAY, PREDOMINANTLY MEDIUM-GRAINED ANDESITIC SANDSTONES IN WHICH SAND GRAINS TYPICALLY SHOW A BLUE AUTHEGENIC CLAY COATING.





APPENDIX A

Attachment A-1

Final Reconnaissance Evaluation of the Areal Extent of Former Inactive Waste Site 6C at the Unocal San Francisco Refinery, Rodeo, California. December 5, 1995.

Attachment A-2

Results of Additional Investigation and Remediation Plan, Inactive Waste Site 6C. August 1997.

Attachment A-3

Addendum to the Inactive Waste Site 6C Report – “Results of Additional Investigation and Remediation Plan, August 1, 1997.” January 7, 1998.

Attachment A-1

Final Reconnaissance Evaluation of the Areal Extent of Former Inactive Waste Site 6C at the Unocal San Francisco Refinery, Rodeo, California.
December 5, 1995.



December 5, 1995

Mr. Steve Mitchell
Corporate Environmental
and Remediation Technology
Northern Region
2000 Crow Canyon Place, Suite 400
San Ramon, California 94583

**Subject: Final Reconnaissance Evaluation of the Areal Extent of Former
Inactive Waste Site 6C at the Unocal San Francisco Refinery
(SFR), Rodeo, California**

Dear Mr. Mitchell:

Montgomery Watson is pleased to submit this final letter report to Unocal Corporate Environmental and Remediation Technology (CERT) for delineation of the recently identified Inactive Waste Site 6C (Site), located in the lower tank farm of the Unocal SFR. Figure 1 depicts the location of the UNOCAL SFR, in Rodeo, California. This report provides an introduction and background to the Site 6C issue, followed by a discussion of an aerial photograph reconnaissance, and information obtained from existing subsurface environmental and geotechnical investigations in the vicinity of the site.

INTRODUCTION AND BACKGROUND

The recently identified Inactive Waste Site 6C is located in the southeastern portion of the lower tank farm of the Unocal SFR. The Site was discovered during the Container Storage Unit (CSU) Closure investigation activities when hydrocarbon-impacted soils were discovered beneath the CSU, and historical aerial photographs were reviewed. The CSU Closure Plan (Woodward-Clyde Consultants (WCC), 1994b.) required the advancement of shallow soil borings and collection of soil samples at the facility. The soil borings encountered coke debris and hydrocarbon-impacted soils that were determined to have predated the construction and operation of the CSU, which was built in the mid-1970's. Facility records were reviewed, and aerial photographs of the site were obtained. Examination of an aerial photograph from December 1954 identified the Site as a fill area that was present prior to construction of aboveground storage tanks in the area. Construction of aboveground storage tanks in the area was evident in an aerial photograph taken in 1957. The fill appeared to contain dark, stained soils (possibly coke debris). Figure 2 shows the historical footprint of the original fill area, as identified from aerial photographs, superimposed on the current plot plan of the SFR. Figure 2 also identifies areas of environmental investigation (the former Tank 109 location, the Container Storage Unit and Soil Piles T2A and T2B) and existing groundwater monitoring wells in the vicinity of the site.

The SFR records review identified a 1958 SFR site plot plan (Map No. 37-58-Y-2) that classified the vicinity of the site as "L-4", apparently a designation for a land disposal site.

This classification is consistent with the identification on the same figure for the previously identified and delineated Inactive Waste Sites 2 and 3, 6, 6A, and 6B. Inactive Waste Sites 2 and 3, 6, 6A, and 6B were previously addressed in the Inactive Waste Sites Report (WCC, 1991). This report presents an evaluation of aerial photographs which provide a historical chronology of visual site conditions between 1953 and 1987, and a discussion of the historical subsurface investigations that were reviewed to assess the potential areal extent of contaminated fill material that may have been associated with the former disposal Site.

FINDINGS

Aerial Photograph Reconnaissance Results

The Site was undeveloped in August 1953, as shown on Figure 3. This undeveloped area lies south of the main SFR property, on a gentle northeast facing slope that comprised the southwestern limb of the San Pablo Syncline. The geology of the San Pablo Syncline and the SFR has been described in detail (WCC, 1990), and is discussed further below. The lower tank farm of the SFR was relatively undeveloped in August 1953, and there is visible evidence of sumps and localized surficial staining along much of the southeastern area of the SFR. Figure 4 shows the Site in August 1953 at a magnified scale, and shows a small drainage in the northeastern corner of the photograph, which existed topographically down gradient from the undeveloped Site.

The historical footprint of the original fill area was identified from an aerial photograph dated 8 December 1954, and is shown on Figures 5 (southwest portion of the photograph) and on Figure 6. The Site was present prior to the construction of Interstate 80, which is reported to have occurred in 1957. Figure 6 shows discrete piles of fill material that appear to have been placed by trucks. Comparing the previously undeveloped portions of the southeastern vicinity of the SFR in 1953, as shown on Figure 3, with the newly constructed units in the same areas shown on Figure 5, it appears that some of the surficial-stained areas and sumps may have been excavated and placed as fill in the area of the Site during operations in 1954. The fill material shown on Figure 6 appears to be a mixture of very dark and light materials, possibly coke debris, hydrocarbon-stained soils, and bedrock cut from the northern limb of the San Pablo Syncline. The areal extent of the fill identified on Figures 5 and 6 has been superimposed as the fill footprint on Figures 2 through 12. This material may have been reworked and spread during construction of the Tanks in this vicinity.

Figures 7 and 8 show the site in May of 1957, during the construction of Interstate 80. It appears that the construction of aboveground storage tanks No. 155 through 158 occurred between 1954 and 1957, and were possibly constructed on fill material placed in 1954.

The freeway is under construction during 1957, however, it does not appear that significant earth moving activities occurred in the vicinity of the Site for the freeway construction project. The significant freeway cuts that were made north of the SFR probably comprise the large volume of fill required for the freeway to traverse the San Pablo Synclinal valley, southeast of the SFR. Figure 8 shows an area in the southwest and southern portion of the photograph that appears to have been ploughed or terraced. This activity is consistent with the waste disposal procedures that were evidenced at the Inactive Waste Sites located on the east side of Interstate 80. This location is approximately coincident with the 1958 SFR site plot plan (Map No. 37-58-Y-2) that classified this vicinity as "L-4", the apparent land disposal area designation.

Figures 9 and 10 show the Site in June of 1959, and illustrates the ploughing pattern that was typical of the Inactive Waste Sites located on the east side of Interstate 80. In the vicinity of the Site, it appears that the construction activities associated with Tanks No. 155 through 158 and Interstate 80 are essentially complete. However, there still appear to be vehicular access roads to the area southwest of Tanks 156 and 158, which could be associated with waste disposal activities.

Figure 11 presents the Site in July 1977. The figure documents the use of the vicinity south of Tanks 156 and 158 as an equipment storage area, and possibly, a waste disposal site. This aerial photograph was examined as a stereo photograph, which facilitated interpretation about topographic relief in this area. There appear to be stained soils (identified as Area B on Figure 11) that drain from terraced areas into topographic depressions, and miscellaneous maintenance equipment storage areas (identified as Area A on Figure 11). A geotechnical investigation for Tank 109 (WCC, 1994) references a historical topographic map of this area from a previous geotechnical investigation for Tank 107, which confirms the topographic relief. This figure was also presented in a report prepared to assess the subsurface soil conditions at a proposed aboveground storage tank (Former Tank 109) that was planned for the recent Reformulated Fuels Project (WCC, 1994). Figure 2 shows the location of the former Tank 109 location.

Figure 12 shows the Site in March 1987. The area has been developed to accommodate the construction of Tanks 107 and 108; and the Container Storage Unit. These features appear to have been built upon the former disposal site. Prior to construction, the areas were likely reworked and leveled, and potentially filled with additional materials. Figure 2 shows these features, with respect to the approximate limits of the fill placed in 1954.

DOCUMENT REVIEW

This section presents brief summaries of previous investigations and documents that were performed in the vicinity of the Site.

Site Geology

The geology of the bedrock underlying the vicinity of the Site is comprised of the Neroly Formation (WCC, 1991). The Neroly Formation is a stratigraphic unit of the San Pablo Group, and is present on both the steeply dipping northeast limb and the gently dipping southwest limb of the San Pablo Syncline. The Neroly consists of gray to blue, massive and bedded, fossiliferous, well to poorly-sorted andesitic sandstones interbedded with siltstones, mudstones, and shales. A total of seven lithologic units (four sandstone and three finer-grained units) were described within the SFR. The Neroly in the vicinity of the Site has been mapped as the Tnss-4 unit and an undifferentiated unit, Tnsc-u. The Tnss-4 unit consists predominantly of gray to blue, poorly- to well-sorted, andesitic sandstone. The sand is typically medium-grained, but it also contains both coarse and fine beds. The unit is both thick- and thinly-bedded. The Tnsc-u is an undifferentiated siltstone and claystone, and underlies the southern-most portion of the Site. The strike of these beds at the vicinity of the Site is approximately east-west. The bedrock surface underlying the current Site vicinity is shallowest towards the southern and eastern portions of the area, and becomes deeper towards the north (i.e., toward Tank 107 and the formerly proposed Tank 109 location). This profile likely represents the pre-development slope of the hillside that was leveled and filled prior to construction in this area.

Groundwater Monitoring Wells in Vicinity of Site 6C

There are three groundwater monitoring wells that were installed as part of the Unocal SFR Hydrocarbon Investigation (WCC, 1992) that are in the vicinity of the Site (Figure 2). Groundwater monitoring well MW-139 (screened approximately 21.7 to 31.7 feet below ground surface) is located within the former footprint of the fill limits identified in the 1954 aerial photograph. Groundwater monitoring well MW-138 (screened approximately 22 to 32 feet below ground surface) is located in a northeasterly direction from the Site. Monitoring well MW-137 (screened approximately 5.5 to 15.5 feet below ground surface) is located north of the site, in the valley floor. The groundwater monitoring data collected from these wells indicate low concentrations of TPH (Method 418.1), ranging from 0.6 to 1.5 mg/l, as reported in the Hydrocarbon Investigation Report (WCC, 1992). Boring logs for these wells do not indicate coke debris, or other visible materials in fill that are indicative of an inactive waste site. However, the soil samples obtained from the installation of well MW-138 do indicate zones of elevated TPH (Method 418.1) at depth: 900 mg/kg at approximately 6 feet below ground surface, 430 mg/kg at approximately 16 feet below ground surface, and 400 mg/kg at approximately 26 feet below ground surface. These detections were each separated by a sample interval that reported a non-detect result for TPH (at 11 feet and 26 feet, respectively).

Former Tank 109 Investigations

A geotechnical investigation was performed in 1994 (WCC) in the vicinity of the former Tank 109 location (Figure 2). A geotechnical investigation which included logs of borings advanced in the general Tank 109 location was also performed in 1977 in support of the construction of Tank 107. The 1977 report indicated that the fill and native soils that covered most of the site were not appropriate for supporting large storage tanks, and consisted of a heterogeneous mixture of coke, expansive clay, organic material and other poorly compacted debris. Earthwork was performed prior to the construction of Tank 107, and may have resulted in the removal of structurally deleterious fill, including contaminated fill. The 1994 geotechnical report recommended removal of the fill and underlying soil beneath the Tank 109 location, and led to the Reformulated Fuels Tankage Soil Characterization project (Montgomery Watson, 1994.) to assess the soil chemistry, and consider soils management and disposal options.

Reformulated Fuels Tankage Soil Investigation

The investigation of the subsurface conditions at the formerly proposed Tank 109 location included the advancement of 5 soil borings around the footprint of the tank (Figure 2) (Montgomery Watson, 1994.). The borings were advanced to depths of approximately 20 feet below ground surface, and continuously sampled for stratigraphic logging. Five soil samples were selected at approximate 5-foot depth intervals from each of the borings, and submitted for chemical analysis using a phased analytical protocol. The Phase 1 analyses included: CCR 17 metals (EPA Method 7000); total petroleum hydrocarbons as gasoline (TPH-g) with benzene, toluene, ethyl benzene, and total xylenes (BTEX) distinction (EPA Method m8015/8020); TPH (EPA Method 5520F) on each sample, and static hazardous abbreviated screen bioassays on one sample (with the highest respective H-nu headspace reading) per tank block. The Phase 2 analyses included: reactivity, corrosivity, and ignitability (RCI) analysis on the single archived sample that had the highest TPH-g/BTEX result; Toxicity-Characteristic Leaching Procedure (TCLP) for lead on selected archived-samples; and California Assessment Method Waste Extraction Test (CAM WET) for lead on selected archived samples.

Heterogeneous fill material was encountered in each of the borings at the proposed Tank 109 location, from ground surface to depths ranging from 11 to 13.5 feet. The fill material contained occasional lithic debris, wood fragments, and sparse concrete debris, and was moderately to highly plastic locally, with occasional non-plastic horizons. The fill contained hydrocarbon staining and visibly discernible coke debris locally. There were variable zones or horizons within the fill that appeared to contain coke and/or tarry debris, and discernible hydrocarbon odors and staining. Bedrock was encountered in two borings, on the eastern and southern perimeters of the proposed tank footprint. Sandstone was

visible in these borings below 19 and 18 feet, respectively, to the total depth of each boring. The material was comprised of light to yellowish brown, very fine to fine-grained, weathered, weak to friable sandstone. The sandstone contained some silt and trace amounts of clay.

Elevated concentrations of total lead were detected in 4 of the 5 borings at variable depths. Five samples contained total lead concentrations in excess of 50 mg/kg (maximum of 1,900 mg/kg). Two samples selected for the CAM WET analysis reported results greater than the STLC value for lead (5.0 mg/l). These included samples from two different borings at depths of approximately 10 to 11 feet (6.7 mg/kg) and 5 to 6 feet (12 mg/kg) below ground surface. TPH-g was not detected above 38 mg/kg, and benzene was not detected above 240 parts per billion (ppb) at this proposed tank location. Heavy-end TPH (EPA 5520F) was detected in each boring at this proposed tank location, with concentrations ranging from 20 to 11,000 mg/kg. The TPH appears to attenuate between approximately 15 and 20 feet bgs, and appears to reach maximum concentrations between approximately 5 and 11 feet bgs. The elevated concentrations are likely associated with localized zones of hydrocarbon materials within the heterogeneous fill.

Container Storage Unit Closure

The CSUC project required the collection and analysis of soil samples from beneath the CSU containment structure (WCC, 1994). Eighteen primary test soil samples were collected underlying the unit (3 intervals at 6 locations) and an additional 4 samples were obtained immediately underlying the asphalt behind the structure to serve as background samples representative of the soil/asphalt interface. Additionally, a set of 12 samples were obtained (3 intervals at 3 locations) to characterize background fill soil chemistry. These samples were obtained south of the SFR fence line, on a small parcel of property in the southernmost portion of the Lower Tank Farm area.

Soils encountered beneath Area 3 of the unit (confirmation borings SB3-1 and SB3-2) were comprised of fill material that was not characteristic of the soils encountered in any of the background soil borings. The fill in these locations, and particularly in the SB3-2 boring, contained petroleum coke debris. This material was historically deposited in this area prior to construction and operation of the Unit. The coke debris contains material up to approximately 3 inches in diameter, and was sporadically present in the fill material of Area 3. The soil samples were analyzed for TPH-g, TPH-diesel (TPH-d), TPH-motor oil (mo), total petroleum hydrocarbons as oil and grease (SM 5520CF); total metals; organic lead; PCBs; pH; VOCs; SVOCs.

The soil chemistry results indicate elevated concentrations of petroleum hydrocarbons, metals and polynuclear aromatic hydrocarbons consistent with coke debris and petroleum

waste. The TPH-g reported detections range in concentration from 1.0 to 15 mg/kg, with an average concentration of 7.5 mg/kg.

Total extractable petroleum hydrocarbons in the diesel range were reported above detection limits in 9 primary and 3 duplicate confirmation soil samples. These were limited to the borings advanced in Area 3 (which was the portion of the Unit where coke debris was observed in the fill material). The reported detections range in concentration from 26 to 360 mg/kg, with an average concentration of 108 mg/kg.

Total extractable petroleum hydrocarbons in the motor oil range were reported above detection limits in the same 9 primary and 3 duplicate confirmation soil samples that reported diesel range petroleum hydrocarbons. The reported detections range in concentration from 30 to 1,500 mg/kg, with an average concentration of 455 mg/kg. These were also associated with the coke material identified below Area 3.

In accordance with the phased analytical approach of the Closure Plan, certain samples were analyzed for total recoverable petroleum hydrocarbons by SM 5520 CF. Total recoverable petroleum hydrocarbons were detected in twelve primary and 2 duplicate soil confirmation samples, with concentrations ranging from 72 to 840 mg/kg. The average concentration detected was 804 mg/kg.

The presence of relatively heavy-end hydrocarbons in soil at Area 3 is likely attributable to the coke debris observed in the fill in Area 3 borings. The coke debris was not associated with the Unit operations, and was placed at the site prior to construction of the Unit.

Polychlorinated biphenyls (PCBs) were reported as PCB 1254 above the detection limit for 6 confirmation soil samples from Area 3 (150, 110, 410, 220, 210 and 760 µg/kg, respectively). One background soil sample was reported to contain PCB 1254 at a concentration of 450 µg/kg.

Toluene and total xylenes were detected in two samples from one boring in Area 3 at concentrations of 19 and 20 µg/kg; and 9.5 and 10.0 µg/kg, respectively. Benzene was detected in one of these samples at a concentration of 5 µg/kg (the detection limit for this constituent).

Ten semivolatile organic compounds were detected from five confirmation soil samples (3 primary and 2 duplicate samples) obtained from one boring location in Area 3. The following compounds were detected at depths ranging between 0.5 and 6.5 feet from fill samples from a boring in Area 3: benzo(a)anthracene (1,200 to 14,000 µg/kg); benzo(b)fluoranthene (1,000 to 10,000 µg/kg); benzo(g,h,i)perylene (3,200 to 5,700 µg/kg); benzo(a)pyrene (1,200 to 12,000 µg/kg); chrysene (4,100 to 7,900 µg/kg); dibenz(a,h)anthracene (2,600 to 6,200 µg/kg); 2-methyl naphthalene (2,600 to 5,700 µg/kg); naphthalene (2,900 µg/kg); phenanthrene (2,700 µg/kg); and pyrene (3,800 to 4,200 µg/kg).

Lead concentrations appear locally elevated in Area 3 soil confirmation samples, and may be attributed to the coke debris observed in the fill in this area. Eight of the soil samples

obtained in Area 3 were reported to contain total lead concentrations in excess of 10xSTLC (>50 mg/kg). These concentrations range from 56 to 440 mg/kg. Mercury was detected in all but two of the soil samples. The mercury concentrations ranged from 0.17 to 2 mg/kg, where detected. Only one sample contained mercury in excess of 10xSTLC (>2 mg/l). The remainder of the Area 3 soil confirmation sample results indicate that metals were not detected at concentrations that exceed 10xSTLC. None of these samples contain metals in excess of the TTLC values listed in CCR Title 22. Unocal awaits California Department of Toxic Substances Control (DTSC) approval of the investigation prior to completion of a Closure Certification Report.

Soil Piles T2A and T2B

Two soil piles exist within the approximate vicinity of the Site. These have been classified as Soil Piles T2A and T2B, and were generated during previous construction operations at the SFR. The volumes of the piles are approximately 4,000 and 3,000 cubic yards, respectively. Pile T2A was generated during the Unit 100 expansion project. The pile has undergone "fluffing" or "conditioning", but was not bioremediated. Pile T2B was generated upon clean-up and site preparation of the area used for lay-down of the Unit 100 expansion project soils. This soil is primarily comprised of material excavated from below the original grade upon which the Unit 100 expansion project soils were placed (this is over-excavated material from the Site 6C subsurface).

The piles were sampled in 1991 and preliminary characterization has been accomplished. Field samples were collected from each pile at depths of approximately 6 inches to 1 foot below surface using a grid for selection of the sample locations. The field samples were composited for chemical analysis in the laboratory. Four sets of composited lab samples (comprised of 4 field samples) were analyzed from each pile for CCR 17 metals; and 8 different sets of composited lab samples (comprised of 4 field samples) were analyzed for the CAM WET for each of the CCR 17 metals. Additionally, TCLP VOC and SVOC were analyzed on the set of 4 composited samples from pile T2A; and TPH as diesel and TPH as heavy petroleum were analyzed on the set of 8 composited samples from T2A. The set of 8 composited samples from T2B were also analyzed for TPH as diesel.

The existing data indicate that the piles contain elevated levels of total and soluble lead, and petroleum hydrocarbons. Based upon the historical sampling, pile T2A contains an average total lead concentration of 121 mg/kg (based upon 4 samples, standard deviation of 51.2 mg/kg) and an average soluble lead concentration of 4.45 mg/l (based upon 8 different samples, standard deviation of 1.26 mg/l). Pile T2B contains an average total lead concentration of 551 mg/kg (based upon 4 samples, standard deviation of 454.81 mg/kg) and an average soluble lead concentration of 24.74 mg/l (based upon 8 different samples, standard deviation of 15.26 mg/l).

Mr. Steve Mitchell
Corporate Environmental
and Remediation Technology
December 5, 1995
Page 9

Montgomery Watson resampled Soil Pile T2B (Montgomery Watson, 1995a.) to assess whether the soil in the pile is vertically stratified, or if the original surficial samples were representative of the soils located at depth. The pile does not appear to be vertically stratified or differ significantly between northern and southern portions with respect to lead concentrations. Both soil piles are significantly vegetated and moderately compacted on their outer surfaces.

Summary

In summary, land disposal was initiated at Inactive Waste Site 6C sometime between August 1953 and December 1954 (see Figures 4 to 6). Fill containing coke debris and petroleum-contaminated soil was deposited at the Site over a trapezoidal-shaped area measuring approximately 6 acres. Since the contaminated fill was originally deposited at the Site, earthwork has been performed and aboveground storage tanks have been constructed within the footprint of the original fill area. Although available aerial photographs provide a reasonable approximation of the boundaries of the Site, a precise evaluation of the extent of the Site is not possible from the available information because earthwork and construction activities that have occurred in the area may have redistributed some of the fill outside of the original visually apparent footprint.

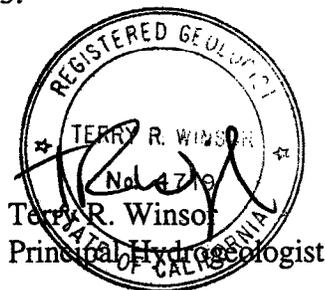
Subsurface soil quality investigations have been performed which indicate that the primary chemical constituents of concern are heavy-end petroleum hydrocarbons, semivolatile organics, lead and mercury. On average, the constituent concentrations indicate that the contaminated subsurface soils are not hazardous.

If you have questions or comments regarding this report, please feel free to call me at (510) 975-3474 or Bob Aaserude at (510) 975-3543.

Sincerely,

//Original Signed By //

✓Simon Bluestone, R.E.A.
Project Manager



Attachment

References

Montgomery Watson. 1994. Reformulated Fuels Tankage Soils Characterization Project Report, prepared for the Unocal San Francisco Refinery, Rodeo, California. March.

Montgomery Watson. 1995. Soil Pile T2B Sampling Results, prepared for the Unocal San Francisco Refinery, Rodeo, California. April.

Union Oil Company of California, Map No. 37-58-Y-2, Oleum Refinery Plot Plan from 1958.

Woodward Clyde Consultants. 1990. Geologic Map and Report of the San Francisco Refinery, Rodeo, California. August.

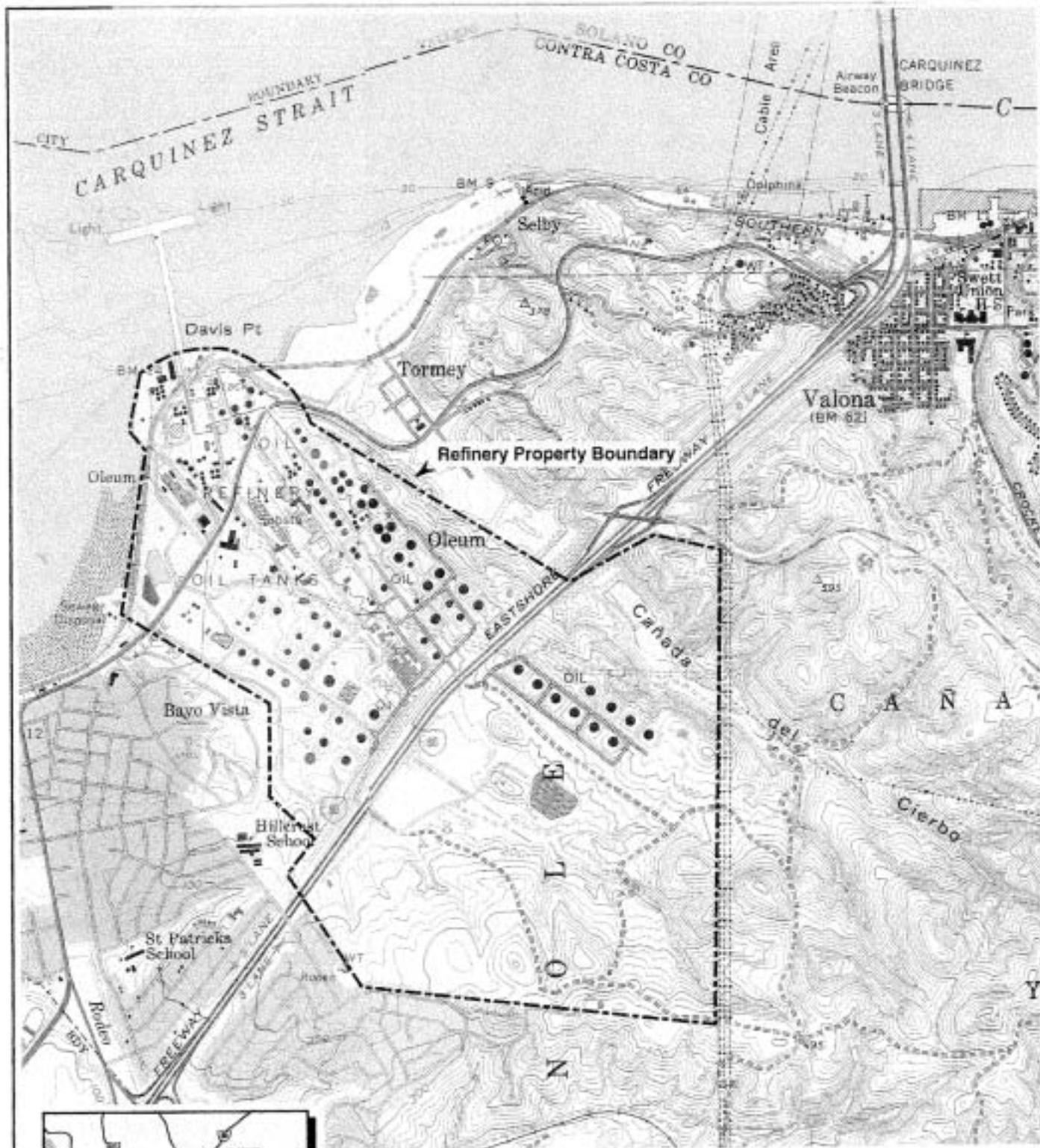
Woodward Clyde Consultants. 1991. Inactive Waste Sites Report, prepared for the Unocal San Francisco Refinery, Rodeo, California. July.

Woodward Clyde Consultants. 1992. Hydrocarbon Investigation Report, prepared for the Unocal San Francisco Refinery, Rodeo, California. September.

Woodward Clyde Consultants. 1994. Geotechnical Engineering Study Unocal Tankage Reassignment/Construction Project, Rodeo, California. January.

Woodward Clyde Consultants. 1994a. Additional Design Recommendations, Unocal Tankage Reassignment/Construction Project, San Francisco Refinery, Rodeo, California. January.

Woodward Clyde Consultants. 1994b. Closure Plan, Unocal San Francisco Refinery Container Storage Unit E.P.A. No. 009108705, prepared for the Unocal San Francisco Refinery, Rodeo, California. April.



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**UNOCAL SAN FRANCISCO REFINERY
RODEO, CALIFORNIA
SITE LOCATION MAP**

FIGURE 1

USGS Topographic Maps, 7.5', Mare Island and Benicia CA Quads., 1980.

DATE 11

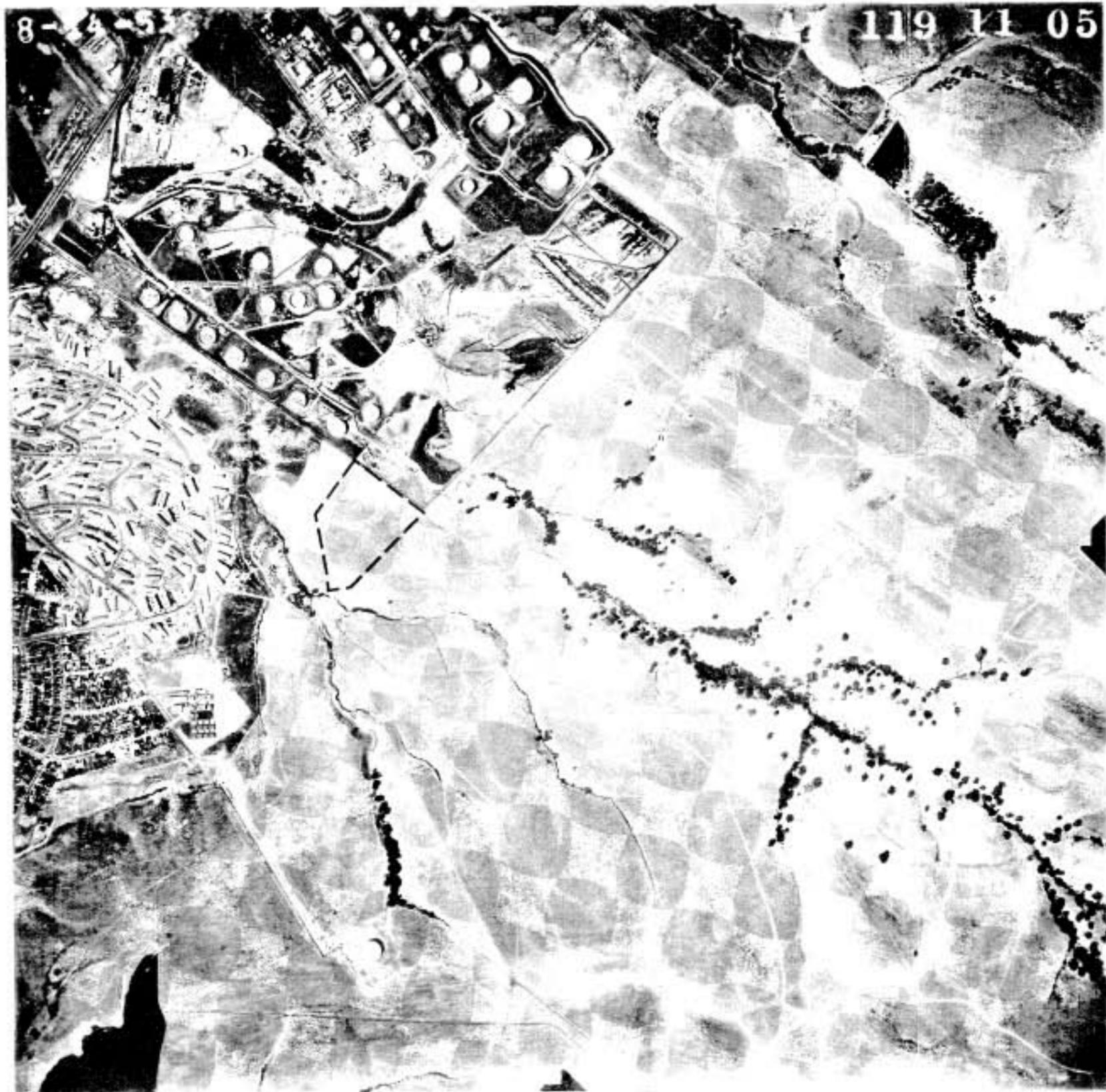


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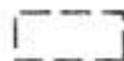
 **MONTGOMERY WATSON**

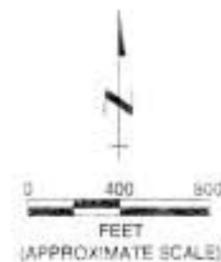
**UNOCAL SAN FRANCISCO REFINERY
 RODEO, CALIFORNIA
 SITE PLAN**

FIGURE 2



EXPLANATION

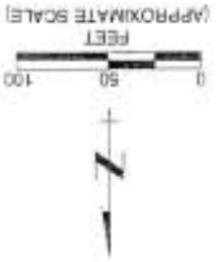
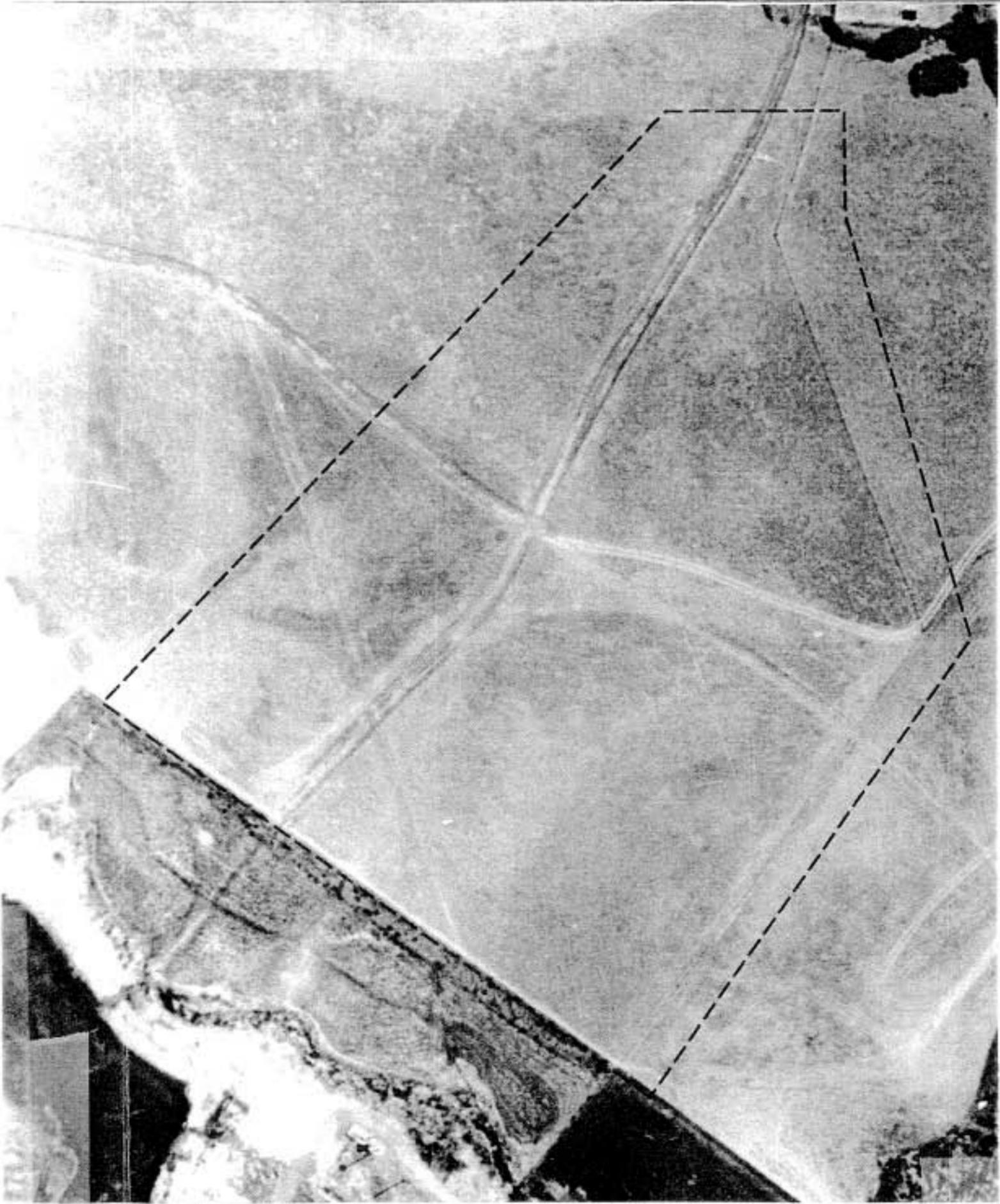
 Approximate Limits of Fill Placed in 1954



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UNOCAL SAN FRANCISCO REFINERY
RODEO, CALIFORNIA
REGIONAL AERIAL PHOTOGRAPH OF
INACTIVE WASTE SITE 6C VICINITY
14 AUGUST 1953

FIGURE 3



EXPLANATION

— Approximate Limits of Fill Placed in 1954



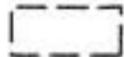
MONTGOMERY WATSON

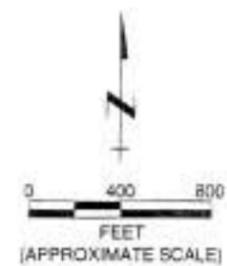
UNOCAL SAN FRANCISCO REFINERY
RODEO, CALIFORNIA
AERIAL PHOTOGRAPH OF
INACTIVE WASTE SITE 6C VICINITY
14 AUGUST 1953

FIGURE 4



EXPLANATION

 Approximate Limits of Fill Placed in 1954



MONTGOMERY WATSON

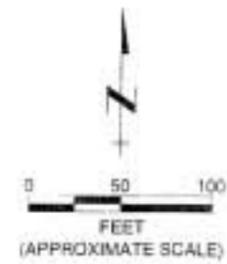
UNOCAL SAN FRANCISCO REFINERY
RODEO, CALIFORNIA
**REGIONAL AERIAL PHOTOGRAPH OF
INACTIVE WASTE SITE 6C VICINITY
8 DECEMBER 1954**

FIGURE 5



EXPLANATION

 Approximate Limits of Fill Placed in 1954



MONTGOMERY WATSON

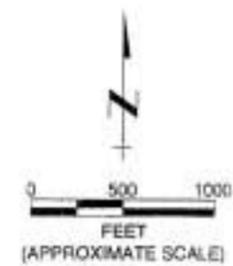
UNOCAL SAN FRANCISCO REFINERY
RODEO, CALIFORNIA
**AERIAL PHOTOGRAPH OF
INACTIVE WASTE SITE 6C VICINITY
8 DECEMBER 1954**

FIGURE 6



EXPLANATION

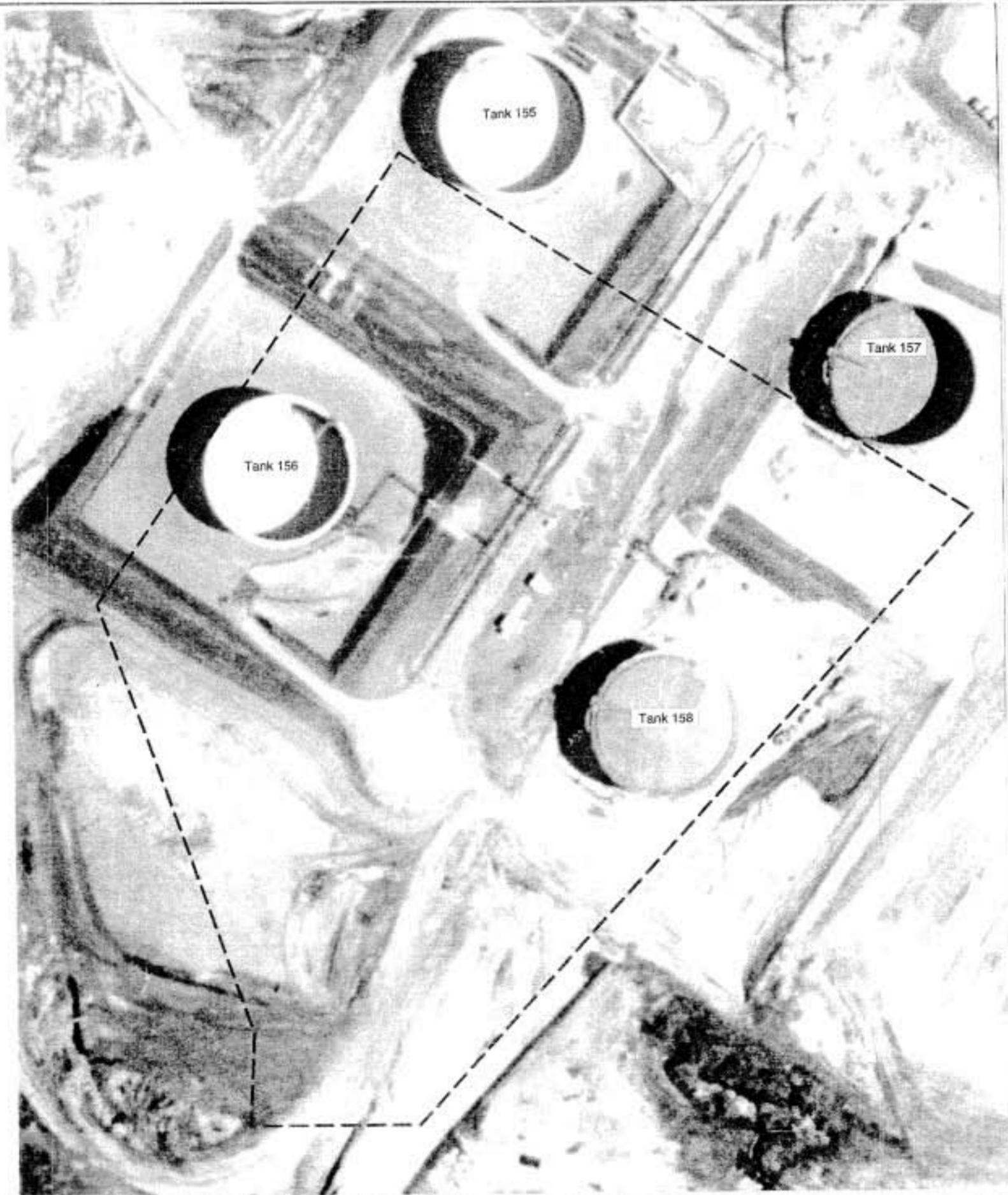
 Approximate Limits of Fill Placed in 1954



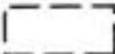
 MONTGOMERY WATSON

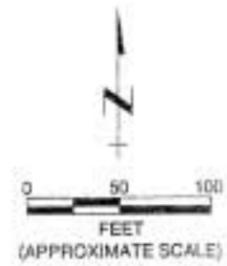
UNOCAL SAN FRANCISCO REFINERY
RODEO, CALIFORNIA
REGIONAL AERIAL PHOTOGRAPH OF
INACTIVE WASTE SITE 6C VICINITY
4 MAY 1957

FIGURE 7



EXPLANATION

 Approximate Limits of Fill Placed In 1954



MONTGOMERY WATSON

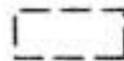
UNOCAL SAN FRANCISCO REFINERY
RODEO, CALIFORNIA
**AERIAL PHOTOGRAPH OF
INACTIVE WASTE SITE 6C VICINITY
4 MAY 1957**

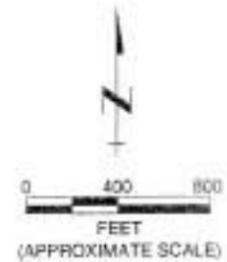
FIGURE 8

0895.U



EXPLANATION

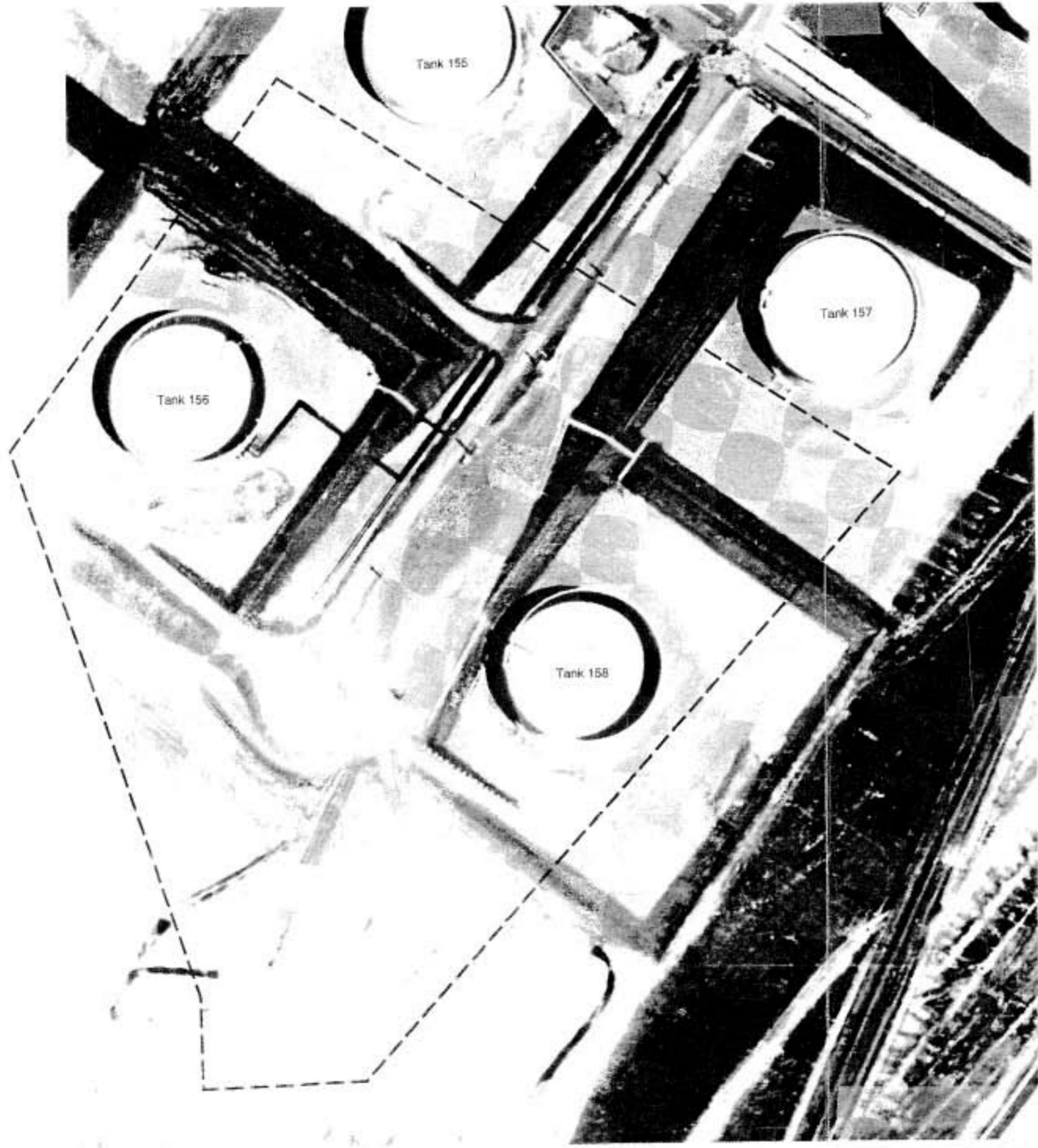
 Approximate Limits of Fill Placed in 1954



MONTGOMERY WATSON

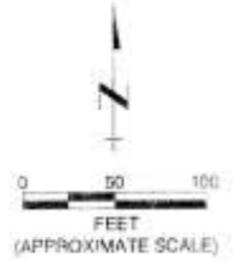
UNOCAL SAN FRANCISCO REFINERY
RODEO, CALIFORNIA
REGIONAL AERIAL PHOTOGRAPH OF
INACTIVE WASTE SITE 6C VICINITY
8 JUNE 1959

FIGURE 9



EXPLANATION

 Approximate Limits of Fill Placed in 1954



 **MONTGOMERY WATSON**
UNOCAL SAN FRANCISCO REFINERY
RODEO, CALIFORNIA
**AERIAL PHOTOGRAPH OF
INACTIVE WASTE SITE 6C VICINITY
8 JUNE 1959**

FIGURE 10



EXPLANATION

-  Approximate Limits of Fill Placed in 1954
-  Indicate areas where visible equipment storage activities are evident
-  Indicate areas where visible ground surface staining is evident



 MONTGOMERY WATSON

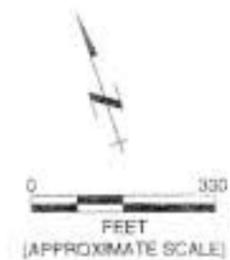
LINOCAL SAN FRANCISCO REFINERY
 RODEO, CALIFORNIA
**AERIAL PHOTOGRAPH OF
 INACTIVE WASTE SITE 6C VICINITY
 19 JULY 1977**

FIGURE 11



EXPLANATION

 Approximate Limits of Fill Placed in 1954



MONTGOMERY WATSON

UNOCAL SAN FRANCISCO REFINERY
RODEO, CALIFORNIA
AERIAL PHOTOGRAPH OF
INACTIVE WASTE SITE 6C VICINITY
24 MARCH 1987

FIGURE 12

Attachment A-2

Results of Additional Investigation and Remediation Plan, Inactive
Waste Site 6C. August 1997.



Prepared for
Tosco Refining Company
San Francisco Area Refineries
Rodeo Refinery
Rodeo, California

Tosco Refining Company Rodeo Refinery

Results of Additional Investigation and Remediation Plan Inactive Waste Site 6C

August 1997



MONTGOMERY WATSON

Prepared by
Montgomery Watson
1340 Treat Blvd., Suite 300
Walnut Creek, California

**RESULTS OF ADDITIONAL INVESTIGATION AND
REMEDATION PLAN -
INACTIVE WASTE SITE 6C**

Prepared For:

Tosco Refining Company
San Francisco Area Refineries - Rodeo Refinery
1380 San Pablo Avenue
Rodeo, California 94572

Prepared By:

Montgomery Watson
1340 Treat Boulevard, Suite 300
Walnut Creek, California 94596

Prepared by: _____
//Original Signed By //
Andrew Kerr
Senior Hydrogeologist

Date: 8/1/97

✓ //Original Signed By //
Lance L. Larsen
Supervising Hydrogeologist

Date: 1 AUG 97

Approved by _____
//Original Signed By //
Robert Aaserude, P.E.
Principal-in-Charge



**RESULTS OF ADDITIONAL INVESTIGATION AND REMEDIATION PLAN
INACTIVE WASTE SITE 6C**

TABLE OF CONTENTS

<u>Section</u>	<u>Page</u>
EXECUTIVE SUMMARY.....	E-1
1.0 INTRODUCTION.....	1-1
1.1 ORDER PROVISION C.2.J.....	1-1
1.2 BACKGROUND.....	1-2
1.3 PROJECT UNDERSTANDING.....	1-2
1.4 FACILITY-WIDE GROUNDWATER MANAGEMENT PROGRAM...	1-3
2.0 SITE CONDITIONS.....	2-1
2.1 LIMITS OF IWS 6C SITE.....	2-1
2.2 COMPOSITION AND DISTRIBUTION OF THE IWS 6C FILL.....	2-2
2.3 OCCURRENCE OF PETROLEUM COMPOUNDS IN THE FILL.....	2-3
2.4 UNDERLYING NATIVE GEOLOGIC UNITS.....	2-3
2.5 OCCURRENCE OF GROUNDWATER.....	2-4
2.6 SOIL CHEMISTRY.....	2-4
2.7 WATER CHEMISTRY.....	2-6
2.8 SUMMARY.....	2-6
3.0 REMEDIATION PLAN.....	3-1
3.1 MOBILITY OF COMPOUNDS.....	3-1
3.2 ASSOCIATED RISK.....	3-1
3.3 RECOMMENDED ACTIONS AND SCHEDULE.....	3-2
4.0 REFERENCES.....	4-1

TABLES

FIGURES

APPENDIX A - SOIL AND GROUNDWATER INVESTIGATION (JUNE/JULY 1997)

**RESULTS OF ADDITIONAL INVESTIGATION AND REMEDIATION PLAN
INACTIVE WASTE SITE 6C**

LIST OF TABLES

**Table
No.**

2-1	Summary of Environmental and Geotechnical Borings at IWS 6C
2-2	Summary of Soil Chemistry Data from Geoprobe Borings
2-3	Summary of Previous Soil Chemistry Data
2-4	Summary of Water Chemistry Data
3-1	Comparison of Maximum Concentrations With Screening Criteria

LIST OF FIGURES

**Figure
No.**

1-1	Site Location Map
1-2	Facility Plan Map
2-1	Boring and Cross-Section Locations
2-2	Limits of IWS 6C Fill
2-3	Current Site Topography
2-4	Hydrogeologic Cross Section A-A'
2-5	Hydrogeologic Cross Section B-B'
2-6	Fill Thickness
2-7	Groundwater Surface Map

EXECUTIVE SUMMARY

The results of additional soil and groundwater investigations were used to develop a remediation plan for Inactive Waste Site 6C (IWS 6C). The investigations and remediation plan were prepared in accordance with Updated Waste Discharge Requirements (WDRs) Order Number 97-027, issued by the San Francisco Bay Regional Water Quality Control Board (RWQCB) in February 1997 (the "Order").

Available data indicates that residual hydrocarbons and discrete layers of petroleum compounds including coke are present within the area identified as IWS 6C. However, leachate from the waste materials in the fill is not impacting groundwater based on water chemistry data from well MW-211; no analytes were detected in the groundwater sample from the well. Well MW-211 is located immediately downgradient of the area that contained the majority of the impacted fill, and is screened in the first encountered water only 10 feet below a distinguishable coke layer and fill that contains large percentages of coke conglomerations.

We do not recommend any active remediation of IWS 6C at this time. The expected mobility of the compounds in the fill is low, with the hydrocarbon content subject to natural attenuation via adsorption and biodegradation. From a risk perspective, the low concentrations of volatile chemicals in the waste materials and the lack of complete exposure pathways for heavy end compounds are not anticipated to pose an unacceptable risk to site workers or other potential receptors.

Recommended actions include groundwater sampling of the IWS 6C monitoring wells for four consecutive quarters with reduction to semi-annual monitoring after that time, and FPLH removal in well MW-138 via the ongoing stinger or passive bailer program. Groundwater monitoring could be initiated during 3rd Quarter 1997, with FPLH recovery initiated as early as August or September.

1.0 INTRODUCTION

This report summarizes the results of soil and groundwater investigations conducted at Inactive Waste Site 6C (IWS 6C) in June and July 1997, and presents a remediation plan that addresses subsurface conditions. Both work elements were completed according to Updated Waste Discharge Requirements (WDRs) Order Number 97-027, issued by the San Francisco Bay Regional Water Quality Control Board (RWQCB) in February 1997 (the "Order"). The Order prescribes activities to address soil and groundwater quality issues at the Unocal Corporation, San Francisco Refinery, located in Rodeo, California (Figure 1-1).

As of April 1, 1997, Tosco Refining Company (Tosco) purchased the refinery and began operations under the name of the Rodeo Refinery. As the current property owner, Tosco is submitting this summary report and remediation plan on behalf of Unocal.

1.1 ORDER PROVISION C.2.J

Provision C.2.J. of the Order requires that Tosco prepare a work plan and schedule investigating IWS 6C by May 2, 1997, and a remediation plan and schedule based on the investigation results by August 1, 1997. A "Work Plan for Additional Investigation at Inactive Waste Site 6C" was submitted to and approved by the RWQCB in May 1997, and proposed investigations were conducted in June and July 1997. Specifics of the field investigation including the completed scope-of-work, methods and procedures, and results are described in Appendix A. The remediation plan is presented in the remainder of this report, which includes a summary of site conditions in Section 2.0, and proposed remedial activities in Section 3.0.

1.2 BACKGROUND

Inactive Waste Site 6C is located in the southeastern portion of the lower tank farm at the Rodeo Refinery near the former Container Storage Unit (CSU) as shown in Figure 1-2. The site was discovered during closure activities at the former CSU in 1994. Soil borings advanced as part of the closure activities encountered coke debris, tar, and petroleum-impacted soils (Montgomery Watson 1995a). In response to these findings, a review of historical aerial photographs and refinery records was performed to collect available information about land disposal activities in this area (Montgomery Watson, 1995d).

The historical aerial photograph and records review indicated that land disposal in the vicinity of Site 6C was initiated sometime between August 1953 and December 1954. A 1958 refinery site plot plan refers to the Site 6C area as "L-4". L-4 is apparently a designation for a land disposal site, and is consistent with refinery designations for other known land disposal sites. Fill materials observed in the historical aerial photographs appeared to be a mixture of very dark and light material, possibly including coke debris and hydrocarbon-stained soils. The fill materials were identified as being spread over an approximately 6-acre trapezoidal shaped plot (plan view) that approximately corresponded with the area covered by the CSU and existing refinery aboveground storage tanks (ASTs) 107, 108, and 155 through 158. The review concluded that these structures were built between 1954 and 1987 over the fill site, although each construction project likely reworked or graded the original waste materials and probably included adding fill material as needed.

1.3 PROJECT UNDERSTANDING

The purpose of this report is to summarize the nature and extent of the waste deposits, and to develop a remediation plan and schedule for IWS 6C. The Rodeo Refinery has implemented a site-wide soil and groundwater quality investigation and remediation program pursuant to the requirements and oversight of the United States Environmental Protection Agency (USEPA) and the RWQCB. The remedial action objectives and activities proposed in this

plan for IWS 6C were developed within the context of previous remedial efforts at the Rodeo Refinery and the overall refinery groundwater program. Tosco is submitting this remediation plan and will conduct the proposed activities and schedule as the current property owner acting on behalf of Unocal.

1.4 FACILITY-WIDE GROUNDWATER MANAGEMENT PROGRAM

The objective of the groundwater quality management program for the Rodeo Refinery is to protect the beneficial uses of groundwater for downgradient users by:

1. Preventing future releases to soil and groundwater,
2. Containing groundwater contaminants on-site, and
3. Mitigating “hot spots” (e.g., free-phase liquid hydrocarbon (FPLH) pools).

The groundwater quality program at the Rodeo Refinery is designed to be compatible with the current and future projected “industrial” land use for the facility. The program recognizes that the facility is an operating petroleum refinery where investigation/remediation of portions of the facility is currently encumbered by a lack of access to many portions of the subsurface due to the density of surface structures. Also, the program considers that subsurface contaminants pose a reduced risk to public health because of controlled perimeters and restricted public access.

The program generally includes four different elements to achieve the program objectives at different areas:

1. **Enhanced Source Control.** The Rodeo Refinery has enhanced several programs (e.g., aboveground tank bottom retrofits, enhanced tank inspection programs, etc.) to reduce the risk of future releases to soil or groundwater.
2. **Perimeter Monitoring of Groundwater Quality.** Long-term monitoring of groundwater quality near the downgradient perimeter of the refinery was

established to monitor potential plume migration. Monitoring of operational effectiveness, maintenance, and water quality is also performed.

3. **Control of Groundwater Quality.** Control of groundwater quality near the downgradient perimeter of portions of the refinery has been implemented by constructing hydraulic control systems. Hydraulic control refers to lowering the water table beneath portions of the refinery by continuously pumping groundwater and free-phase liquid hydrocarbons (FPLH). Total fluids extraction recovers FPLH pools and associated dissolved-phase plumes using engineered control systems. Typically this is modeled in advance of designing and building the systems, then further evaluated using empirical data once the system is operational.
4. **Source Removal.** Source removal involves activities that mitigate interior “hot spots”.

2.0 SITE CONDITIONS

This section summarizes the site conditions at IWS 6C as identified from the results of the additional soil and groundwater quality investigations completed in June and July 1997 and from the aerial photography and records review conducted in 1995 (Montgomery Watson, 1995b). Where applicable, the information collected during these studies was augmented with results from previous environmental and geotechnical work in the area. A map that shows the location of all the soil borings or monitoring wells used to compile this description of site conditions is included as Figure 2-1.

2.1 LIMITS OF IWS 6C

The aerial photography and records review identified fill material placed over an approximately 6-acre trapezoidal-shaped plot that included the area beneath the CSU and ASTs 107, 108, and 155 through 158. This area and a revised representation of the limits of IWS 6C are shown in Figure 2-2. The revised area was delineated based upon the results of the recent investigation (see Appendix A) and the presence or absence of petroleum impacted soil and/or petroleum compounds in the fill. Impacted soil and other petroleum compounds (including coke) were observed in 7 of the 12 geoprobe borings (GP-45, GP-46, GP-47, GP-48, GP-49, GP-50, and GP-51) and in the boring for well MW-211. Similar observations of petroleum odors or compounds are described on the logs of previously completed geotechnical borings TSC-B1 through TSC-B5 (Montgomery Watson, 1994), geotechnical borings B1, B5, B7, B14, B15, B16, and B19 (WCC, 1977/1994), and CSU borings SB3-1 and SB3-2 (Montgomery Watson 1995a,b).

The revised configuration of IWS 6C is a similar shape to that originally identified during the aerial photograph review (Montgomery Watson, 1995), but is interpreted to be centered approximately 400 feet further west. Hydrocarbon odors and stained soil were noted in selected intervals of the fill and underlying native sediments at geoprobe boring locations

GP-42 and GP-43. However, we believe that these conditions are not associated with IWS 6C, but are residual hydrocarbons associated with long-term operation of the lower tank farm.

We note that the location of IWS 6C is interpreted to be closely related to the topography in this portion of the refinery. The existing topography of the area is contoured in Figure 2-3 and diagrammed in the two cross sections included as Figures 2-4 and 2-5. As depicted in the figures, the area surrounding ASTs 107, 108, 156, and 180 is a relatively flat, upland area that drops abruptly to the west adjacent to the refinery fenceline, and steeply to the north-northeast at the berm between tanks 156/180 and 106/155. Historically, the topography of this area was sloped gently toward the north-northwest. The limits of the IWS 6C fill is interpreted to be delineated by the abrupt changes in the current topography and the natural bedrock outcrops that are located south and west of the site.

2.2 COMPOSITION AND DISTRIBUTION OF THE IWS 6C FILL

The composition of the IWS 6C fill is heterogeneous, consisting of interbedded layers of clay, silt, sand, decomposed bedrock, and heavy-end petroleum components such as coke. Lateral continuity of distinct, identifiable layers (principally the coke or broken sandstone layers) appears limited. In most cases, a distinct layer can not be traced to adjacent borings (see Figures 2-4 and 2-5) even with the high density of geotechnical work that has been completed at the site in the past. The relative heterogeneity of the fill is consistent with the hypothesis that the fill was deposited during construction dating back to the 1950's (Montgomery Watson, 1995).

The distribution of the fill is also spatially variable, thickening and thinning based on the original site topography and the current elevation of the tank infrastructure. In the central portion of the IWS 6C area, the fill is approximately 10 to 17 feet thick; a map that shows fill thickness across the site is included in Figure 2-6. As shown in Figure 2-6, the fill appears to be thickest along the western boundary of the site near geoprobe borings GP-47 and GP-48.

2.3 OCCURRENCE OF PETROLEUM COMPOUNDS IN THE FILL

The occurrence of petroleum compounds in the IWS 6C fill is highly variable. Typically, the sediments that comprise the fill around the perimeter of the area contain low concentrations of residual hydrocarbons. However, in the central portion of the site, the fill also includes layers of hydrocarbon-stained broken sandstone, visible FPLH, localized grains or conglomerations (0.5 to 1-inch-diameter nodules) of coke in a silt or sand matrix, and thin (1 to 4-inch-thick) layers of sand-sized coke particles.

As shown in Figures 2-4 and 2-5, the occurrence of these different fill components is not consistent or laterally continuous. In general, the impacted fill sediments are buried beneath several feet of overlying fill, but extend to the top of the buried soil horizon or colluvial unit (see section 2.4 below). The percentage of coke and other petroleum compounds in the IWS 6C fill is highest in the area near geoprobe borings GP-47, GP-48, and GP-49, between tanks 107 and 108 and the refinery fenceline to the west-northwest (see Figure 2-2).

2.4 UNDERLYING NATIVE GEOLOGIC UNITS

The IWS 6C fill is predominantly underlain by what is interpreted as a buried soil horizon or colluvial layer. This layer consists of very dark brown to gray sandy/clayey silt that characteristically contains organic material including rootlets and localized calcium carbonate stringers. The layer is typically 5 to 7 feet thick, although it is absent along the southwestern and southeastern edges of the site (see Figures 2-4 and 2-5) where bedrock is near ground surface and historic construction activities appear to have changed the original topography.

The buried soil horizon or colluvial layer is underlain by bedrock units that include two members of the Neroly formation and the Pinole Tuff (WCC, 1991). The Neroly formation in the area is typically grayish brown to buff sandstone, siltstone, or sandy claystone. The Pinole Tuff consists of upper and lower tuff units separated by predominantly fine-grained

clastic sediments. The occurrence of the different bedrock units beneath the IWS 6C area are shown in Figures 2-4 and 2-5.

2.5 OCCURRENCE OF GROUNDWATER

Groundwater was encountered during this investigation in only three of the twelve Geoprobe borings (GP-42, GP-43, and GP-47). In each case, groundwater was either encountered within the residual soil/colluvial layer or within bedrock; groundwater was not encountered in the fill. However, the fill material may be locally saturated with perched groundwater in areas where the underlying native units are relatively shallow or during wet winter months.

A groundwater potentiometric surface map compiled using the water levels from the four wells surrounding IWS 6C (MW-137, MW-138, MW-139, and MW-211) and upgradient well MW-6B2 is included as Figure 2-7. The water levels suggest that groundwater flow is toward the north-northwest across a very steep gradient of approximately 10 feet/foot. The identified flow direction and gradient is similar to regional flow patterns as compiled in the facility wide groundwater monitoring program.

2.6 SOIL CHEMISTRY

Soil chemistry results from approximately 75 samples are available from the IWS 6C area to characterize the nature and occurrence of petroleum compounds in the fill. The samples were collected from a variety of locations, including intervals that were visually unimpacted, intervals that contained residual hydrocarbons, intervals that contained coke conglomerations, and intervals within or immediately adjacent to coke layers. In addition, a few samples were collected in the residual soil/colluvial layer or bedrock that underlie the fill. A summary of each sample and the material that it represents is included in Table 2-1. Soil chemistry results from the recent investigation are summarized in Table 2-2, while results from historic soil borings and the installation of monitoring wells are summarized in Table 2-3. In general, the compounds and concentrations detected during the recent investigation are similar to

those identified during the CSU closure (Montgomery Watson, 1995a,b) and geotechnical (Montgomery Watson, 1994) investigations.

The highest concentrations of petroleum compounds detected in the IWS 6C fill appear to be associated with those intervals that contain the largest percentages of coke. For example, the four samples collected during the recent investigation (GP-47-7.5', GP-48-14.5', and GP-51-3.5') that contained PAHs (EPA Method 8270) and the highest concentrations of extractable total petroleum hydrocarbons (TPH-e) (EPA method 8015M), were either collected immediately above or below a coke layer, or contained large percentages of coke. The other three highest detections of TPH-e during the recent investigation included samples GP-48-4.5' (240 mg/kg), GP-50-2.5' (67 mg/kg), and GP-49-3.5' (23 mg/kg), all of which were collected in zones that contained conglomerations of coke. The hydrocarbons identified by the TPH-e testing (carbon range C9 to C22) were typically quantified within the diesel range, although other unidentified heavier end compounds (carbon chains greater than C18) were present. PAHs were detected in two of the recent soil samples, including GP-47-7.5' and GP-48-14.5'; compounds and maximum concentrations detected included benzo(a)anthracene (33 mg/kg), benzo(b)fluoranthene (24 mg/kg), benzo(a)pyrene (24 mg/kg), chrysene (46 mg/kg), phenanthrene (19 mg/kg), and pyrene (14 mg/kg).

Quantitative polychlorinated biphenol (PCB) data is available from the five samples that contained the highest concentrations of TPH-e (GP-47-7.5'; GP-48-4.5'; GP-48-14.5'; GP-50-2.5'; and GP-51-3.5'); PCB data from the remainder of the recent soil samples is pending and will be reported to the RWQCB under separate cover. PCBs were not detected in the five samples, except for PCB 1254 (82 ug/kg) in sample GP-48-14.5'. To serve as supplemental information until the remainder of the PCB data is available, the EPA Method 8270 chromatograms were re-evaluated to qualitatively assess the presence or absence of PCBs; PCBs were not identified on the chromatograms of any of the twenty soil samples.

2.7 WATER CHEMISTRY

Water chemistry results from samples collected during the recent investigation at three monitoring wells in the IWS 6C area and upgradient well MW-6B2 are summarized in Table 2-4. Similar to the soil data, quantitative PCB data is not available from the water samples collected during this investigation. However, the EPA Method 8270 chromatograms were re-evaluated in order to provide qualitative results. Groundwater samples from the IWS 6C wells are being collected during the first week of August 1997 as part of the refinery groundwater quality monitoring program; the samples will be tested for PCBs with the results to be reported to the RWQCB under separate cover. A groundwater sample was not collected from the only other monitoring well in the IWS-6C area (Well MW-138) because of the presence of a thin layer of FPLH. Once the FPLH layer is removed, the dissolved phase concentrations of TPH and PCBs will be quantified.

Groundwater from wells MW-139, MW-211, and MW-6B2 did not contain TPH-e, PAHs, or the metals lead and mercury at or above detection limits. TPH-e (1,200 ug/L) identified as diesel and unidentified hydrocarbons greater than C15, 2-methylnaphthalene (10 ug/L), and lead (7.8 ug/L) were detected in the groundwater sample collected from well MW-137. PCBs were not present in any of the water samples at an approximate detection limit of 500 ug/L based on qualitative re-inspection of the EPA Method 8270 chromatograms.

2.8 SUMMARY

The cumulative, available data suggests that residual hydrocarbons and discrete layers of petroleum compounds including coke are present within the area identified as IWS 6C. However, leachate from the waste materials in the fill is not impacting groundwater, based on water chemistry data from well MW-211, which is located immediately downgradient of the area that contained the majority of the coke and petroleum compounds in the fill. Well MW-211 is screened in the first encountered water approximately 10 feet below a distinguishable

coke layer and fill containing large percentages of coke conglomerations, yet all analytes were not detected in the groundwater.

3.0 REMEDIATION PLAN

We do not recommend any active remediation at this time because leachate from the fill is apparently not impacting groundwater. As described below, the expected mobility of the compounds is low, and the potential for human exposure is limited with the only completed exposure route being intrusive activities into the subsurface. Intrusive activities in this area would be covered under a site-specific safety plan and overseen by a site safety officer. Groundwater monitoring of the wells sampled during the recent investigation is recommended as described in Section 3.3 below.

3.1 MOBILITY OF COMPOUNDS

The expected mobility of the identified compounds in the IWS 6C fill is low for several reasons. Foremost, the waste deposits are typically heavy end carbon chains that are bound in relatively stable compounds such as coke and tar in the unsaturated (or vadose) zone; residence time of any water migrating through the deposits is limited. In addition, the fill matrix that the compounds are contained within is relatively fine-grained, being comprised predominantly of silt and clay. The rate at which leachate from the waste deposits migrates to the groundwater zone is expected to be low, with the hydrocarbon content subject to natural attenuation via adsorption and biodegradation. Groundwater data collected during the investigation supports these interpretations, as the compounds detected in the IWS 6C fill have not leached into groundwater despite the deposition of some portions of the fill as early as the 1950's.

3.2 ASSOCIATED RISK

Some of the chemicals that were detected in association with the buried coke, including TPH-e and PAHs, are considered to be of moderate to high toxicity. An evaluation of risk associated with site-related contaminants, is based on the toxicity of each chemical and the potential for exposure. Toxicity is generally based on the potential of a chemical to (1) cause

acute or chronic non-carcinogenic effects, or (2) initiate or promote cancer. Exposure potential is a function of land use, and potentially present receptors and completed exposure pathways.

No toxicity criteria are currently available for the evaluation of TPH. Potential risks associated with exposures to TPH are generally evaluated based on the use of indicator compounds known to be present in certain petroleum products. Commonly, BTEX constituents are used in the evaluation of potential risks associated with the presence of TPH-gasoline in site media. Similarly, BTEX and PAHs are frequently used as indicator compounds for diesel fuel, and PAHs are generally evaluated for higher molecular weight petroleum substances.

Specific chemicals detected in site media associated with suspected sources of contamination at the IWS 6C include BTEX constituents; the PAHs benzo(a)anthracene, benzo(b)fluoranthene, benzo(a)pyrene, chrysene, phenanthrene, and pyrene; PCBs, and the inorganics lead and mercury (Tables 2-2 through 2-4). These chemicals were selected as indicator compounds for evaluating potential risks associated with petroleum-related materials present in the IWS 6C. Maximum concentrations of these compounds measured in soil and groundwater were compared to USEPA Region IX preliminary remediation goals (PRGs) (USEPA, 1996) as summarized in Table 3-1. This comparison indicates that BTEX constituents, PCBs, lead, mercury, and pyrene in site soils are lower than USEPA Region IX PRGs for industrial soils, but that maximum concentrations of benzo(a)anthracene, benzo(b)fluoranthene, benzo(a)pyrene, and chrysene are higher than the established PRGs for industrial soils. A USEPA Region IX PRG is not available for phenanthrene. However, phenanthrene is non-carcinogenic, and its toxicity is in the range of that for pyrene.

The concentration of lead detected in groundwater was only slightly higher than the USEPA Region IX tap water PRG (Table 3-1). However, this screening criterion is based on use of the water as a drinking water source. The shallow aquifer at IWS is considered non-potable

and is not used as a drinking water source. Therefore, groundwater is not anticipated to pose an unacceptable risk.

Although maximum concentrations of several PAHs were higher than soil screening criteria, these concentrations were measured at depth (approximately 14 to 15 feet bgs). The concentrations of PAHs in the top five feet of soil were generally non-detect. Furthermore, there is no exposed soil at the site. Berms surrounding the site are covered by an asphaltic emulsion, and the remainder of the surface is covered by gravel for erosion and dust control. Therefore, surface soil exposure pathways such as inhalation of fugitive dust emissions, and incidental oral or dermal contact with soil are incomplete. The only potentially complete exposure pathways are associated with subsurface construction or excavation activities. Any activities of this kind would be performed by trained personnel under a site-specific health and safety plan (HSP). The HSP would identify potential physical and chemical hazards, and personal protective equipment (PPE) would be required to minimize exposures to site-related contaminants.

In summary, due to the low concentrations of volatile chemicals such as BTEX, and the lack of complete exposure pathways for non-volatile chemicals such as PAHs, petroleum-related contaminants in soils associated with the Former Inactive Waste Site 6C are not anticipated to pose an unacceptable risk to site workers or other potential receptors.

3.3 RECOMMENDED ACTIONS AND SCHEDULE

Groundwater sampling of monitoring wells MW-137, MW-139, MW-211, and MW-6B2 is recommended for four consecutive quarters. Sampling frequency may be reduced to semi-annual monitoring after that time. This approach is consistent with other inactive waste sites at the refinery. The FPLH in well MW-138 is thin (0.01 feet). We recommend including this well in the stinger or passive bailer program during the next several months. If the FPLH is successfully removed from the well within this time period, groundwater samples should also be collected from this well according to the sampling frequency described above.

The proposed groundwater monitoring of the IWS 6C wells and FPLH recovery from well MW-138 would be conducted as part of the ongoing groundwater monitoring and FPLH recovery programs. Assuming acceptance of this plan, groundwater sampling of the four monitoring wells could be initiated during 3rd Quarter 1997, currently scheduled for the first week of August 1997; FPLH recovery could be initiated as early as the August or September well stinger field event.

TABLES

TABLE 2-1
SUMMARY OF ENVIRONMENTAL AND GEOTECHNICAL BORINGS AT IWS 6C
TOSCO REFINING COMPANY - SAN FRANCISCO AREA REFINERIES
RODEO REFINERY

Boring	Total Depth (feet)	Fill Thickness (feet)	Samples Collected	Sample Interval (feet bgs)	Description of Sample Location
<u>Geoprobe Borings</u>					
GP-40	5	0	GP-40-3.5	3.5 - 4	In native soil horizon
GP-41	1	0.5	-	-	no samples collected
GP-42	18	6	GP-42-15.5	15.5 - 16	Collected in buried soil / colluvial layer
GP-43	16	4.5	GP-43-7.5	7.5 - 8	Collected in buried soil / colluvial layer
GP-44	8	2.5	GP-44-3.5	3.5 - 4	Collected in Pinole Tuff bedrock
GP-45	13	6	GP-45-3.5	3.5 - 4	Collected in fill
			GP-45-7.5	7.5 - 8	Collected in buried soil / colluvial layer
			GP-45-11	11 - 11.5	Collected in buried soil / colluvial layer
GP-46	14.5	6	GP-46-3.5	3.5 - 4	Collected in fill
			GP-46-7.5	7.5 - 8	Collected in buried soil / colluvial layer
GP-47	22.5	15.5	GP-47-7.5	7.5 - 8	Collected in fill just below a coke layer
			GP-47-13.5	13.5 - 14	Collected in fill where occasional coke grains were present
			GP-47-21.5	21.5 - 22	Collected in Neroly Fm bedrock
GP-48	23	15	GP-48-4.5	4.5 - 5	Collected in fill where coke conglomerations were present
			GP-48-14.5	14.5 - 15	Collected in fill just above a coke layer
GP-49	20	13	GP-49-3.5	3.5 - 4.0	Collected in fill where occasional coke grains were present
			GP-49-7.5	7.5 - 8.0	Collected in fill where occasional coke grains were present
GP-50	4	3.5	GP-50-2.5	2.5 - 3.0	Collected in fill where coke conglomerations were present
GP-51	14.5	14	GP-51-3.5	3.5 - 4	Collected in fill where coke conglomerations were present
			GP-51-11	11 - 11.5	Collected in fill where coke conglomerations were present
			GP-51-13.5	13.5 - 14	Collected in fill just above bedrock
<u>Monitoring Wells</u>					
MW-137	32.5	6	-	6.2 - 6.5	Collected in buried soil / colluvial layer
			-	11.2 -	Collected in buried soil / colluvial layer
MW-138	35	7	-	6.0	Collected in fill
			-	11.5	Collected in buried soil / colluvial layer
			-	16.0	Collected in buried soil / colluvial layer
			-	20.5	Collected in buried soil / colluvial layer
			-	26	Collected in buried soil / colluvial layer
			-	26.5	Collected in buried soil / colluvial layer
MW-139	33	7	-	6.0	Collected in fill
			-	11.5	Collected in buried soil / colluvial layer
			-	16.0	Collected in buried soil / colluvial layer
			-	20.5	Collected in buried soil / colluvial layer
			-	26	Collected in buried soil / colluvial layer
			-	26.5	Collected in buried soil / colluvial layer
MW-211	28	15.5	GP-51-3.5	3.5 - 4	no samples collected
<u>Geotechnical Borings (WCC, 1994)</u>					
TSC-B1	20	14.5	-	1 - 2	Collected in fill
			-	7 - 8	Collected in fill where coke conglomerations were present
			-	11 - 12	Collected in fill where coke conglomerations were present
			-	15 - 16	Collected in buried soil / colluvial layer
TSC-B2	19	11	-	19 - 20	Collected in buried soil / colluvial layer
			-	1 - 2	Collected in fill
			-	5 - 6	Collected in fill

TABLE 2-1
SUMMARY OF ENVIRONMENTAL AND GEOTECHNICAL BORINGS AT IWS 6C
TOSCO REFINING COMPANY - SAN FRANCISCO AREA REFINERIES
RODEO REFINERY

Boring	Total Depth (feet)	Fill Thickness (feet)	Samples Collected	Sample Interval (feet bgs)	Description of Sample Location
TSC-B2 (Contd.)			-	10 - 11	Collected in fill
			-	15 - 16	Collected in buried soil / colluvial layer
			-	18 - 19	Collected in Neroly Fm bedrock
TSC-B3	20	11.5	-	1 - 2	Collected in fill
			-	6 - 7	Collected in fill where tar and asphalt are present
			-	10 - 11	Collected in fill where coke conglomerations were present
			-	14 - 15	Collected in buried soil / colluvial layer
			-	19 - 20	Collected in buried soil / colluvial layer
TSC-B4	20	13.5	-	1 - 2	Collected in fill
			-	5 - 6	Collected in fill with hydrocarbon staining
			-	11 - 12	Collected in fill where coke conglomerations were present
			-	15 - 16	Collected in buried soil / colluvial layer
			-	19 - 20	Collected in buried soil / colluvial layer
TSC-B5	20	12.25	-	1 - 2	Collected in fill
			-	5 - 6	Collected in fill with hydrocarbon staining
			-	9 - 10	Collected in fill where coke conglomerations were present
			-	14 - 15	Collected in buried soil / colluvial layer
			-	19 - 20	Collected in Neroly Fm bedrock
<u>Geotechnical Borings (WCC, 1977)</u>					
B1	20	8	-	-	no samples collected
B2	10	3	-	-	no samples collected
B3	29	13	-	-	no samples collected
B4	8	3	-	-	no samples collected
B5	20	13	-	-	no samples collected
B6	25	11.5	-	-	no samples collected
B7	35	13	-	-	no samples collected
B8	24.5	14	-	-	no samples collected
B9	24.5	6	-	-	no samples collected
B10	20	2	-	-	no samples collected
B11	20	2	-	-	no samples collected
B12	20	1	-	-	no samples collected
B13	20	6	-	-	no samples collected
B14	9.5	7	-	-	no samples collected
B15	35	12	-	-	no samples collected
B16	20	17	-	-	no samples collected
B17	10	12	-	-	no samples collected
B18	29	3	-	-	no samples collected
B19	8	17	-	-	no samples collected
<u>Container Storage Unit Borings (Montgomery Watson, 1995a,b)</u>					
SB-1-1	6.5	0.5	-	-	-
			-	0.6 - 1.1	Collected in Neroly Fm bedrock
			-	3.0 - 3.5	Collected in Neroly Fm bedrock
			-	6.0 - 6.5	Collected in Neroly Fm bedrock
SB-2-1	6.5	1	-	-	-
			-	0.5 - 1.0	Collected in fill
			-	3.0 - 3.5	Collected in Neroly Fm bedrock
			-	6.0 - 6.5	Collected in Neroly Fm bedrock

TABLE 2-1
SUMMARY OF ENVIRONMENTAL AND GEOTECHNICAL BORINGS AT IWS 6C
TOSCO REFINING COMPANY - SAN FRANCISCO AREA REFINERIES
RODEO REFINERY

Boring	Total Depth (feet)	Fill Thickness (feet)	Samples Collected	Sample Interval (feet bgs)	Description of Sample Location
SB-2-2	6.5	0.5	-	-	-
			-	0.6 - 1.1	Collected in Neroly Fm bedrock
			-	3.0 - 3.5	Collected in Neroly Fm bedrock
			-	6.0 - 6.5	Collected in Neroly Fm bedrock
SB-3-1	6.5	> 6.5	-	-	-
			-	0.5 - 1.0	Collected in fill with minor to trace coke and/or tar
			-	3.0 - 3.5	Collected in fill with minor to trace coke and/or tar
			-	6.0 - 6.5	Collected in fill with minor to trace coke and/or tar
SB-3-2	6.5	> 6.5	-	-	-
			-	0.5 - 1.0	Collected in fill with coke debris
			-	3.0 - 3.5	Collected in fill with coke debris
			-	6.0 - 6.5	Collected in fill with coke debris
SB-3-3	6.0	> 6	-	-	-
			-	0.5 - 1.0	Collected in fill
			-	3.0 - 3.5	Collected in fill
			-	5.0 - 5.5	Collected in fill

feet bgs - feet below ground surface
Fm- formation

TABLE 2-2
SUMMARY OF SOIL CHEMISTRY DATA FROM GEOPROBE BORINGS
TOSCO REFINING COMPANY - SAN FRANCISCO AREA REFINERIES
RODEO REFINERY

Geoprobe Boring	Sample	TPH-e		PAHs (mg/kg)	PCBs (ug/kg)	Lead (mg/kg)	Mercury (mg/kg)
		Concentration (mg/kg)	Pattern				
GP-40	GP-40-3.5'	ND (1.0)	-	ND (0.25 - 0.50)	(a)	7.0	0.028
GP-42	GP-42-15.5'	ND (1.0)	-	ND (0.25 - 0.50)	(a)	4.1	0.012
GP-43	GP-43-7.5'	ND (1.0)	-	ND (0.25 - 0.50)	(a)	4.3	ND (0.010)
GP-44	GP-44-3.5'	ND (1.0)	-	ND (0.25 - 0.50)	(a)	6.5	0.049
GP-45	GP-45-3.5'	13	Diesel and unidentified hydrocarbons >C20	ND (0.25 - 0.50)	(a)	14	0.014
	GP-45-7.5'	2.2	Unidentified hydrocarbons >C16	ND (0.25 - 0.50)	(a)	11	0.029
	GP-45-11'	ND (1.0)	-	ND (0.25 - 0.50)	(a)	4.5	0.015
GP-46	GP-46-3.5'	ND (1.0)	-	ND (0.25 - 0.50)	(a)	6.9	0.072
	GP-46-7.5'	ND (1.0)	-	ND (0.25 - 0.50)	(a)	5.4	0.015
GP-47	GP-47-7.5'	200	Diesel and unidentified hydrocarbons >C20	benzo(a)anthracene: 0.76 benzo(b)fluoranthene: 0.70 benzo(a)pyrene: 0.69 chrysene: 1.2	ND (20 - 80)	26	0.057
	GP-47-13.5'	ND (1.0)	-	ND (0.25 - 0.50)	(a)	5.0	0.026
	GP-47-21.5'	ND (1.0)	-	ND (0.25 - 0.50)	(a)	4.0	ND (0.010)
GP-48	GP-48-4.5'	240	Diesel and unidentified hydrocarbons >C20	ND (0.25 - 0.50)	ND (20 - 80)	190	0.30

TABLE 2-2

SUMMARY OF SOIL CHEMISTRY DATA FROM GEOPROBE BORINGS
TOSCO REFINING COMPANY - SAN FRANCISCO AREA REFINERIES
RODEO REFINERY

Geoprobe Boring	Sample	TPH-e		PAHs (mg/kg)	PCBs (ug/kg)	Lead (mg/kg)	Mercury (mg/kg)
		Concentration (mg/kg)	Pattern				
GP-48 (contd.)	GP-48-14.5'	6,500	Diesel and unidentified hydrocarbons >C20	benzo(a)anthracene: 33 benzo(b)fluoranthene: 24 benzo(a)pyrene: 24 chrysene: 46 phenanthrene: 19 pyrene: 14	PCB 1254: 82	17	0.59
GP-49	GP-49-3.5'	23	Diesel and unidentified hydrocarbons >C20	ND (0.25 - 0.50)	(a)	170	0.11
	GP-49-7.5'	ND (1.0)	-	ND (0.25 - 0.50)	(a)	5.3	0.019
GP-50	GP-50-2.5'	67	Unidentified hydrocarbons >C18	ND (1.3 - 2.5)	ND (20 - 80)	170	0.66
GP-51	GP-51-3.5'	200	Diesel and unidentified hydrocarbons >C20	chrysene: 1.5	ND (20 - 80)	14	0.088
	GP-51-11'	6.1	Unidentified hydrocarbons >C15	ND (0.25 - 0.50)	(a)	6.5	0.066
	GP-51-13.5'	ND (1.0)	-	ND (0.25 - 0.50)	(a)	3.4	0.095
	<i>Method:</i>	<i>3550 / 8015m</i>		<i>8270</i>	<i>8080</i>	<i>7420</i>	<i>7471</i>

TPH-e - extractable total petroleum hydrocarbons

mg/kg - milligrams per kilogram

ND - Not detected equal to or greater than method reporting limit shown in par

PAHs - polynuclear aromatic hydrocarbons

PCBs - polychlorinated biphenols

µg/kg - micrograms per kilogram

(a) - PCB data pending. Qualitative review of EPA Method chromatograms indicated no PCBs present in sample.

TABLE 2-3

**SUMMARY OF PREVIOUS SOIL CHEMISTRY DATA
TOSCO REFINING COMPANY - SAN FRANCISCO AREA REFINERIES
RODEO REFINERY**

Well / Boring	Interval (feet bgs)	TPH (mg/kg)	TPH-e (mg/kg)	TPH-gas (mg/kg)	Benzene (µg/kg)	PAHs (mg/kg)	PCBs (µg/kg)	Lead (mg/kg)	Mercury (mg/kg)
TSC-B1	1 - 2	300	-	ND (0.2)	ND (5)	-	-	-	-
	7 - 8	5,500	-	38	30	-	-	-	-
	11 - 12	2,100	-	33	ND (50)	-	-	-	-
	15 - 16	150	-	ND (1)	ND (10)	-	-	-	-
	19 - 20	ND (10)	-	ND (0.2)	ND (5)	-	-	-	-
TSC-B2	1 - 2	130	-	ND (1)	ND (10)	-	-	-	-
	5 - 6	11,000	-	ND (700)	ND (300)	-	-	-	-
	10 - 11	2,600	-	ND (1)	ND (10)	-	-	-	-
	15 - 16	20	-	ND (0.2)	ND (5)	-	-	-	-
	18 - 19	ND (10)	-	ND (0.2)	ND (5)	-	-	-	-
TSC-B3	1 - 2	5,200	-	ND (1.0)	ND (5)	-	-	-	-
	6 - 7	770	-	24	240	-	-	-	-
	10 - 11	520	-	31	92	-	-	-	-
	14 - 15	30	-	ND (0.2)	ND (5)	-	-	-	-
	19 - 20	20	-	ND (0.2)	ND (5)	-	-	-	-
TSC-B4	1 - 2	410	-	ND (90)	ND (30)	-	-	-	-
	5 - 6	3,000	-	ND (1)	ND (30)	-	-	-	-
	11 - 12	370	-	ND (1)	ND (5)	-	-	-	-
	15 - 16	ND (10)	-	ND (0.2)	ND (5)	-	-	-	-
	19 - 20	ND (10)	-	ND (0.2)	ND (5)	-	-	-	-

TABLE 2-3

SUMMARY OF PREVIOUS SOIL CHEMISTRY DATA
TOSCO REFINING COMPANY - SAN FRANCISCO AREA REFINERIES
RODEO REFINERY

Well / Boring	Interval (feet bgs)	TPH (mg/kg)	TPH-e (mg/kg)	TPH-gas (mg/kg)	Benzene (µg/kg)	PAHs (mg/kg)	PCBs (µg/kg)	Lead (mg/kg)	Mercury (mg/kg)
TSC-B5	1 - 2	170	-	ND (0.2)	ND (5)	-	-	-	-
	5 - 6	190	-	ND (40)	ND (10)	-	-	-	-
	9 - 10	2,600	-	ND (50)	ND (50)	-	-	-	-
	14 - 15	70	-	ND (0.2)	ND (5)	-	-	-	-
	19 - 20	ND (10)	-	ND (0.2)	ND (5)	-	-	-	-
MW-137	6.2 - 6.5	100	-	-	-	-	-	-	-
	11.2 - 11.5	10	-	-	-	-	-	-	-
MW-138	6	900	-	-	-	-	-	-	-
	11.5	ND (10)	-	-	-	-	-	-	-
	16	430	-	-	-	-	-	-	-
	20.5	ND (10)	-	-	-	-	-	-	-
	26	400	-	-	-	-	-	-	-
	26.5	ND (10)	-	-	-	-	-	-	-
MW-139	6	60	-	-	-	-	-	-	-
	11.5	ND (10)	-	-	-	-	-	-	-
	16	ND (10)	-	-	-	-	-	-	-
	20.5	ND (10)	-	-	-	-	-	-	-
	26	ND (10)	-	-	-	-	-	-	-
	26.5	ND (10)	-	-	-	-	-	-	-
SB-1-1	0.6 - 1.1	-	< 10	< 0.5	-	-	ND (<30/<70)	8.1	< 0.1
	3.0 - 3.5	-	< 10	< 0.5	-	-	ND (<30/<70)	4.1	< 0.1
	6.0 - 6.5	-	< 10	< 0.5	-	-	ND (<30/<70)	3.6	< 0.1

TABLE 2-3

SUMMARY OF PREVIOUS SOIL CHEMISTRY DATA
TOSCO REFINING COMPANY - SAN FRANCISCO AREA REFINERIES
RODEO REFINERY

Well / Boring	Interval (feet bgs)	TPH (mg/kg)	TPH-e (mg/kg)	TPH-gas (mg/kg)	Benzene (µg/kg)	PAHs (mg/kg)	PCBs (µg/kg)	Lead (mg/kg)	Mercury (mg/kg)
SB-2-1	0.5 - 1.0	-	< 10	< 0.5	-	-	ND (<30/<70)	4.9	< 0.1
	3.0 - 3.5	-	< 10	< 0.5	-	-	ND (<30/<70)	4.4	< 0.1
	6.0 - 6.5	-	< 10	< 0.5	-	-	ND (<30/<70)	3.4	< 0.1
SB-2-2	0.6 - 1.1	-	< 10	< 0.5	-	-	ND (<30/<70)	4.7	< 0.1
	3.0 - 3.5	-	< 10	< 0.5	-	-	ND (<30/<70)	4.8	< 0.1
	6.0 - 6.5	-	< 10	< 0.5	-	-	ND (<30/<70)	3.8	< 0.1
SB-3-1	0.5 - 1.0	-	120	13	-	ND (<1/<25)	PCB 1254: 150	110	0.58
	3.0 - 3.5	-	150	10	-	ND (<1/<25)	PCB 1254: 410	190	0.25
	6.0 - 6.5	-	26	< 0.5	-	ND (<1/<25)	PCB 1254: 220	75	< 0.1
SB-3-2	0.5 - 1.0	-	360	8.8	-	benzo(a) anthracene: 7.1 benzo(b)fluoroanthene: 4.6 benzo(a)pyrene: 6.3 chrysene 4.1 dibenz(a,h)anthracene: 2.6	ND (<200/<800)	56	0.86
	3.0 - 3.5	-	130	3.9	-	benzo(a) anthracene: 14 benzo(b)fluoroanthene: 9.3 benzo(a)pyrene: 12 chrysene 7.9 dibenz(a,h)anthracene: 6.2 2-methylnapthalene 2.6 phenanthrene 2.7 pyrene 4.2	ND (<200/<800)	20	< 0.1

TABLE 2-3
SUMMARY OF PREVIOUS SOIL CHEMISTRY DATA
TOSCO REFINING COMPANY - SAN FRANCISCO AREA REFINERIES
RODEO REFINERY

Well / Boring	Interval (feet bgs)	TPH (mg/kg)	TPH-e (mg/kg)	TPH-gas (mg/kg)	Benzene (µg/kg)	PAHs (mg/kg)	PCBs (µg/kg)	Lead (mg/kg)	Mercury (mg/kg)
SB-3-2 Contd.	6.0 - 6.5	-	120	3.4	-	benzo(a) anthracene: 1.2 benzo(b)fluoroanthene: 1.0 benzo(a)pyrene: 1.3	ND (<200/<800)	22	2
SB-3-3	0.5 - 1.0	-	35	< 0.5	-	ND (<0.1/<2.5)	ND (<30/<80)	120	0.32
	3.0 - 3.5	-	36	< 0.5	-	ND (<1/<25)	PCB 1254: 210	440	0.23
	5.0 - 5.5	-	26	1.0	-	ND (<1/<25)	PCB 1254: 760	80	0.17
<i>Method:</i>		<i>418.1</i>	<i>8015m</i>	<i>8015m</i>	<i>8020</i>	<i>8270</i>	<i>8080</i>	<i>6010</i>	<i>7471</i>

TPH - total petroleum hydrocarbons

TPH -e - total extractable petroleum hydrocarbons

mg/kg - milligrams per kilogram

ND - Not detected equal to or greater than method reporting limit shown in parenthesis.

µg/kg - micrograms per kilogram

feet bgs - feet below ground surface

PAHs - polynuclear aromatic hydrocarbons

PCBs - polychlorinated biphenols

- Not analyzed for these compounds

TABLE 2-4

SUMMARY OF WATER CHEMISTRY DATA
TOSCO REFINING COMPANY - SAN FRANCISCO AREA REFINERIES
RODEO REFINERY

Well	TPH-e		Benzene (µg/L)	Toluene (µg/L)	Ethyl- Benzene (µg/L)	Total Xylenes (µg/L)	PAHs (µg/L)	PCBs	Lead (µg/L)	Mercury (µg/L)
	Concentration (µg/L)	Pattern								
MW-137	1,200	diesel and unidentified hydrocarbons <C15	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	2-methylnaphthalene (10) all other compds. ND (5.0 - 10)	(a)	7.8	ND (2.0)
MW-139	ND (50)	-	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (5.0 - 10))	(a)	ND (2.0)	ND (2.0)
MW-211	ND (50)	-	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (5.0 - 10))	(a)	ND (2.0)	ND (2.0)
MW-6B2	ND (50)	-	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (5.0 - 10))	(a)	ND (2.0)	ND (2.0)
	<i>3510 / 8015m</i>		<i>5030/ 8020</i>	<i>5030/ 8020</i>	<i>5030/ 8020</i>	<i>5030/ 8020</i>	<i>8270</i>	-	<i>7421</i>	<i>7470</i>

TPH -e - extractable total petroleum hydrocarbons
mg/L- milligrams per liter

ND - Not detected equal to or greater than method reporting limit shown in parenthesis.

PAHs - polynuclear aromatic hydrocarbons

PAHs - polynuclear aromatic hydrocarbons

µg/L - micrograms per liter

PCBs - polychlorinated biphenols

(a) PCB data pending. Qualitative review of EPA Method 8270 chromatogram indicated no PCBs present

TABLE 3-1

**COMPARISON OF MAXIMUM CONCENTRATIONS OF SITE CONTAMINANTS
WITH SCREENING CRITERIA
TOSCO REFINING COMPANY - SAN FRANCISCO AREA REFINERIES
RODEO REFINERY**

Constituent	Maximum Concentration	USEPA Region IX PRG (a)
	Soils (mg/kg)	
BTEX		
Benzene	0.24	1.4
Toluene	0.27	880
Ethylbenzene	0.089	230
Xylenes	0.59	320
PAHs		
Benzo(a)anthracene	33	2.6
Benzo(b)fluoranthene	24	2.6
Benzo(a)pyrene	24	0.26
Chrysene	1.5	7.2
Phenanthrene	19	NA
Pyrene	14	100
PCBs		
PCB 1254	0.082	19
Inorganics		
Lead	190	1,000
Mercury	0.59	510
	Groundwater (ug/L)	
Inorganics		
Lead	7.8	4

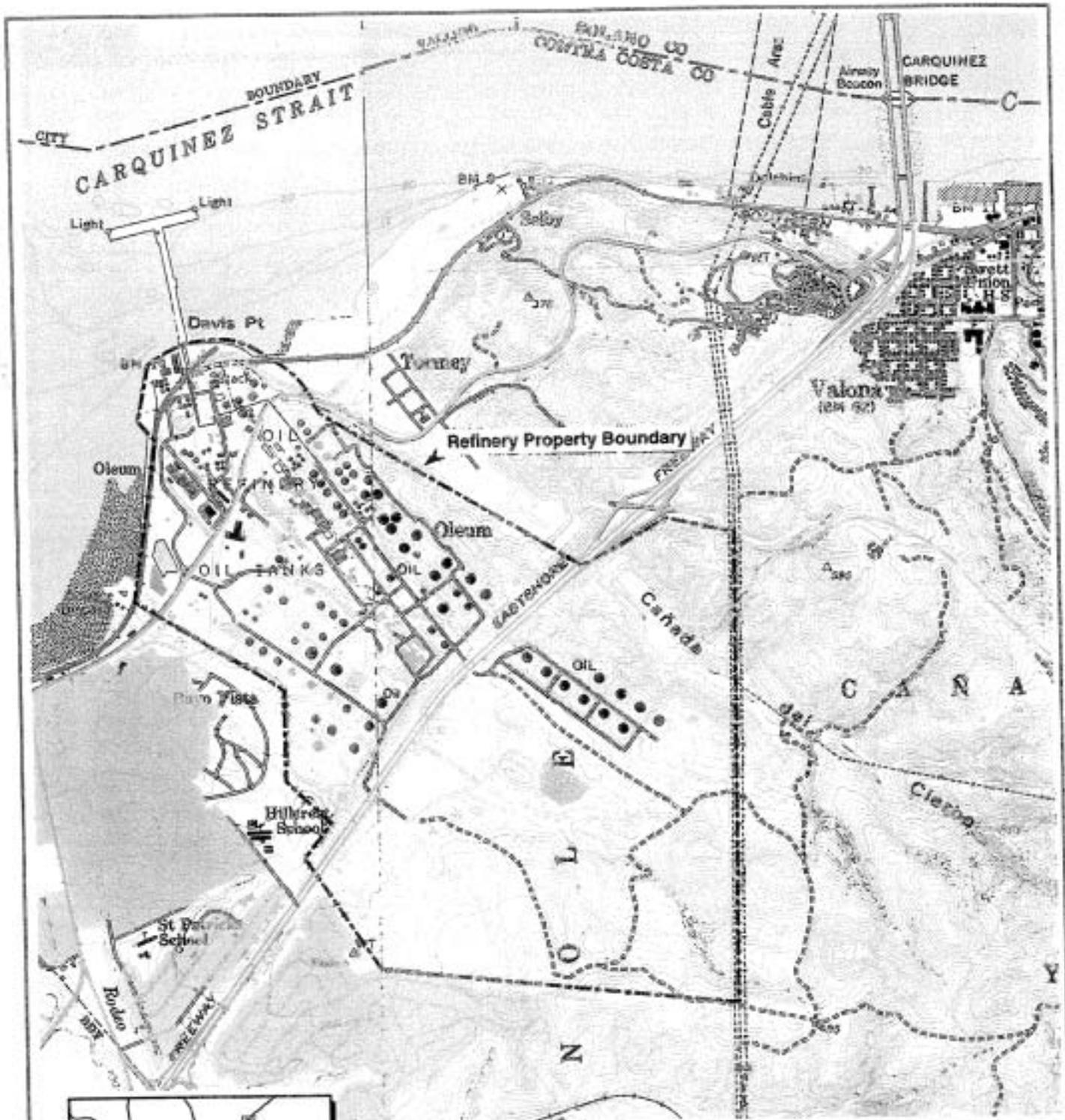
Notes:

NA - Not available

mg/kg - milligrams per kilogram

ug/L - micrograms per liter

(a) PRG - preliminary remediation goal for industrial sites from USEPA, 1996.



SCALE IN MILES



USGS Topographic Maps, 7.5', Mare Island and Benicia CA Quads., 1980.

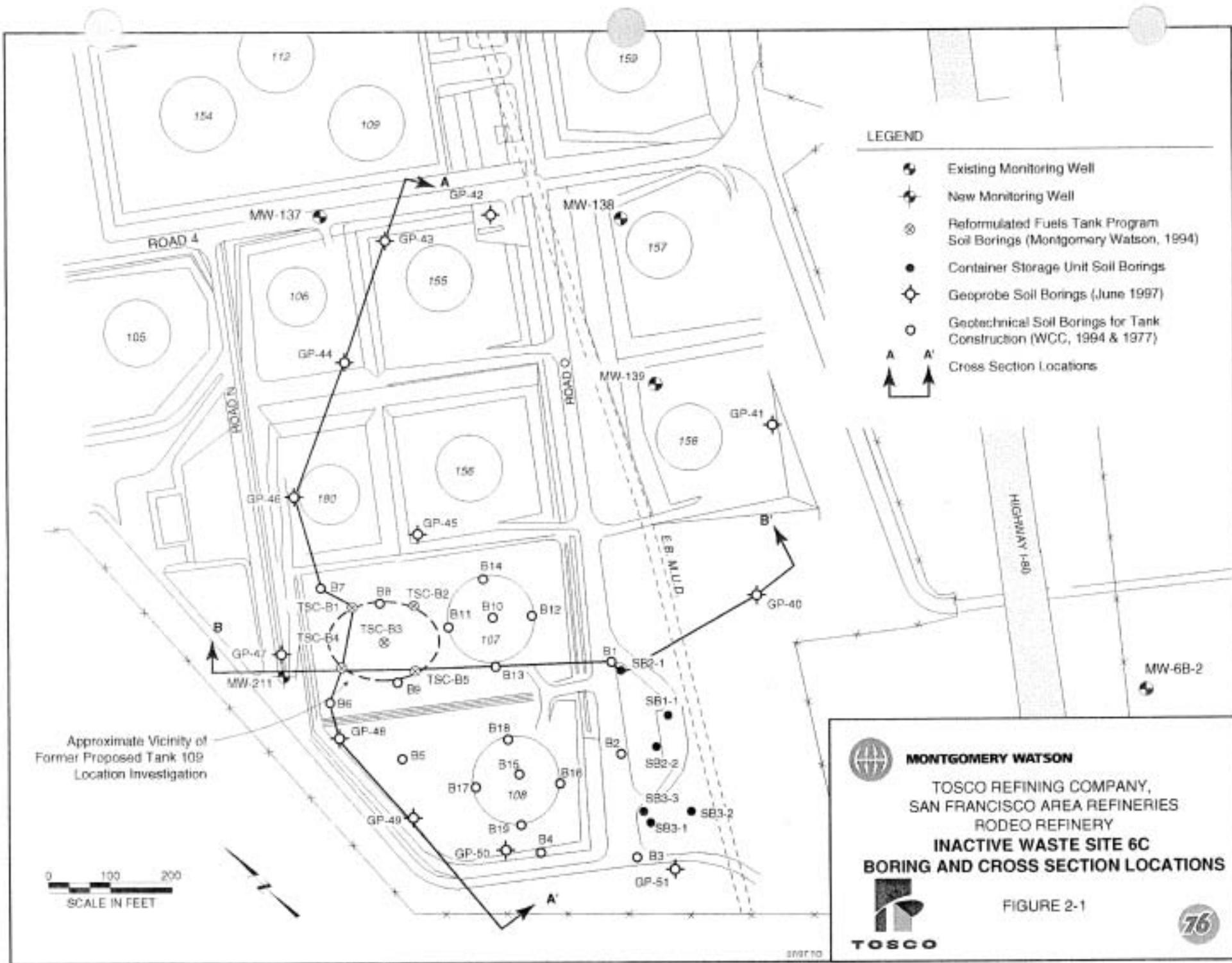


MONTGOMERY WATSON

TOSCO REFINING COMPANY, SAN FRANCISCO AREA REFINERIES
RODEO REFINERY
SITE LOCATION MAP



FIGURE 1-1



LEGEND

- Existing Monitoring Well
- New Monitoring Well
- Reformulated Fuels Tank Program Soil Borings (Montgomery Watson, 1994)
- Container Storage Unit Soil Borings
- Geoprobe Soil Borings (June 1997)
- Geotechnical Soil Borings for Tank Construction (WCC, 1994 & 1977)
- Cross Section Locations

Approximate Vicinity of Former Proposed Tank 109 Location Investigation

0 100 200
SCALE IN FEET



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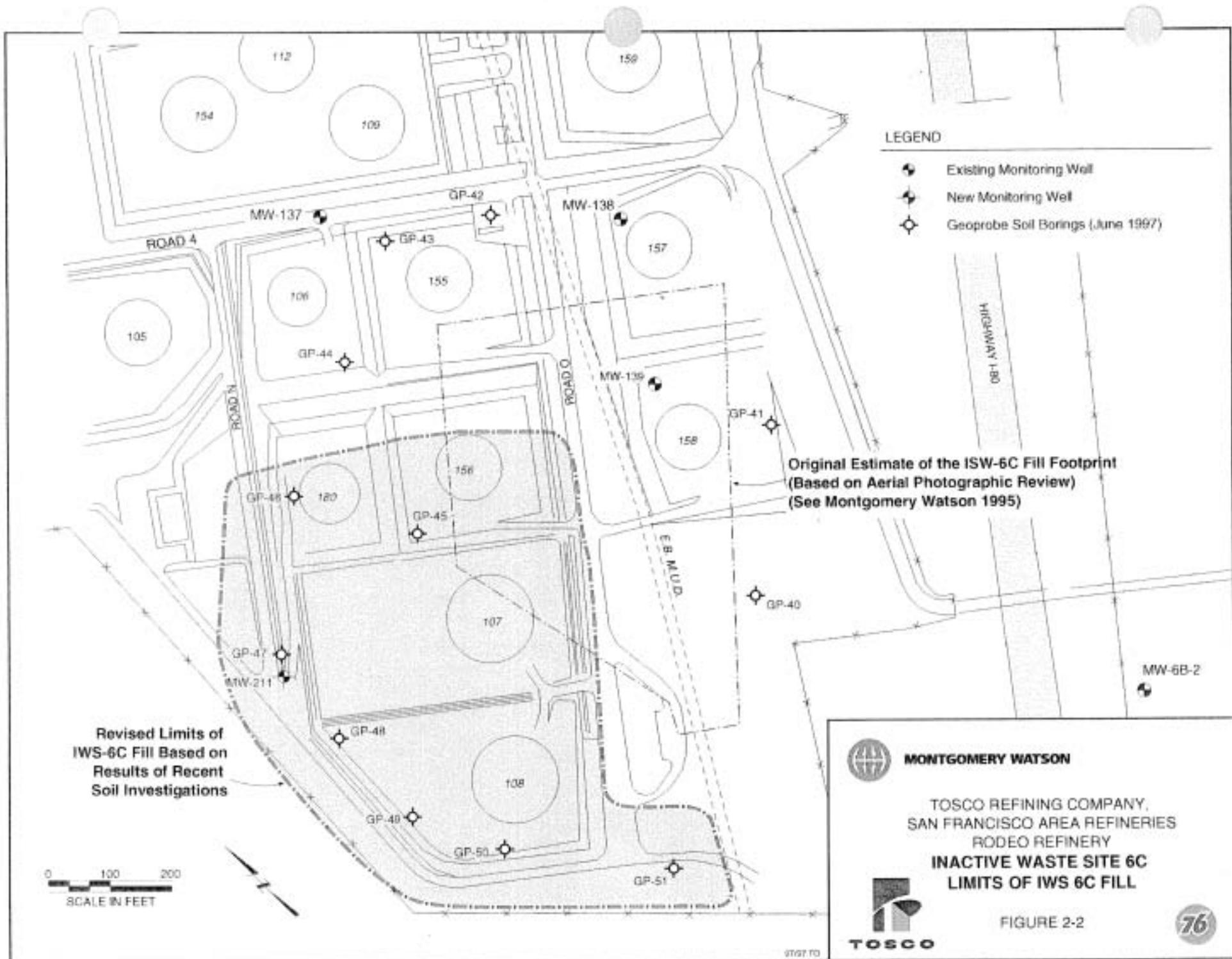
TOSCO REFINING COMPANY,
SAN FRANCISCO AREA REFINERIES
RODEO REFINERY

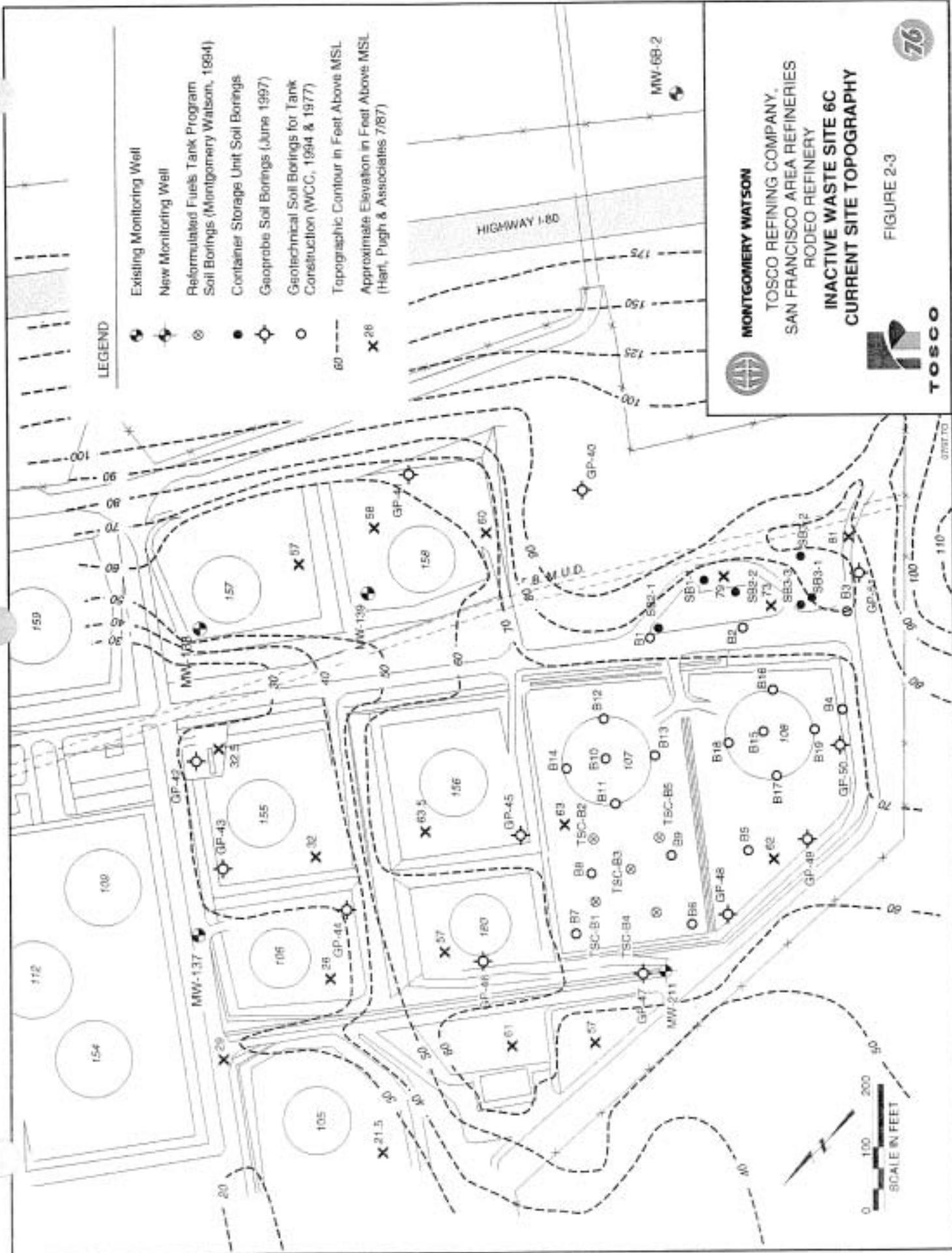
**INACTIVE WASTE SITE 6C
BORING AND CROSS SECTION LOCATIONS**



FIGURE 2-1

3/97/10



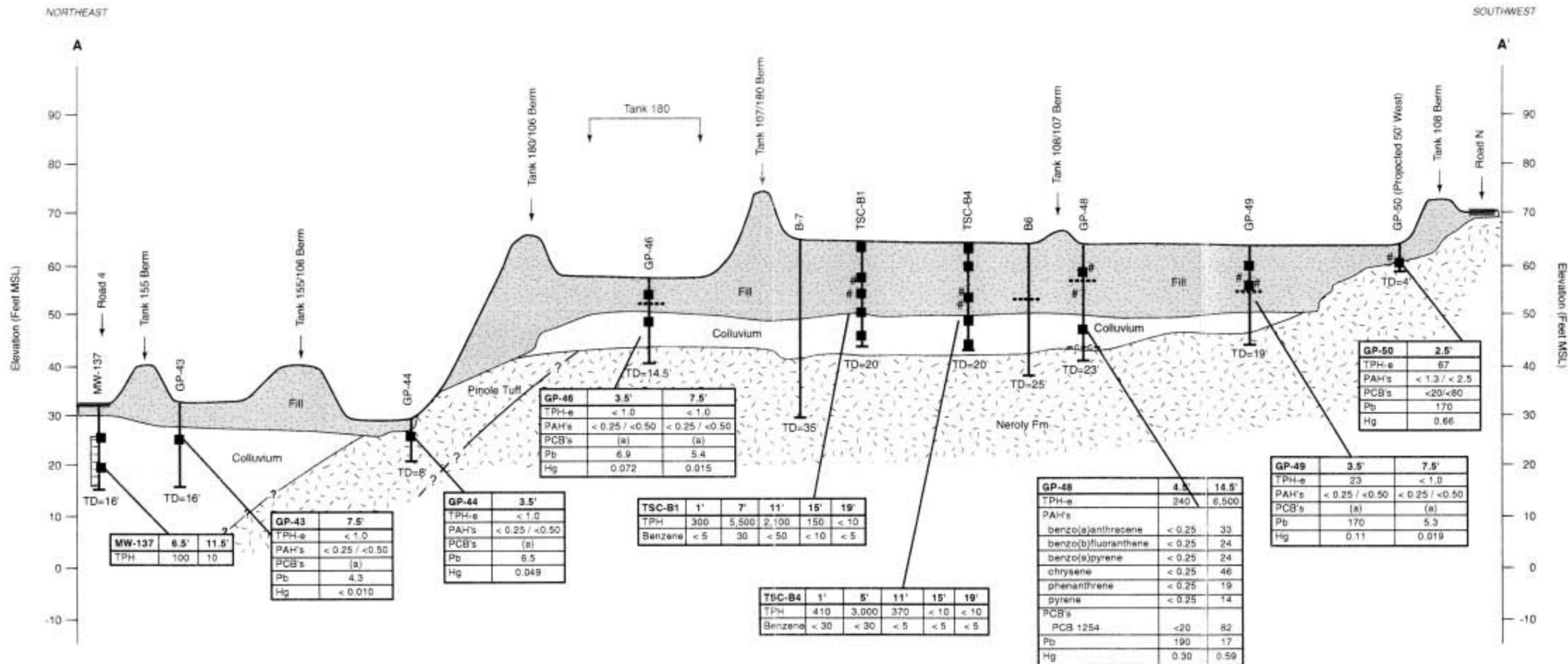


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 TOSCO REFINING COMPANY,
 SAN FRANCISCO AREA REFINERIES
 RODEO REFINERY
INACTIVE WASTE SITE 6C
CURRENT SITE TOPOGRAPHY

TOSCO

FIGURE 2-3

76



LEGEND

- Fill: Heterogeneous mixture of sediments and assorted debris, comprised predominately of silt and clay with brick, concrete, wood, and petroleum coke
 - Buried soil horizon or colluvium
 - Neroly Formation and Pinole Tuff
 - Area of petroleum coke conglomerations in fill matrix
 - Discrete layer of petroleum coke
 - Layer of sandstone cobbles (broken Neroly Fm)
 - (a) Data Pending
- Soil boring with total depth and soil sample locations**
- Monitoring well with total depth, screened interval, and soil sample locations**
- Boring**
- | | |
|-------|-------|
| GP-44 | 3.5' |
| TPH-e | < 1.0 |
- Sample Interval**
- Analyte** **Concentration**

Concentration:

- TPH-e - Extractable total petroleum hydrocarbons in mg/kg (EPA Method 3550/8015m)
- TPH - Total petroleum hydrocarbons in mg/kg (EPA Method 418.1)
- benzene - Benzene in ug/kg (EPA Method 8020)
- PAH's - Polynuclear aromatic hydrocarbons in mg/kg (EPA Method 8270)
- Pb - Lead in mg/kg (EPA Method 7420)
- Hg - Mercury in mg/kg (EPA Method 7471)
- PCB's - Polychlorinated biphenols in ug/kg (EPA Methods 8270 & 8080)



MONTGOMERY WATSON

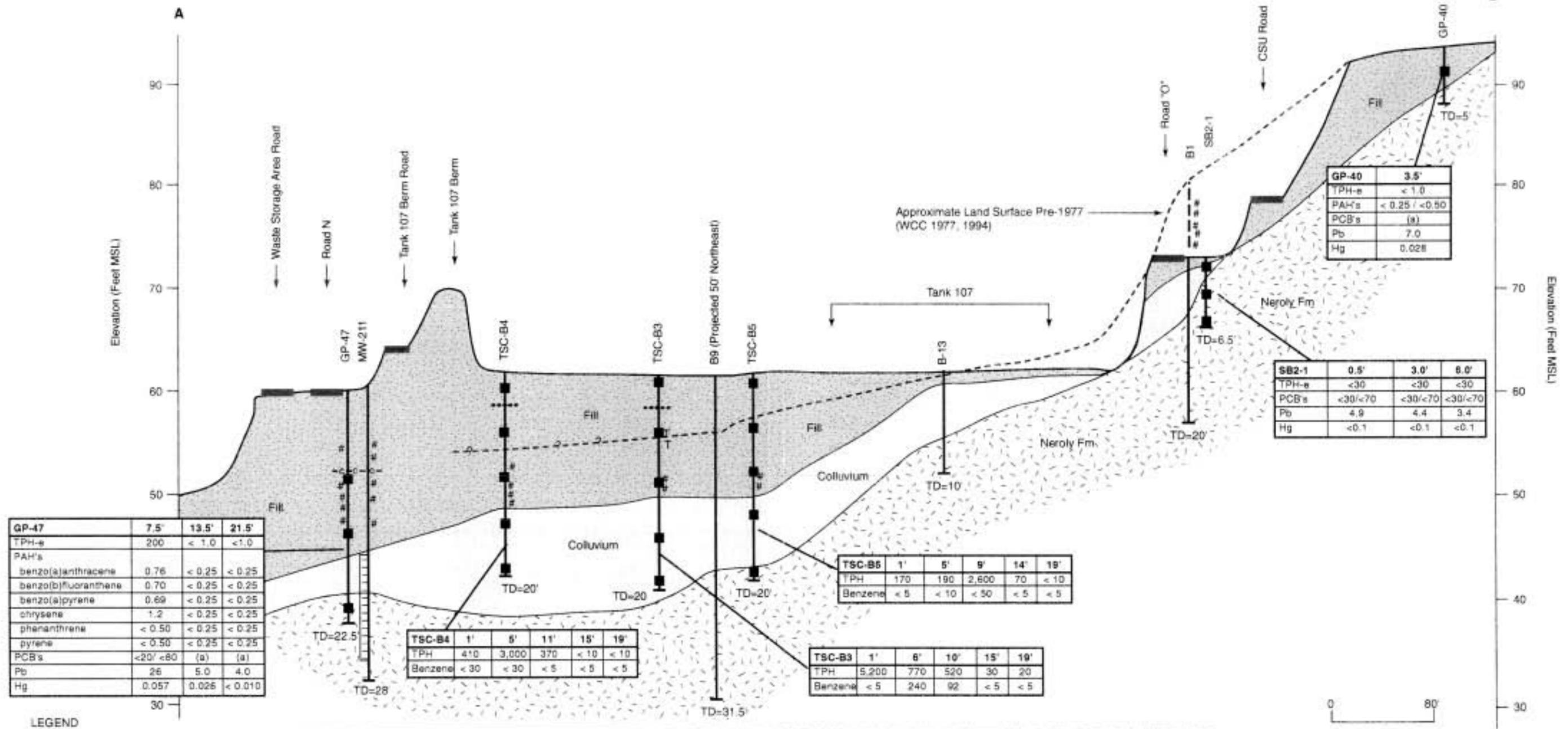
TOSCO REFINING COMPANY,
SAN FRANCISCO AREA REFINERIES
RODEO REFINERY
INACTIVE WASTE SITE 6C
HYDROGEOLOGIC CROSS SECTION A-A'

TOSCO

FIGURE 2-4

NORTHEAST

SOUTHWEST



LEGEND

- Fill, Heterogeneous mixture of sediments and assorted debris, comprised predominately of silt and clay with brick, concrete, wood, and petroleum coke
 - Buried soil horizon or colluvium
 - Neroly Formation and Pinole Tuff
 - Area of petroleum coke conglomerations in fill matrix
 - Discrete layer of petroleum coke
 - Layer of sandstone cobbles (broken Neroly Fm)
 - (a) Data Pending
 - Soil boring with total depth and soil sample locations
 - Monitoring well with total depth, screened interval, and soil sample locations
- Concentration:
- TPH-e - Extractable total petroleum hydrocarbons in mg/kg (EPA Method 3550/8015m)
 TPH - Total petroleum hydrocarbons in mg/kg (EPA Method 418.1)
 benzene - Benzene in ug/kg (EPA Method 8020)
 PAH's - Polynuclear aromatic hydrocarbons in mg/kg (EPA Method 8270)
 Pb - Lead in mg/kg (EPA Method 7420)
 Hg - Mercury in mg/kg (EPA Method 7471)
 PCB's - Polychlorinated biphenols in ug/kg (EPA Methods 8270 & 8080)

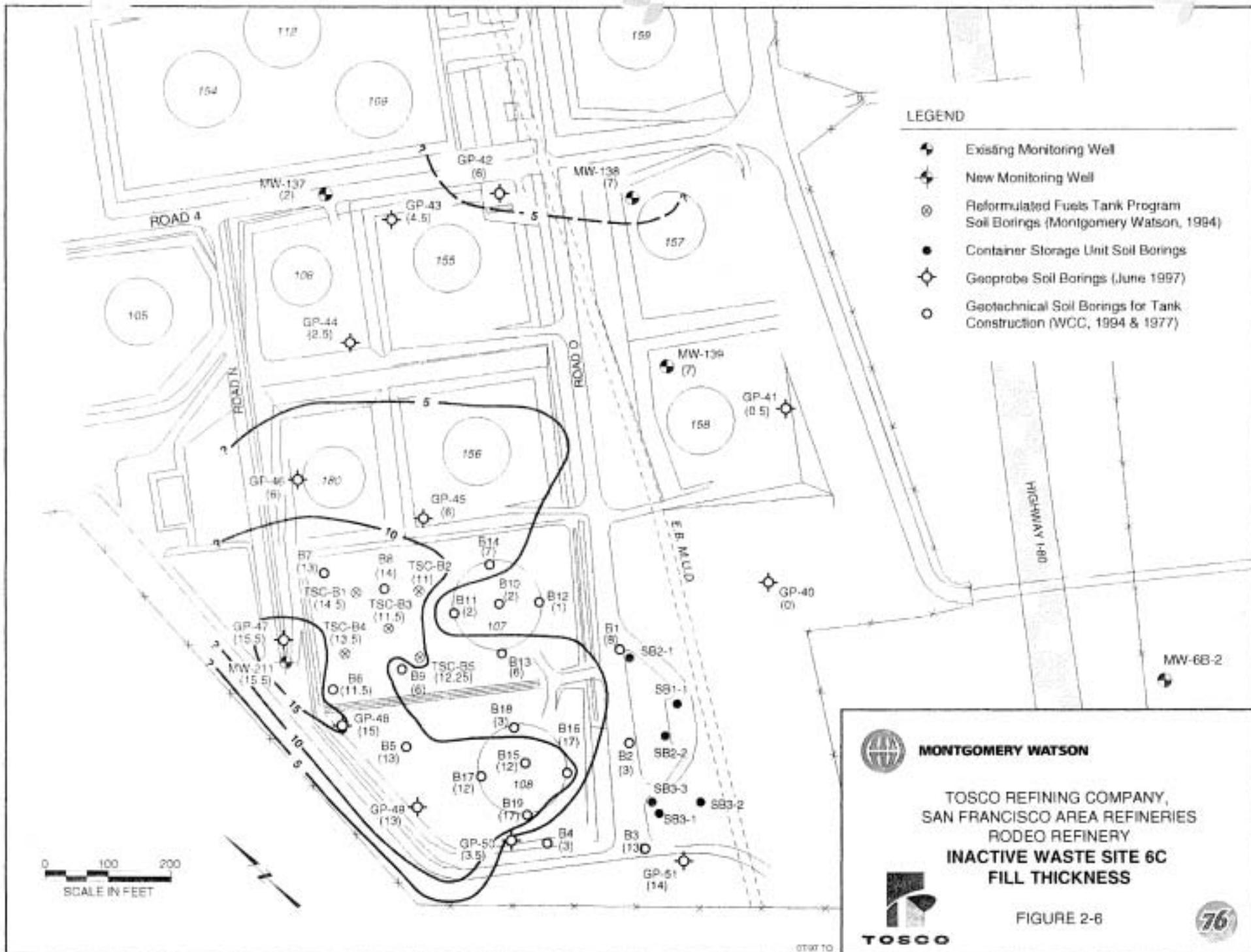
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 RODEO REFINERY
INACTIVE WASTE SITE 6C
HYDROGEOLOGIC CROSS SECTION B-B'

TOSCO

FIGURE 2-5

31-67 TO



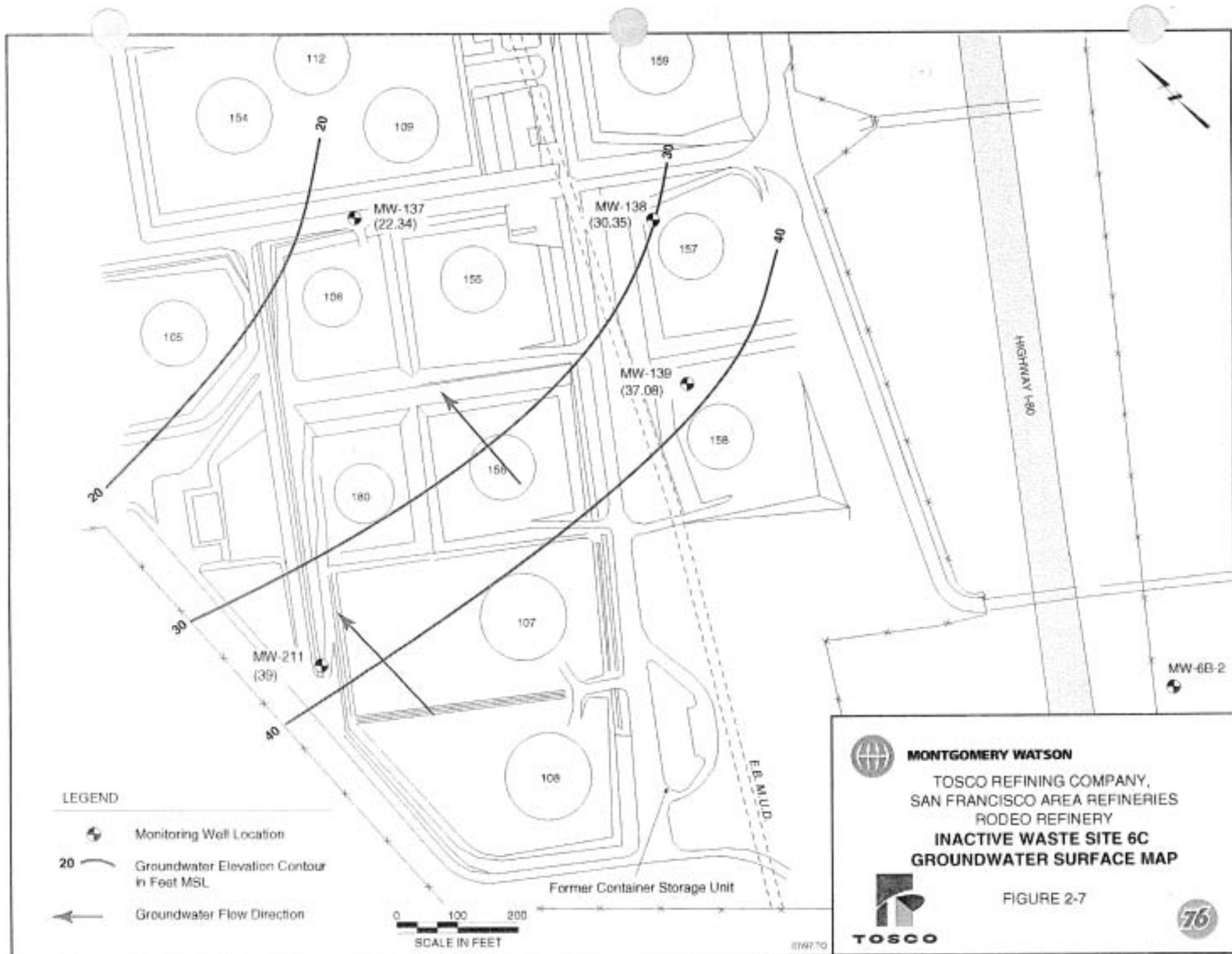
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TOSCO REFINING COMPANY,
 SAN FRANCISCO AREA REFINERIES
 RODEO REFINERY
**INACTIVE WASTE SITE 6C
 FILL THICKNESS**

TOSCO

FIGURE 2-8

76



LEGEND

Monitoring Well Location

20 Groundwater Elevation Contour in Feet MSL

Groundwater Flow Direction

0 100 200

SCALE IN FEET

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SAN FRANCISCO AREA REFINERIES
RODEO REFINERY
INACTIVE WASTE SITE 6C
GROUNDWATER SURFACE MAP

TOSCO

FIGURE 2-7

76

APPENDIX A - ADDITIONAL IWS 6C SOIL AND GROUNDWATER INVESTIGATIONS

This appendix summarizes the additional soil and groundwater investigation conducted at IWS 6C during June and July 1997 as proposed in the “Work Plan for Additional Investigation at Inactive Waste Site 6C” (Montgomery Watson, 1997). The work plan was submitted to and approved by the Regional Water Quality Control Board (RWQCB) in May 1997.

A.1 INVESTIGATION OBJECTIVES AND SCOPE OF WORK

The additional soil and groundwater investigations had the following objectives:

- Delineate the approximate horizontal and vertical extent of coke debris, tar, and petroleum-impacted soils in the fill beneath Inactive Waste Site 6C, and
- Develop a groundwater monitoring program to evaluate whether leachate from the coke debris, tar, and petroleum-impacted soils is impacting groundwater quality.

The scope of work completed for the investigation included:

- 12 Geoprobe™ soil borings (GP-40 through GP-51) advanced at the locations shown in Figure A-1. The borings were generally completed through the fill, bottoming in the underlying native colluvium/residual soil horizon or bedrock units. A summary of the total depth of each boring and samples collected is included in Table A-1.
- 20 soil samples from the Geoprobe™ borings were chemically tested to assess the nature and distribution of compounds in the fill.
- One new monitoring well (well MW-211) was installed adjacent to Geoprobe™ boring GP-47 to serve as a downgradient water quality monitoring well.
- Four monitoring wells including the new well (MW-211) and three existing wells (MW-137, MW-139, and MW-6BC) were sampled to provide groundwater chemistry results. Well MW-138 was not sampled as originally proposed because it contained a thin (approximately 0.01-foot) free-phase liquid hydrocarbon (FPLH) layer.

A.1.1 Geoprobe™ Soil Borings

Eleven of the twelve Geoprobe™ borings were completed at IWS 6C on June 25-26, 1997; boring GP-48 was completed on July 3, 1997. Each boring was completed through the fill into the underlying residual soil / native colluvium or bedrock at the locations shown in Figure A-1. Borings were logged from continuous cores to help in the identification of layers of coke debris, tar, or petroleum-impacted sediments in the fill. Soil boring logs for the Geoprobe™ borings will be forwarded under separate cover upon completion in early August.

Twenty soil samples were collected from the Geoprobe™ borings and submitted for chemical testing (see Table A-1). Typically, either one or two soil samples was submitted to the lab from each boring; a third sample was submitted from borings GP-45, GP-47, and GP-51 to further characterize the nature and vertical distribution of petroleum compounds in the fill. Soil samples were analyzed for extractable total petroleum hydrocarbons (TPH-e) by EPA Method 8015 Modified, lead by EPA method 7420, mercury by EPA Method 7471, polyaromatic hydrocarbons (PAHs) using EPA Method 8270. In addition, the five soil samples that contained the highest concentrations of hydrocarbons were tested for polychlorinated biphenols (PCBs) using EPA Method 8080; PCB data for the remaining soil samples is pending and will be forwarded to the RWQCB under separate cover; to serve as supplemental information until the remainder of the PCB data is available, the EPA Method 8270 chromatograms were re-evaluated to qualitatively assess the presence or absence of PCBs. Soil chemistry results from the samples are summarized in Table A-2.

A.1.2 Monitoring Well Installation

One groundwater monitoring well (MW-211) was installed along the western edge of the IWS 6C area as shown in Figure A-1. Well MW-211 was drilled and installed between July 1 and July 3, 1997; a boring and well completion log for well MW-211 will be forwarded under separate cover upon completion in August.

Monitoring well (MW-211) was used to augment the network for groundwater quality monitoring at IWS 6C. Other wells included in the network are downgradient well MW-137, sidegradient wells MW-138 and MW-139, and upgradient well MW-6B-2.

A.1.3 Groundwater Sampling

A groundwater sampling round of the well network was completed on July 9, 1997; sampling logs are included at the back of this appendix for reference. Groundwater samples were collected from wells MW-137, MW-139, MW-211, and MW-6B-2. A sample was not collected from well MW-138 because of the presence of a thin layer of FPLH. Samples were analyzed for TPH-e by EPA Method 8015 Modified, lead by EPA method 7421, mercury by EPA Method 7470, and PAHs using EPA Method 8270. Similar to the soil data, quantitative PCB data is not available, however the EPA Method 8270 chromatograms were re-evaluated in order to provide qualitative results. Groundwater samples from the IWS 6C wells are being collected during the first week of August 1997 as part of the refinery groundwater quality monitoring program; the samples will be tested for PCBs with the results reported to the RWQCB alongwith the pending soils data.

A.2 METHODS AND PROCEDURES

A.2.1 Preparatory Activities

Underground Service Alert (USA) was contacted to locate public utilities near the work area prior to the commencement of drilling. USA locates underground utilities leading from the public corridor onto private property. An independent underground utility locating company (California Utility Surveys, San Ramon, California) was subcontracted to identify underground hazards and utility corridors within the refinery boundaries that might be near the proposed borings and monitoring well. "As-built" site plans or other schematic diagrams provided by Tosco showing underground utilities were also reviewed.

Montgomery Watson's existing Health and Safety Plan (HSP) for the Rodeo Refinery was used during the field efforts. The HSP addresses basic health and safety requirements for the subsurface environmental investigation, including drilling of boreholes and soil and groundwater sampling. All personnel was briefed daily on safety requirements prior to commencing with field operations during tailgate safety meetings.

A.2.2 Geoprobe™ Borings

The Geoprobe™ borings were completed under soil boring permits obtained from Contra Costa County Health Services Department. Soil borings were advanced using a truck-mounted, hydraulically-driven Geoprobe™ 5400 pneumatic coring system. The system was adapted with the Macro core sampler, which is a 2-inch diameter, 4-foot long stainless-steel casing that is lined with disposable acetate sleeves for core retrieval. A continuous core was extracted from the boring; the intervals that were desired for chemical testing were cut from the lined core, sealed, and placed in a cooler under standard chain-of-custody procedures for delivery to the laboratory.

The soil core was logged by a Montgomery Watson field hydrogeologist. Soil was checked for visual and olfactory signs of contamination, and classified in accordance with the Unified Soil Classification System (USCS). Soil color and hue were classified using the Munsell color system. Each boring was abandoned by grouting the borehole to ground surface with a bentonite cement slurry tremied into place.

A.2.3 Monitoring Well Installation

The monitoring well was installed under a permit from the Contra Costa County Health Services Department. The following procedures were used for drilling, completing, and developing the well.

A.2.3.1 Drilling. The monitoring well was installed using a truck-mounted Mobile B-61 drilling rig equipped with 10.5-inch diameter, continuous-flight hollow-stem augers. Soil

samples were collected every five feet due to the adjacent location of Geoprobe™ boring GP-47. Soil samples were collected using a modified California split-spoon sampler and evaluated for visual and olfactory signs of contamination. Soil cuttings were screened using a photoionization detector (PID) to check for organic vapors and to assist in selection soil samples to be submitted for chemical analysis. Soils were classified according to the USCS and the Munsell color system as discussed above.

A.2.3.2 Well Completion. Well MW-211 was completed using 4-inch diameter, Schedule 40 polyvinyl chloride (PVC) casing with a 10-foot screened interval placed between 17 and 27 feet below ground surface (bgs). The well screen was constructed of 0.010-inch factory slotted PVC screen with a screw-on end cap. No chemical cements, glues, or solvents were used in well construction. The annular space surrounding the well screen was backfilled through the hollow-stem auger from the bottom of the boring to one foot above the top of the screen interval with Lonestar #2/12 graded sand. A 2-foot thick bentonite pellet seal and bentonite cement grout seal to ground surface was placed on top of the sand pack to seal off the well annulus. The well head was capped with a locking water-tight "plumbers" expansion cap and enclosed within a traffic-rated, water-tight Christy box.

A.2.3.3 Well Development. Well MW-211 was developed using a surge block and a bailer on July 8, 1997. A well development log is attached at the back of this appendix for reference. The purpose of well development is to remove suspended sediment from the well system and to stabilize and settle the sand pack. Development was completed by raising and lowering a rigid surge block through the screened interval, and then pumping out the water contained in the casing. Groundwater parameters including pH, electrical conductivity, temperature, and turbidity were monitored during development after approximately every well volume.

The yield from well MW-211 during development was very low; approximately only two well volumes could be removed before the well dewatered. An additional one to two well volumes was removed after allowing the water level to recharge. Further development was not completed because the water being removed had consistent pH, electrical conductivity, and temperature, and

because the well was installed in the upper portion of the bedrock where groundwater yield was expected to be low based on the performance of other refinery wells screened in similar units.

A.2.4 Soil Sampling

The soil samples submitted for chemical testing were generally obtained from the lowermost (least disturbed) end of the acetate sample liner. Upon removal from the sampler, the ends of the liner were sealed with Teflon sheeting and capped with plastic end caps. Silicon tape was used to secure the end caps and the sample was labeled with a unique sample I.D., date and time of collection, and analyses to be performed. Each sample will be placed in refrigerated storage for preservation. Soil samples will be delivered under chain-of-custody to Sequoia Analytical of Walnut Creek, California, a California State-certified laboratory.

The soil samples submitted for chemical analysis were selected by the field hydrogeologist to characterize both the nature and extent of petroleum compounds in the fill. Accordingly, samples were collected from a variety of locations, including intervals that were visually unimpacted, intervals that contained coke conglomerations, and intervals within or immediately adjacent to coke layers. In addition, a few samples were collected from the residual soil/colluvial layer and from the underlying bedrock to assess potential downward migration. A summary of each sample and the material that it represents is included Table A-1.

A.2.5 Groundwater Sampling

Groundwater samples were collected from well MW-211 and from the other existing wells by MPDS Services Inc., Concord, California on July 9, 1997. Logs documenting the sampling event are included at the back of this appendix for reference. Each well was gauged prior to sampling to check for the presence of FPLH and measure the depth to groundwater. Wells were purged of a minimum of three well casing volumes of water and then sampled after the water level had recovered to at least 80% of the pre-purging height. The wells were purged using a disposable

bailer. Groundwater parameters including pH, electrical conductivity, and temperature were monitored during purging to ensure steady-state groundwater conditions at the time of sampling.

Groundwater samples were collected in a dedicated (disposable) polycarbonate bailer and decanted into the appropriate container. Each sample container was labeled, placed in refrigerated storage for preservation, and logged on the chain-of-custody for delivery to the laboratory.

A.2.6 Waste Management

Soil cuttings generated during drilling and Geoprobe operations were placed in an appropriate storage container which was labeled, sealed, and transferred to the Tosco waste management division for final disposition. Groundwater generated during well development and sampling was temporarily stored in storage tanks on the sampling and development vehicles, and then transferred to Tosco waste water treatment plant for handling alongwith the refinery wastewater.