

FINAL REMEDY COMPLETION REPORT

HITACHI GLOBAL STORAGE TECHNOLOGIES, INC.
REDEVELOPMENT PROPERTY
5600 COTTLE ROAD, SAN JOSE, CALIFORNIA

Prepared for:

Hitachi Global Storage Technologies, Inc.
San Jose, California

Prepared by:

ENVIRON International Corporation
Emeryville, California

August 29, 2007

03-11903E

Prepared by:

ENVIRON International Corporation
6001 Shellmound Street, Suite 700
Emeryville, California 94608
Tel. (510) 655-7400

In accordance with Title 22, 66270.11(d), I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to be the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Anne Wooster Gates, P.E.
Senior Manager
ENVIRON International Corporation

Prepared for:

Hitachi Global Storage Technologies, Inc.
5600 Cottle Road (MS: PFX/123)
San Jose, California 95193
Tel. (408) 717-5696

John F. Grewohl
Manager, San Jose Site Operations
Hitachi Global Storage Technologies, Inc.

TABLE OF CONTENTS

	<u>Page</u>
1.0 INTRODUCTION.....	1-1
1.1 OVERVIEW	1-1
1.2 BACKGROUND	1-1
1.3 REPORT ORGANIZATION.....	1-3
2.0 SITE CHARACTERIZATION	2-1
2.1 SITE HISTORY AND OPERATIONS	2-1
2.2 SURROUNDING AREA.....	2-1
2.3 FUTURE LAND USE	2-2
2.4 GROUNDWATER USE.....	2-2
2.5 PHYSICAL DESCRIPTION.....	2-3
2.5.1 Topography	2-3
2.5.2 Geology and Hydrogeology	2-4
3.0 SUMMARY OF INVESTIGATIONS.....	3-1
3.1 SITE-WIDE GROUNDWATER.....	3-1
3.1.1 Previous Investigations	3-1
3.1.2 Current Conditions.....	3-10
3.2 INVESTIGATIONS IN SOIL, SOIL GAS, AND GROUNDWATER	3-11
3.2.1 Historical Investigations	3-11
3.2.2 Current Investigations – 2004 to 2007	3-12
3.2.3 Parcel O-1	3-12
3.2.4 Parcel O-2	3-18
3.2.5 Parcel O-3	3-39
3.2.6 Parcel O-4	3-42
3.2.7 Parcel O-5	3-61
3.2.8 Endicott Boulevard/Tucson Way	3-70
3.2.9 Naturally-Occurring Asbestos (NOA) on the Redevelopment Property	3-71
4.0 DEVELOPMENT OF RISK-BASED TARGET CONCENTRATIONS	4-1
4.1 SELECTION OF CHEMICALS TO BE EVALUATED	4-2
4.1.1 Groundwater	4-2
4.1.2 Soil Gas.....	4-2
4.1.3 Soil	4-2
4.2 POTENTIAL POPULATIONS AND EXPOSURE PATHWAYS.....	4-3
4.2.1 Potentially Exposed Populations.....	4-3
4.2.2 Relevant Exposure Pathways.....	4-3
4.2.2.1 Groundwater	4-3
4.2.2.2 Soil Gas.....	4-4
4.2.2.3 Soil	4-4

TABLE OF CONTENTS

(Continued)

	<u>Page</u>
4.3 EXPOSURE ASSESSMENT	4-5
4.3.1 Estimation of Intake	4-5
4.3.2 Exposure Assumptions.....	4-6
4.3.2.1 Human Physiological Assumptions	4-6
4.3.2.2 Population-Specific Assumptions.....	4-7
4.3.2.3 Route-Specific Assumptions.....	4-8
4.3.3 Quantification of Exposure.....	4-8
4.4 FATE AND TRANSPORT MODELING	4-9
4.4.1 Migration from Groundwater to Residential Indoor Air.....	4-11
4.4.2 Migration from Groundwater to Commercial Indoor Air.....	4-11
4.4.3 Migration from Groundwater to Ambient Air	4-11
4.4.4 Migration from Groundwater to Construction Trench Ambient Air	4-12
4.4.5 Migration from Soil Gas to Indoor and Ambient Air	4-12
4.4.6 Migration from Soil to Indoor and Ambient Air	4-13
4.4.7 Windblown Dust.....	4-13
4.5 TOXICITY ASSESSMENT	4-14
4.5.1 Carcinogenic Effects.....	4-14
4.5.2 Noncarcinogenic Effects.....	4-16
4.5.3 Sources of Toxicity Values.....	4-16
4.5.4 Total Petroleum Hydrocarbons.....	4-16
4.6 CALCULATION OF RISK-BASED TARGET CONCENTRATIONS	4-17
4.6.1 Methodology.....	4-17
4.6.2 Target Concentrations.....	4-19
5.0 COMPARISON OF RISK-BASED TARGET CONCENTRATIONS TO MEASURED CONCENTRATIONS	5-1
5.1 SITE-WIDE GROUNDWATER.....	5-1
5.2 PARCEL O-1	5-2
5.2.1 Soil.....	5-2
5.2.2 Soil Gas.....	5-3
5.3 PARCEL O-2.....	5-4
5.3.1 Soil.....	5-4
5.3.2 Soil Gas.....	5-8
5.3.3 Groundwater	5-9
5.4 PARCEL O-3.....	5-10
5.5 PARCEL O-4.....	5-11
5.5.1 Soil.....	5-11
5.5.2 Soil Gas.....	5-14
5.5.3 Groundwater	5-15
5.6 PARCEL O-5.....	5-16
5.6.1 Soil.....	5-16

TABLE OF CONTENTS

(Continued)

	<u>Page</u>
5.6.2 Soil Gas.....	5-18
5.7 ENDICOTT BOULEVARD/TUCSON WAY	5-18
6.0 RISK CHARACTERIZATION.....	6-1
6.1 METHOD FOR ESTIMATING RISK	6-1
6.2 CALCULATION OF EXPOSURE POINT CONCENTRATIONS	6-2
6.3 SITE-WIDE GROUNDWATER.....	6-3
6.4 PARCEL O-1	6-4
6.4.1 Soils.....	6-4
6.4.2 Soil Gas.....	6-4
6.4.3 Cumulative Risks.....	6-5
6.5 PARCEL O-2.....	6-5
6.5.1 Soil.....	6-5
6.5.2 Soil Gas.....	6-7
6.5.3 Groundwater	6-9
6.5.4 Cumulative Risks.....	6-9
6.6 PARCEL O-3.....	6-10
6.7 PARCEL O-4.....	6-10
6.7.1 Soil.....	6-10
6.7.2 Soil Gas.....	6-12
6.7.3 Groundwater	6-12
6.7.4 Cumulative Risk.....	6-13
6.8 PARCEL O-5.....	6-13
6.8.1 Soil.....	6-13
6.8.2 Soil Gas.....	6-14
6.8.3 Cumulative Risk.....	6-14
6.9 ENDICOTT BOULEVARD/TUCSON WAY	6-15
7.0 UNCERTAINTIES	7-1
7.1 EXPOSURE ASSESSMENT	7-1
7.2 FATE AND TRANSPORT MODELING	7-1
7.3 TOXICITY ASSESSMENT	7-3
7.3.1 Carcinogens.....	7-3
7.3.2 Noncarcinogens.....	7-4
7.4 UNCERTAINTIES IN RISK.....	7-4
8.0 SUMMARY/CONCLUSIONS.....	8-1
9.0 REFERENCES.....	9-1

TABLES

Table 1.1	Corrective Measure Study – Remedial Goals (RGs) for Soil
Table 3.1	Maximum Groundwater Concentrations Compared to Current Cleanup Levels
Table 3.2	Summary of Shallow (A-aquifer) Monitoring, Extraction, and Observation Wells on the Redevelopment Property
Table 3.3	Maximum Concentrations Detected in A- and B-Aquifer Wells on the Redevelopment Property (2004 through 2006)
Table 3.4	Soil Gas Sampling Results for Parcel O-1 (5 feet bgs)
Table 3.5	Soil Gas Sampling Results for Parcel O-1 (10 – 15 feet bgs)
Table 3.6	Soil Sampling Results for Parcel O-1
Table 3.7	Historical Soil Analytical Data for Parcel O-1
Table 3.8	Soil Gas Sampling Results for Parcel O-2 (5 feet bgs)
Table 3.9	Soil Gas Sampling Results for Parcel O-2 (10 – 15 feet bgs)
Table 3.10	Historical Soil Analytical Data for Parcel O-2
Table 3.11	Soil Sampling Results for Parcel O-2
Table 3.12	Groundwater Sampling Results for Parcel O-2
Table 3.13	Soil Sampling Results for Parcel O-3
Table 3.14	Soil Sampling Results for Parcel O-4
Table 3.15	Groundwater Sampling Results for Parcel O-4
Table 3.16	Historical Soil Sampling Results for Parcel O-4
Table 3.17	Soil Gas Sampling Results for Parcel O-4 (5 feet bgs)
Table 3.18	Soil Gas Sampling Results for Parcel O-4 (10 – 15 feet bgs)
Table 3.19	Soil Sampling Results for Parcel O-5
Table 3.20	Historical Soil Sampling Results for Parcel O-5
Table 3.21	Soil Gas Sampling Results for Parcel O-5 (5 feet bgs)
Table 3.22	Soil Sampling Results for Endicott Boulevard/Tucson Way
Table 4.1	Chemicals of Potential Concern in Groundwater, Soil Gas, and Soil
Table 4.2	Intake Equations for Exposure via Inhalation of Vapors from Groundwater/Soil
Table 4.3	Intake Equations for Exposure via Inhalation of Windblown Soil Particulates
Table 4.4	Intake Equations for Exposure via Incidental Ingestion of Soil
Table 4.5	Intake Equations for Exposure via Dermal Contact with Soil
Table 4.6	Exposure Assumptions
Table 4.7	Dermal Absorption Fraction from Soil
Table 4.8	Intake Factors
Table 4.9	Physical/Chemical Properties of Volatile Chemicals
Table 4.10	Modeling Parameters
Table 4.11	Estimated Groundwater-to-Air Transfer Factors
Table 4.12	Estimated Soil Gas-to-Air Transfer Factors
Table 4.13	Estimated Soil-to-Air Transfer Factors
Table 4.14	Carcinogenic and Noncarcinogenic Toxicity Values
Table 4.15	Risk-Based Target Concentrations (RBTCs) for Groundwater
Table 4.16	Risk-Based Target Concentrations (RBTCs) for Soil Gas at Depth of 5 Feet
Table 4.17	Risk-Based Target Concentrations (RBTCs) for Soil Gas at Depth of 10 Feet
Table 4.18	Risk-Based Target Concentrations (RBTCs) for Soil Gas at Depth of 15 Feet

TABLE OF CONTENTS

(Continued)

Table 4.19	Risk-Based Target Concentrations (RBTCs) for Soil
Table 4.20	Risk-Based Target Concentrations (RBTCs) for TPH-Diesel in Soil
Table 4.21	Risk-Based Target Concentrations (RBTCs) for TPH- Shell Sol 140 in Soil
Table 4.22	Risk-Based Target Concentrations (RBTCs) for TPH-Motor Oil in Soil
Table 5.1	Comparison of Maximum Detected Analytical Results to Minimum Residential Risk-Based Target Concentrations (RBTCs) for Groundwater
Table 5.2	Analytical Results above Residential Risk-Based Target Concentrations (RBTCs) for Groundwater
Table 5.3	Comparison of Maximum Detected Analytical Results to Minimum Residential Risk-Based Target Concentrations (RBTCs) for Soil
Table 5.4	Analytical Results above Residential Risk-Based Target Concentrations (RBTCs) for Soil
Table 5.5	Comparison of Maximum Detected Analytical Results to Minimum Residential Risk-Based Target Concentrations (RBTCs) for Soil Gas at Depth of 5 Feet
Table 5.6	Comparison of Maximum Detected Analytical Results to Minimum Residential Risk-Based Target Concentrations (RBTCs) for Soil Gas at Depth of 10 Feet
Table 5.7	Comparison of Maximum Detected Analytical Results to Minimum Residential Risk-Based Target Concentrations (RBTCs) for Soil Gas at Depth of 15 Feet
Table 5.8	Analytical Results above Residential Risk-Based Target Concentrations (RBTCs) for Soil Gas
Table 6.1	Estimated Cancer Risks and Noncancer Hazard Indices for Site-Wide Groundwater
Table 6.2	Estimated Cancer Risks and Noncancer Hazard Indices for Parcel O-1 - Soil (Old Septic Tank Near B010)
Table 6.3	Estimated Cancer Risks and Noncancer Hazard Indices for Parcel O-1 - Soil (Current and Former Orchard Areas)
Table 6.4	Estimated Cancer Risks and Noncancer Hazard Indices for Parcel O-1 - Soil Gas (Near Monitoring Well RA-24)
Table 6.5	Estimated Cancer Risks and Noncancer Hazard Indices for Parcel O-1 - Soil Gas (Near Storm Drain)
Table 6.6	Summary of Estimated Cancer Risks and Noncancer Hazard Indices for Parcel O-1 – Soil and Soil Gas
Table 6.7	Estimated Cancer Risks and Noncancer Hazard Indices for Parcel O-2 - Soil (Hydrofluoric Acid Release - Building 026)
Table 6.8	Estimated Cancer Risks and Noncancer Hazard Indices for Parcel O-2 - Soil (Chemical Penetrating Laboratory Floor - Building 026)
Table 6.9	Estimated Cancer Risks and Noncancer Hazard Indices for Parcel O-2 - Soil (Room 400 - Building 026)
Table 6.10	Estimated Cancer Risks and Noncancer Hazard Indices for Parcel O-2 - Soil (Rooms 113C and 114A - Building 026)
Table 6.11	Estimated Cancer Risks and Noncancer Hazard Indices for Parcel O-2 - Soil (Beneath Building 026, Including Chemical Storage Room)
Table 6.12	Estimated Cancer Risks and Noncancer Hazard Indices for Parcel O-2 - Soil (Buried Concrete Trench)

TABLE OF CONTENTS

(Continued)

Table 6.13	Estimated Cancer Risks and Noncancer Hazard Indices for Parcel O-2 - Soil (Former WV-02 (Original) - Building 026)
Table 6.14	Estimated Cancer Risks and Noncancer Hazard Indices for Parcel O-2 - Soil (Former Clay Pipeline - Building 026)
Table 6.15	Estimated Cancer Risks and Noncancer Hazard Indices for Parcel O-2 - Soil (Former WV-02 (Second) - Building 026)
Table 6.16	Estimated Cancer Risks and Noncancer Hazard Indices for Parcel O-2 - Soil (Former WV-15 - Building 026)
Table 6.17	Estimated Cancer Risks and Noncancer Hazard Indices for Parcel O-2 - Soil (Emergency Generator at Building 010)
Table 6.18	Estimated Cancer Risks and Noncancer Hazard Indices for Parcel O-2 - Soil (Building 026 Clarifier)
Table 6.19	Estimated Cancer Risks and Noncancer Hazard Indices for Parcel O-2 – Soil (Current and Former Orchards)
Table 6.20	Estimated Cancer Risks and Noncancer Hazard Indices for Parcel O-2 - Soil Gas (Near Monitoring Well A-30)
Table 6.21	Estimated Cancer Risks and Noncancer Hazard Indices for Parcel O-2 - Soil Gas (Buried Concrete Trench)
Table 6.22	Estimated Cancer Risks and Noncancer Hazard Indices for Parcel O-2 - Soil Gas (Former WV-02 (Original) - Building 026)
Table 6.23	Estimated Cancer Risks and Noncancer Hazard Indices for Parcel O-2 - Soil Gas (Beneath Building 026 Footprint)
Table 6.24	Estimated Cancer Risks and Noncancer Hazard Indices for Parcel O-2 - Groundwater (Near Building 026)
Table 6.25	Summary of Estimated Cancer Risks and Noncancer Hazard Indices for Parcel O-2 – Soil, Soil Gas, and Groundwater
Table 6.26	Estimated Cancer Risks and Noncancer Hazard Indices for Parcel O-3 - Soil
Table 6.27	Estimated Cancer Risks and Noncancer Hazard Indices for Parcel O-4 - Soil (Soil Beneath Building 028)
Table 6.28	Estimated Cancer Risks and Noncancer Hazard Indices for Parcel O-4 - Soil (Industrial Wastewater Pipe Leak and Line Removal)
Table 6.29	Estimated Cancer Risks and Noncancer Hazard Indices for Parcel O-4 - Soil (Building 028J Area)
Table 6.30	Estimated Cancer Risks and Noncancer Hazard Indices for Parcel O-4 – Soil (Buried Concrete Trench)
Table 6.31	Estimated Cancer Risks and Noncancer Hazard Indices for Parcel O-4 - Soil (Former WV-04)
Table 6.32	Estimated Cancer Risks and Noncancer Hazard Indices for Parcel O-4 - Soil (Former Diesel UST at Building 028)
Table 6.33	Estimated Cancer Risks and Noncancer Hazard Indices for Parcel O-4 - Soil (Building 018 Pipe Backfill)
Table 6.34	Estimated Cancer Risks and Noncancer Hazard Indices for Parcel O-4 - Soil (Current and Former Orchards, includes near Homestead Lake)
Table 6.35	Estimated Cancer Risks and Noncancer Hazard Indices for Parcel O-4 - Soil Gas (Near Core Area)

TABLE OF CONTENTS

(Continued)

Table 6.36	Estimated Cancer Risks and Noncancer Hazard Indices for Parcel O-4 - Soil Gas (Building 028J Area)
Table 6.37	Estimated Cancer Risks and Noncancer Hazard Indices for Parcel O-4 - Soil Gas (Buried Concrete Trench)
Table 6.38	Estimated Cancer Risks and Noncancer Hazard Indices for Parcel O-4 - Groundwater (Building 028J Area)
Table 6.39	Estimated Cancer Risks and Noncancer Hazard Indices for Parcel O-4 - Groundwater (Freight Elevator at Building 028)
Table 6.40	Summary of Estimated Cancer Risks and Noncancer Hazard Indices for Parcel O-4 – Soil, Soil Gas, and Groundwater
Table 6.41	Estimated Cancer Risks and Noncancer Hazard Indices for Parcel O-5 - Soil (Electrical Substation)
Table 6.42	Estimated Cancer Risks and Noncancer Hazard Indices for Parcel O-5 - Soil (Soil in Raleigh Road)
Table 6.43	Estimated Cancer Risks and Noncancer Hazard Indices for Parcel O-5 - Soil (Passenger Elevator Pit - Building 051)
Table 6.44	Estimated Cancer Risks and Noncancer Hazard Indices for Parcel O-5 - Soil (Loading Dock Elevator - Building 051)
Table 6.45	Estimated Cancer Risks and Noncancer Hazard Indices for Parcel O-5 - Soil (Parking Lot - Building 051)
Table 6.46	Estimated Cancer Risks and Noncancer Hazard Indices for Parcel O-5 - Soil (Current and Former Orchards)
Table 6.47	Estimated Cancer Risks and Noncancer Hazard Indices for Parcel O-5 - Soil Gas (Due Diligence Sampling)
Table 6.48	Summary of Estimated Cancer Risks and Noncancer Hazard Indices for Parcel O-5 – Soil and Soil Gas
Table 6.49	Estimated Cancer Risks and Noncancer Hazard Indices for Endicott Boulevard/Tucson Way - Soil

FIGURES

Figure 1.1	Site Location Map
Figure 1.2	Site and Surrounding Area
Figure 1.3	Site Layout – Prior to Redevelopment
Figure 1.4	Site Layout – Redevelopment Property and Core Area
Figure 2.1	Groundwater Elevations in the A-Aquifer, 7/1/06 – 12/31/06
Figure 3.1	Potential Historical Sources of Groundwater Contamination
Figure 3.2	On-Site Groundwater Monitoring and Extraction Well Locations – A-Aquifer, 7/1/06-12/31/06
Figure 3.3	Observation Well Locations – A-Aquifer, 7/1/06 -12/31/06
Figure 3.4	Current Extent of Freon 113 in Site Groundwater – A-Aquifer, 7/1/06 -12/31/06

TABLE OF CONTENTS

(Continued)

- Figure 3.5 Current Extent of Trichloroethane (TCA) in Site Groundwater – A-Aquifer, 7/1/06 - 12/31/06
- Figure 3.6 Current Extent of Trichloroethene (TCE) in Site Groundwater – A-Aquifer, 7/1/06 - 12/31/06
- Figure 3.7 Current Extent of 1,1-Dichloroethene (1,1-DCE) in Site Groundwater – A-Aquifer, 7/1/06 -12/31/06
- Figure 3.8 Layout Prior to Redevelopment Activities and Historical Sampling Locations – Parcel O-1
- Figure 3.9 Soil Gas Sample Locations – Parcel O-1
- Figure 3.10 Soil Sample Locations – Parcel O-1
- Figure 3.11 Layout Prior to Redevelopment Activities and Historical Sampling Locations – Parcel O-2
- Figure 3.12 Soil Gas Sample Locations – Parcel O-2
- Figure 3.13 Soil Sample Locations – Parcel O-2
- Figure 3.14 Soil Sample Location Detail for Building 026 Clarifier Excavation – Parcel O-2
- Figure 3.15 Grab Groundwater Sample Locations – Parcel O-2
- Figure 3.16 Soil Sample Location Detail for Pesticide Excavation Area – Parcel O-2
- Figure 3.17 Layout Prior to Redevelopment Activities – Parcel O-3
- Figure 3.18 Soil Sample Locations – Parcel O-3
- Figure 3.19 Layout Prior to Redevelopment Activities and Historical Sampling Locations – Parcel O-4
- Figure 3.20 Soil Sample Locations – Parcel O-4
- Figure 3.21 Soil Sample Location Detail for Suspected Former UST Location at Building 028 – Parcel O-4
- Figure 3.22 Sample Location Detail for Freight Elevator at Building 028 – Parcel O-4
- Figure 3.23 Grab Groundwater Sample Locations – Parcel O-4
- Figure 3.24 Soil Sample Location Detail and Chloroform Results for Building 028J Area – Parcel O-4
- Figure 3.25 Grab Groundwater Sample Location Detail and Chloroform Results for Building 028J Area – Parcel O-4
- Figure 3.26 Soil Gas Sample Locations – Parcel O-4
- Figure 3.27 Soil Gas Sample Location Detail and Chloroform Results for Building 028J Area – Parcel O-4
- Figure 3.28 Soil Sample Location Detail for Building 018 Pipe Backfill Excavation – Parcel O-4
- Figure 3.29 Layout Prior to Redevelopment Activities and Historical Sampling Locations – Parcel O-5
- Figure 3.30 Soil Sample Locations – Parcel O-5
- Figure 3.31 Soil Gas Sample Locations – Parcel O-5
- Figure 3.32 Soil Sample Locations – Endicott Boulevard/Tucson Way
- Figure 3.33 Soil Sample Location Detail for Shell Sol 140 Release Area – Endicott Boulevard/Tucson Way
- Figure 4.1 Conceptual Site Model (CSM) - Groundwater/Soil on Redevelopment Property

TABLE OF CONTENTS
(Continued)

APPENDICES

- Appendix A Redevelopment Property Shallow (A-aquifer) Groundwater Analytical Results (2004 through May 2007)
- Appendix B Supporting Data for Fate and Transport Modeling Parameters

ACRONYMS

AST	Aboveground Storage Tank
ASTM	American Society for Testing and Materials
bgs	below ground surface
BTEX	Benzene, Toluene, Ethylbenzene, and Xylenes
CAG	Carcinogen Assessment Group
CalEPA	California Environmental Protection Agency
CCR	Current Conditions Report
CFR	Code of Federal Regulations
CMS	Corrective Measures Study
CSF	Cancer Slope Factor
CSM	Conceptual Site Model
DCA	Dichloroethane
DCE	Dichloroethene
DDD	Dichlorodiphenyldichloroethane
DDE	Dichlorodiphenyldichloroethylene
DDT	Dichlorodiphenyltrichloroethane,
DHS	Department of Health Services
DJPA	David J. Powers & Associates
DNAPL	Dense Non-aqueous Phase Liquid
DTSC	Department of Toxic Substances Control
EAK	Ethyl Amyl Ketone
EIR	Environmental Impact Report
EPC	Exposure Point Concentration
ESA	Environmental Site Assessment
ESL	Environmental Screening Levels
FEMA	Federal Emergency Management Agency
FRP	Fiberglass Reinforced Plastic
FT	Fuel Tank
GAC	Granular Activated Carbon
GC	Gas Chromatograph
GPA	General Plan Amendment
GST	Global Storage Technologies
HEAST	Health Effects Assessment Summary Tables
HF	Hydrofluoric
HHRA	Human Health Risk Assessment
HI	Hazard Index
HLA	Harding Lawson Associates
IBM	International Business Machines
IF	Intake Factor
IPA	Isopropyl Alcohol
IRIS	Integrated Risk Information System
IT	International Technology Corporation
IW	Industrial Wastewater
K/J/C	Kennedy/Jenks/Chilton

ACRONYMS

(Continued)

LBNL	Lawrence Berkeley National Laboratory
LQG	Large Quantity Generator
MCL	Maximum Contaminant Level
MEK	Methyl Ethyl Ketone
NCEA	National Center for Environmental Assessment
NCP	National Contingency Plan
NMP	N-Methyl-2-Pyrrolidone
NOA	Naturally-Occurring Asbestos
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
msl	mean sea level
OCP	Organochlorine Pesticides
OEHHA	Office of Environmental Human Health Assessment
O&G	Oil and Grease
PAH	Polyaromatic Hydrocarbon
PCE	Perchloroethene or Tetrachloroethene
PD	Planned Development
PEF	Particulate Emission Factor
PG&E	Pacific Gas and Electric
PID	Photoionization Detector
PRG	Preliminary Remediation Goal
PVC	Polyvinyl Chloride
RBTC	Risk-Based Target Concentration
RCRA	Resource, Conservation and Recovery Act
R&D	Research and Development
RfC	Reference Concentration
RfD	Reference Dose
RG	Remedial Goal
RME	Reasonable Maximum Exposure
RO/DI	Reverse Osmosis/Deionized
ROD	Record of Decision
ROS	Regression on Order Statistics
RWQCB-SF	Regional Water Quality Control Board - San Francisco Bay Region
SCR	Site Cleanup Requirements
SCVWD	Santa Clara Valley Water District
SI/SP	Soil Inspection/Sampling Plan
SMP	Soil Management Plan
STLC	Soluble Threshold Limit Concentration
SVE	Soil Vapor Extraction
SVOC	Semi-Volatile Organic Compound
SWRCB	State Water Resources Control Board
TCA	Trichloroethane
TCE	Trichloroethene
TOG	Total Oil and Grease
TPH	Total Petroleum Hydrocarbon

ACRONYMS

(Continued)

TPHCWG	Total Petroleum Hydrocarbon Criteria Working Group
TTHM	Total Trihalomethanes
TTLC	Total Threshold Limit Concentration
TVH	Total Volatile Hydrocarbons
USEPA	United States Environmental Protection Agency
US	United States
USGS	United States Geological Survey
UST	Underground Storage Tank
VOC	Volatile Organic Compound
WV	Waste Vault
<	less than
>	greater than
%	percent
atm	atmosphere
cm ²	square centimeter
g	gram
gpm	gallons per minute
kg	kilogram
kV	kilovolt
L	liter
lb	pound
m ³	cubic meter
mg	milligram
mol	mole
MW	megawatt
pH	potential of hydrogen
µg	microgram
s	second

EXECUTIVE SUMMARY

ES.1 Overview

In June 2005, David J. Powers & Associates (DJPA) prepared an Environmental Impact Report (EIR) for the proposed General Plan Amendment (GPA) and Planned Development (PD) Zoning on the approximately 321-acre property located at 5600 Cottle Road in San Jose, California (“the Site”). The City of San Jose Planning Commission certified the Final EIR on June 6, 2005 (City of San Jose 2005a, 2005b). The Site, which is owned by Hitachi Global Storage Technologies, Inc. (Hitachi GST), was formerly owned and operated by International Business Machines Corporation (IBM).

Hitachi GST has moved its research and development (R&D) and administrative office operations to a different location in San Jose (3403 Yerba Buena Road). A portion of the Site has been rezoned and will be sold and redeveloped into a mixed residential, commercial, and recreational open space area. The area to be redeveloped is divided into five Parcels (Parcel O-1 through O-5). In addition, Hitachi GST will be transferring ownership of Endicott Boulevard/Tucson Way, which borders the Site to the north, to the City of San Jose. For the purposes of this report, Parcels O-1 through O-5 and Endicott Boulevard/Tucson Way are hereafter referred to as “the Redevelopment Property”. The Redevelopment Property is approximately 143 acres.

Hitachi GST plans to continue industrial operations (developing and manufacturing of computer storage devices) on the remaining portion of the Site, termed “the Core Area”. All manufacturing-related activities previously located on Parcels O-1 through O-5 were moved to the Core Area under the redevelopment plan.

The Hitachi GST Site is a large quantity generator (LQG) of hazardous waste and also maintains a Resource, Conservation and Recovery Act (RCRA) Permit for on-site storage and treatment of hazardous waste. The RCRA Permit encompasses the full 321 acres of the Site. Hitachi GST is working with the California Environmental Protection Agency (CalEPA) Department of Toxic Substances Control (DTSC) to remove the Redevelopment Property from the RCRA Permit.

The purpose of this Final Remedy Completion Report is to characterize the current condition of the Redevelopment Property in order to ensure that the property is appropriately characterized and remediated prior to removal from the RCRA Permit.

ES.2 Background

As part of the EIR, ENVIRON International Corporation (ENVIRON) prepared a screening human health risk assessment (Screening HHRA) to evaluate the potential impacts on human health for Parcels O-1 through O-5. The overall objective of the Screening HHRA was to identify potential areas within these parcels needing further investigation and/or mitigation prior to redevelopment. To accomplish this objective, the following steps were completed in the Screening HHRA for Parcels O-1 through O-5: 1) determine the nature of historical operations and chemical use; 2) compile and collect data regarding groundwater, soil gas, and soil conditions; 3) develop risk-based target concentrations (RBTCs) for comparison to groundwater, soil gas and soil data; and 4)

compare the RBTCs to the data collected from each parcel to determine areas requiring further investigation or mitigation measures. The RBTCs correspond to the level that would pose a *de minimis* health risk to future on-site populations.

The Screening HHRA was followed by a Draft Current Conditions Report (CCR) (ENVIRON 2005a), which addressed Parcels O-1 through O-5 and Endicott Boulevard/Tucson Way. The Draft CCR plus the letter response to comments received from DTSC on the report (CalEPA 2006) constitute the final CCR.

Additional inspection/investigation needed to fill data gaps identified in the Screening HHRA/CCR were addressed in the Soil Inspection/Sampling Plan (SI/SP) and its associated attachments (ENVIRON 2005b).

The SI/SP was followed by the Corrective Measures Study (CMS) Report for the Redevelopment Property (ENVIRON 2006a). The CMS Report for the Redevelopment Property was prepared to address the presence of potential contamination in soil that may be encountered during building demolition and/or earthwork activities and/or discovered during implementation of the SI/SP.

A Completion Report was prepared for each SI/SP Attachment (ENVIRON 2007a through i). These Completion Reports summarized the inspections/investigations conducted as part of each Attachment (including implementation of the CMS Report for the Redevelopment Property) and included supporting information such as photographs, tank closure reports, laboratory analytical data, truck logs, Straight Bills of Lading, and hazardous waste manifests associated with the off-haul of impacted soils and liquids.

In addition to the reports listed above, a separate CMS Report for the Chloroform Release Area at Former Building 028J was prepared to address chloroform in soil, soil gas and groundwater in this area (ENVIRON 2007j).

ES.3 Site Characterization

In the early 1980s, chlorinated hydrocarbons were detected in soil beneath an on-site underground tank farm. Site-wide investigations showed that volatile organic compounds (VOCs), primarily Freon 113, trichloroethene (TCE), 1,1,1-trichloroethane (TCA) and 1,1-dichloroethene (1,1-DCE) were present in groundwater beneath and downgradient of the Site. Subsequently, the Site has undergone extensive remedial action including the remediation of solvent-impacted soil and extraction and treatment of on-site and off-site groundwater. Under an order from the Regional Water Quality Control Board, San Francisco Bay Region (RWQCB-SF) (Order No. R2-2002-0082 – Final Site Cleanup Requirements, as amended by Order No. R2-2007-0004), IBM is obligated to remediate the groundwater (RWQCB-SF 2002, 2007). According to IBM personnel, on-site groundwater remedial actions are expected to continue for at least 10 years.

According to the RWQCB-SF Order No. R2-2002-0082 (Final Site Cleanup Requirements) issued to IBM, institutional constraints are required to limit on-site exposure to acceptable levels. The institutional constraints include a deed restriction that notifies future owners of subsurface

contamination and prohibits the use of shallow groundwater beneath the Site as a source of drinking water until cleanup standards are met (RWQCB-SF 2002).

Hitachi GST has moved its R&D and administrative office operations to a different location in San Jose (3403 Yerba Buena Road). In turn, most of the R&D and administrative office buildings at the Site (Buildings 010, 012, 018, 026, 028, 028J, and 051) have been demolished. Two buildings on the Redevelopment Property, Buildings 009 (office) and 011 (cafeteria), are considered historically significant and will remain intact.

ES.4 Summary of Investigations

Numerous investigations have been conducted at the Site to characterize the nature and extent of chemicals in groundwater and soil. A brief overview is provided below.

ES.5.1 Site-Wide Groundwater

IBM initiated a groundwater protection program at the Site in 1978 as part of a corporate-wide review of IBM's environmental protection plan. IBM's groundwater protection program included analysis of existing data on local groundwater quality and movement, identification of chemicals handled on-site, identification of on-site activities that could create a potential groundwater problem, and a review of past on-site chemical handling practices. In October 1980, the presence of chemicals in soil and groundwater at the Site was confirmed during removal of underground storage tanks (USTs) from Tank Farm 001 (on the Core Area). The RWQCB-SF was notified of the discovery of the release. Subsequent to the discovery, a comprehensive site-wide investigation program was initiated at the request of the RWQCB-SF, which included extensive soil and groundwater sampling both within and outside the boundaries of the Site. The investigation resulted in an extensive groundwater monitoring network consisting of over 400 wells, over 1,000 soil borings being drilled with almost 4,000 soil samples collected and analyzed (Kennedy/Jenks/Chilton [K/J/C] 1987).

The soil and groundwater investigations, which were conducted by Harding Lawson Associates (HLA), revealed elevated chemical concentrations in soil and groundwater on-site and in groundwater off-site. In 1988, the off-site groundwater plume extended more than three miles to the northwest, past the intersection of Monterey Road and Capitol Expressway, and exceeded a depth of 180 feet below ground surface (bgs). Currently, in general, the extent of chemicals in the shallow A-aquifer is limited to on-site and near-site to the northwest (downgradient). Chemicals in off-site groundwater are primarily present only in the deeper B-aquifer.

No specific events have been identified that caused the release of chemicals to soil and/or groundwater at the Site; rather, IBM determined that the releases to soil and groundwater were due to tank and pipeline fitting failures, tank and sump overflows, spillage from drum handling, and other slow chemical releases to soil and groundwater from a number of source areas over an extended period of time. The primary chemicals in groundwater are four VOCs: Freon 113, TCA, 1,1-DCE, and TCE, although other chemicals have been detected in on-site soil and groundwater, including chloroform, tetrachloroethene (PCE), benzene, toluene, xylenes, diesel fuel, Shell Sol 140, petroleum naphtha, acetone, methyl ethyl ketone (MEK), isopropyl alcohol (IPA), and n-

methyl-2-pyrrolidone (NMP). Based on the results of the soil and groundwater investigations, extensive interim remedial measures were conducted in the early 1980s, including removal of 65 USTs and excavation and off-site disposal of over 23,000 cubic yards of on-site soil. The majority (over 98%) of the soil excavated from the Site was located in the Core Area.

IBM operates an on-site (and near-site) groundwater extraction and treatment system, which include shallow and deep aquifer extraction wells, conveyance piping, and air stripping via an air-stripping column. According to the *Annual Report to the RWQCB, Second Semi-Annual July 1, 2006 Through December 31, 2006, Groundwater Self-Monitoring Program*, dated February 2007 (“2006 Annual Report”) (MACTEC 2007), a total of approximately 11,527 pounds of chemicals have been removed by the groundwater treatment system.

Currently, a total of 108 groundwater wells are sampled on a quarterly, semiannual, or annual basis. Forty-one (41) of these wells are located off-site and sixty-seven (67) of these wells are located on-site (or near-site).

According to the 2006 Annual Report, 26 on-site and near-site A-aquifer wells currently exceed the cleanup standards. No on-site B-aquifer wells currently exceed the cleanup standards. Eight of these A-aquifer wells (A-30, A-39, A-41, RA-04, RA-24, RA-27, and RA-29, and RA-30) are located on the Redevelopment Property. The A-aquifer wells exceed the cleanup standards primarily for TCE (5 µg/L), as well as 1,1-dichloroethane (1,1-DCA) (5 µg/L) and 1,1-DCE (6 µg/L).

Parcels O-1 and O-2, which overlay portions of the groundwater plume, are being considered for unrestricted redevelopment. ENVIRON conducted a soil gas investigation on these two parcels in October 2004 and May 2006. Results of the soil gas investigation in this area showed low concentrations of VOCs were detected in all samples.

ES.5.2 Parcel Specific Investigations

ENVIRON requested from Hitachi GST all the soil analytical data for borings located on the Redevelopment Property. Hitachi GST responded that the majority of soil investigations for the Site are summarized in Appendix A of the 1987 Comprehensive Plan (K/J/C 1987). ENVIRON was provided with the soil data summarized in the 1987 Comprehensive Plan and several additional soil investigation reports. This information was used by ENVIRON to identify potential areas needing further investigation prior to redevelopment.

Between October 2004 and April 2007, ENVIRON conducted soil, soil gas, and groundwater investigations on Parcels O-1 through O-5 and Endicott Blvd/Tucson Way on the Redevelopment Property. The investigations were conducted primarily to implement the SI/SP (ENVIRON 2005b), which investigated data gaps that were identified in the Screening HHRA/CCR (ENVIRON 2005a). Some investigations were also conducted in accordance with the CMS Report for the Redevelopment Property (ENVIRON 2006), as well as on behalf of the future developer of the Redevelopment Property for due diligence purposes.

ES.6 Development of Risk-Based Target Concentrations

Chemical concentrations detected in groundwater, soil gas and soil at the Site were compared to RBTCs in order to identify any additional areas needing further investigation and/or mitigation prior to redevelopment. RBTCs represent the concentration of a chemical that can remain in these media and still be protective of human health for future land use. The methodology used to develop the RBTCs is consistent with CalEPA, RWQCB-SF, and United States Environmental Protection Agency (USEPA) risk assessment guidance.

The proposed land use for Parcels O-1 through O-5 is residential, commercial, and open space (or park) use. Based on this proposed future land use, populations that could potentially be exposed to chemicals remaining in groundwater, soil gas and soil in the Redevelopment Property include residents (children and adults), commercial workers, and park visitors (children and adults). Additional populations on the Redevelopment Property could include short-term construction/maintenance workers during redevelopment or other short-term maintenance activities. RBTCs were calculated for each of these populations for all chemicals detected in groundwater, soil gas and soil. Endicott Boulevard/Tucson Way will become a public thoroughfare.

The National Contingency Plan (NCP) (40 Code of Federal Regulations [CFR] §300) is commonly cited as the basis for target risk and hazard levels. According to the NCP, lifetime incremental cancer risks posed by a site should not exceed one in a million (1×10^{-6}) to one hundred in a million (1×10^{-4}), and noncarcinogenic chemicals should not be present at levels expected to cause adverse health effects (i.e., hazard index [HI] greater than one). As a risk management policy, the CalEPA generally considers 1×10^{-6} to be a point of departure for purposes of making risk management decisions, with most approved remediation achieving incremental risk levels of 10 in one million (1×10^{-5}) or lower. The California Safe Drinking Water and Toxic Enforcement Act considers 1×10^{-5} as a no significant risk level.

For this assessment, the calculated RBTCs correspond to a cancer risk of 1×10^{-6} . For noncancer health hazards, a target HI of one is identified. Individual chemical exposures that yield HIs of less than one are not expected to result in adverse noncancer health effects (USEPA 1989a).

ES.7 Comparison of Risk-Based Target Concentrations to Measured Concentrations

In order to assess whether residual chemical concentrations in groundwater, soil gas and soil on the Redevelopment Property are within acceptable risk ranges based on proposed future land uses, measured concentrations were compared to the RBTCs calculated for the applicable media. For soil, potential exposure pathways included in the RBTCs are soil ingestion, dermal contact and inhalation (of either vapors or windblown particulates). For soil gas and groundwater, the potential pathway included in the RBTC is inhalation of vapors. There is a deed restriction on the Redevelopment Property prohibiting use of shallow groundwater as a drinking water source. The results of this comparison were used to evaluate whether residual chemical concentrations could potentially pose unacceptable risks to human health.

As a conservative screen, individual groundwater, soil gas and soil samples were compared directly to the chemical-specific RBTCs developed for a residential land use scenario. Chemicals with

concentrations exceeding the minimum residential RBTC in at least one sample included arsenic, chloroform, dieldrin, iron, methylene chloride, nickel and toxaphene in soil; benzene, chloroform, and TCE in soil gas; and chloroform in groundwater. Since naturally-occurring background concentrations for some inorganic chemicals are in some cases higher than risk-based concentrations, concentrations of these chemicals in soil were also compared to site-specific background concentrations or published background ranges.

ES.8 Estimated Cancer Risks and Noncancer Hazard Indices

According to USEPA, the exposure point concentration (EPC) term in the intake equation is the arithmetic average of the concentration that is contacted over the exposure period (USEPA 1989). Although this concentration does not reflect the maximum concentration that could be contacted at any one time, it is regarded as a reasonable estimate of the concentration likely to be contacted over time, since assuming long-term contact with the maximum concentration is not reasonable. Because of the uncertainty associated with any estimate of exposure concentration, USEPA recommends that the 95 percent upper confidence limit (UCL) on the arithmetic average be used for this variable (USEPA 1989). The 95 percent UCL provides reasonable confidence that the true site average will not be underestimated (USEPA 1992). Therefore, even if any one sample concentration exceeds the RBTC, the average may not.

Cancer risks and noncancer HIs were estimated for all areas within each parcel using calculated EPCs for each chemical of concern in each applicable exposure area. These risk estimates include all exposure pathways included in the development of the RBTCs. Not including arsenic or iron, both of which were determined to be present at background concentrations in Site soils, cancer risk estimates for all areas were below or within the target risk range (1×10^{-4} to 1×10^{-6}) and the noncancer HIs were below the target HI of 1.0.

ES.9 Summary/Conclusions

In all but four areas (excluding arsenic present in soil at background concentrations), the estimated cancer risks were below 1×10^{-6} . These areas include soil gas near monitoring well RA-24 on Parcel O-1 (1.2×10^{-6}), soil gas near monitoring well A-30 on Parcel O-2 (1.9×10^{-6}), soil beneath Building 028 on Parcel O-4 (1.2×10^{-6}), and in soil and soil gas in the Building 028J Area on Parcel O-4 (combined 5.8×10^{-6}).

The major chemical contributor to the estimated cancer risk for soil gas near monitoring well A-30 on Parcel O-2 is TCE. TCE exceeded the minimum residential RBTC (3.8 mg/m^3) in five shallow soil gas samples located just north of Building 010 (ranging from 5.1 to 21 mg/m^3). Soil gas results near monitoring well A-30 on Parcel O-2 are thought to be related to the Site-wide groundwater plume. Groundwater remediation is being conducted by IBM in this area. According to the *In Situ* Remedial Technologies Feasibility Study for Source Area Remediation prepared by Golder in June 2007 (Golder 2007) on behalf of IBM, groundwater remediation in the area of monitoring well A-30 will involve a modified pump and treat system (or extraction/injection system) with accelerated bioremediation, and a targeted *in situ* source zone treatment. In preparation of groundwater remediation, Golder will also conduct a supplemental Site characterization to assess biogeochemical

conditions, source zone delineation, residual source zone characteristics, and a detailed characterization of the contaminant flow paths.

In the Building 028J area, chloroform is the major chemical contributor to the cancer risk estimate. The maximum detected concentrations of chloroform exceeded the lowest residential RBTCs in at least two samples for all media (thirteen locations for soil, seven locations for soil gas, and two locations for groundwater). In addition, chloroform was detected above the groundwater cleanup standard for chloroform (0.080 mg/L) required by the current IBM RWQCB-SF Order No. R2-2002-0082 for the Site in ten locations. Soil, soil gas and groundwater in the Building 028J Area on Parcel O-4 are currently undergoing remediation. A CMS Report for the Chloroform Release Area at Former Building 028J has been prepared (ENVIRON 2007j) recommending 2-PHASE™ Extraction as the preferred remedial alternative.

As documented in this Final Remedy Completion Report, extensive soil, soil gas and groundwater investigations have been conducted on the Redevelopment Property. In regards to Site-wide groundwater on the Redevelopment Property, IBM will continue remediation under the oversight of the RWQCB-SF. Remediation of chloroform in the Building 028J Area on Parcel O-4 is currently ongoing under the oversight of DTSC. All remaining areas on the Redevelopment Property have been determined to meet residential standards and are ready for removal from the RCRA Permit.

1.0 INTRODUCTION

1.1 OVERVIEW

In June 2005, David J. Powers & Associates (DJPA) prepared an Environmental Impact Report (EIR) for the proposed General Plan Amendment (GPA) and Planned Development (PD) Zoning on the approximately 321-acre property located at 5600 Cottle Road in San Jose, California (“the Site”). The City of San Jose Planning Commission certified the Final EIR on June 6, 2005 (City of San Jose 2005a, 2005b). The Site, which is owned by Hitachi Global Storage Technologies, Inc. (Hitachi GST), was formerly owned and operated by International Business Machines Corporation (IBM). The location of the Site is shown on Figures 1.1 and 1.2. The Site layout prior to redevelopment is shown on Figure 1.3.

Hitachi GST has moved its research and development (R&D) and administrative office operations to a different location in San Jose (3403 Yerba Buena Road). A portion of the Site has been rezoned and will be sold and redeveloped into a mixed residential, commercial, and recreational open space area. The area to be redeveloped is divided into five Parcels (Parcel O-1 through O-5), as shown on Figure 1.4. In addition, Hitachi GST will be transferring ownership of Endicott Boulevard/Tucson Way, which borders the Site to the north, to the City of San Jose. For the purposes of this report, Parcels O-1 through O-5 and Endicott Boulevard/Tucson Way are hereafter referred to as “the Redevelopment Property”. The Redevelopment Property is approximately 143 acres.

Hitachi GST plans to continue industrial operations (developing and manufacturing of computer storage devices) on the remaining portion of the Site, termed “the Core Area”. All manufacturing-related activities previously located on Parcels O-1 through O-5 were moved to the Core Area under the redevelopment plan. The Core Area is also shown on Figure 1.4.

The Hitachi GST Site is a large quantity generator (LQG) of hazardous waste and also maintains a Resource, Conservation and Recovery Act (RCRA) Permit for on-site storage and treatment of hazardous waste. The RCRA Permit encompasses the full 321 acres of the Site. Hitachi GST is working with the California Environmental Protection Agency (CalEPA) Department of Toxic Substances Control (DTSC) to remove the Redevelopment Property from the RCRA Permit

The purpose of this Final Remedy Completion Report is to characterize the current condition of the Redevelopment Property in order to ensure that the property is appropriately characterized and remediated prior to removal from the RCRA Permit.

1.2 BACKGROUND

As part of the EIR, ENVIRON International Corporation (ENVIRON) prepared a screening human health risk assessment (Screening HHRA) to evaluate the potential impacts on human health for Parcels O-1 through O-5. The overall objective of the Screening HHRA was to identify potential areas within these parcels needing further investigation and/or mitigation prior to redevelopment. To accomplish this objective, the following steps were completed in the Screening HHRA for Parcels O-1 through O-5: 1) determine the nature of historical operations and chemical use; 2)

compile and collect data regarding groundwater, soil gas, and soil conditions; 3) develop risk-based target concentrations (RBTCs) for comparison to groundwater, soil gas and soil data; and 4) compare the RBTCs to the data collected from each parcel to determine areas requiring further investigation or mitigation measures. The RBTCs correspond to the level that would pose a *de minimis* health risk to future on-site populations.

The Screening HHRA was followed by a Draft Current Conditions Report (CCR) (ENVIRON 2005a), which addressed Parcels O-1 through O-5 and Endicott Boulevard/Tucson Way. The Draft CCR plus the letter response to comments received from DTSC on the report (CalEPA 2006) constitute the final CCR.

Additional inspection/investigation needed to fill data gaps identified in the Screening HHRA/CCR were addressed in the Soil Inspection/Sampling Plan (SI/SP) and its associated attachments (ENVIRON 2005b). The areas to be inspected/investigated were divided into the following nine categories:

Attachment I	Roads/Parking Lots
Attachment II	Aboveground Storage Tanks Associated with Emergency Generators
Attachment III	Buried Concrete Trenches, Building 028J, and Former Waste Vaults 02-04
Attachment IV	Hydraulic Elevators
Attachment V	Former Petroleum Underground Storage Tanks
Attachment VI	Former Orchard Areas
Attachment VII	Endicott Boulevard/Tucson Way
Attachment VIII	Other Remaining Areas
Attachment IX	Soil Gas Evaluation for Parcels O-1 and O-2

The SI/SP was followed by the Corrective Measures Study (CMS) Report for the Redevelopment Property (ENVIRON 2006a). The CMS Report for the Redevelopment Property was prepared to address the presence of potential contamination in soil that may be encountered during building demolition and/or earthwork activities within the Redevelopment Property and/or discovered during implementation of the SI/SP. The CMS Report for the Redevelopment Property included remedial goals (RGs) for soil which were either the minimum residential soil RBTC or naturally-occurring background concentrations for metals (for arsenic only)¹. These RGs are summarized on Table 1.1.

A Completion Report was prepared for each SI/SP Attachment (ENVIRON 2007a through i). These Completion Reports summarized the inspections/investigations conducted as part of each Attachment (including implementation of the CMS Report for the Redevelopment Property) and included supporting information such as photographs, tank closure reports, laboratory analytical data, truck logs, Straight Bills of Lading, and hazardous waste manifests associated with the off-haul of impacted soils and liquids.

¹ The arsenic RG was based on soil samples collected in current orchard areas on the Redevelopment Property in 2004. The average arsenic concentration (i.e., the 95% upper confidence limit on the mean concentration) was determined to be 8 mg/kg. The maximum concentration of 12 mg/kg is equal to the average plus two times the standard deviation of the data.

The data collected as part of the SI/SP, along with applicable historical investigation data, provide the basis for this Final Remedy Completion Report. As part of the Final Remedy Completion Report, the RBTCs were updated. The RBTCs calculated as part of the Screening HHRA/CCR, were based on conservative default assumptions for soil properties at the Site. Since the development of these target concentrations, site-specific data has been collected and the RBTCs have been revised accordingly. In addition, a limited number of toxicity values and exposure assumptions have changed based on CalEPA and United States Environmental Protection Agency (USEPA) guidance. Data presented in this report have been compared to the updated RBTCs.

In addition to the reports listed above, a separate CMS Report for the Chloroform Release at Former Building 028J has been prepared to address chloroform in soil, soil gas and groundwater in this area (ENVIRON 2007j).

1.3 REPORT ORGANIZATION

This Final Remedy Completion Report is divided into nine sections as follows:

Section 1.0 – Introduction: describes the purpose and scope of this report, briefly summarizes the reports prepared by ENVIRON to date for the Redevelopment Property, and outlines the report organization.

Section 2.0 – Site Characterization: presents an overview of the Site and surrounding area, discusses current and proposed land uses, and identifies features at the Site including topography and hydrogeology.

Section 3.0 – Summary of Investigations: summarizes the investigations and remedial activity conducted on the Redevelopment Property to date and provides detailed information regarding current conditions.

Section 4.0 – Development of Risk-Based Target Concentrations (RBTCs): combines quantitative information on potential human exposure, chemical fate and transport, and chemical toxicity to calculate site-specific human health RBTCs for the protection of future populations.

Section 5.0 – Comparison of Risk-Based Target Concentrations (RBTCs) to Measured Concentrations: compares groundwater, soil gas and soil data representative of current conditions on the Redevelopment Property to the applicable RBTCs to identify any potential areas of concern.

Section 6.0 – Risk Characterization: presents estimated potential cancer risks and chronic noncancer health effects related to the Redevelopment Property.

Section 7.0 – Uncertainties: identifies the uncertainties associated with the calculations and assumptions used in the development of the RBTCs and risk characterization.

Section 8.0 – Summary/Conclusions: summarizes the results of the risk assessment and presents conclusions regarding the potential for adverse health risks due to exposure to site-related chemicals on the Redevelopment Property.

Section 9.0 – References: includes all references cited in this report.

Supporting information is provided in the appendices. Appendix A includes shallow groundwater monitoring data for the Site-wide groundwater plume on the Redevelopment Property (for chemicals detected in groundwater on the Redevelopment Property). Appendix B provides supporting data for the fate and transport modeling parameters.

2.0 SITE CHARACTERIZATION

2.1 SITE HISTORY AND OPERATIONS

The Site is located at 5600 Cottle Road in San Jose, Santa Clara County, California, and is approximately 321 acres in size. Prior to 1955, the Site was agricultural land, primarily tree orchards, with associated residences. In 1955, IBM purchased the Site. The Storage Technology Division of IBM owned and operated the Site from 1955 through 2002. IBM designed, developed, and manufactured computer storage devices, including hard disk drives, read/write heads, and disk storage media at the Site. On or about January 1, 2003, Hitachi GST, a new company formed as a result of a strategic combination of IBM and Hitachi's storage technology businesses, bought the Site.

As shown on Figure 1.3, approximately 30 buildings were present on the Site prior to commencement of redevelopment activities in August 2006. On-site buildings were used for a range of activities, including manufacturing, testing, assembly, research, development, wastewater treatment, reverse osmosis/deionized water (RO/DI) production, utilities, chemical storage, other storage, security, offices, and cafeteria. Exterior areas of the Site primarily consisted of landscaped areas, orchards, sidewalks, water fountains, asphalt parking lots, and paved private roads.

Two electrical substations located in the central-southeastern portion of the Site provide electricity to the Site. One 115-kilovolt (kV) substation, which contains a 50 megawatt (MW) electrical generator, is owned and operated by Hitachi GST; the other 115-kV substation is owned and operated by Pacific Gas & Electric (PG&E). Facility personnel reported that electricity for the Site is provided by PG&E, and Hitachi GST's generator is only operated for testing, when there is a major Site power outage or when PG&E requests that Hitachi GST provide electrical back up during peak demand periods. Both electrical substations will remain.

In the early 1980s, chlorinated hydrocarbons were detected in soil beneath an on-site underground tank farm. Site-wide investigations showed that volatile organic compounds (VOCs), primarily Freon 113, trichloroethene (TCE), 1,1,1-trichloroethane (TCA) and 1,1-dichloroethene (1,1-DCE) were present in groundwater beneath and downgradient of the Site. Subsequently, the Site has undergone extensive remedial action including the remediation of solvent-impacted soil and extraction and treatment of on-site and off-site groundwater. Under an order from the Regional Water Quality Control Board, San Francisco Bay Region (RWQCB-SF) (Order No. R2-2002-0082 – Final Site Cleanup Requirements, as amended by Order No. R2-2007-0004), IBM is obligated to remediate the groundwater (RWQCB-SF 2002, 2007). According to IBM personnel, on-site groundwater remedial actions are expected to continue for at least 10 years.

2.2 SURROUNDING AREA

The Site is located in a mixed industrial, commercial and residential area near the intersections of Monterey Highway, Blossom Hill Road, and United States (US) Route 101, approximately seven miles southeast of downtown San Jose. Figure 1.2 shows the immediate Site vicinity, which includes the following:

- Cottle Road is located to the west, with a shopping center, other commercial buildings, a hospital/medical center, and a medium-high density residential area beyond.
- IBM Building 025 (formerly part of the Site), which is still owned by IBM, is located to the northwest. This parcel is the proposed location of a future Lowe’s Store.
- Parcel O-6 (formerly part of the Site) is located to the northeast; bordering the Core Area and Endicott Boulevard/Tucson Way. Hitachi GST transferred ownership of Parcel O-6, which is approximately 11 acres, to the City of San Jose in November 2005. The planned land use for this parcel is a future City of San Jose Police Substation.
- Southern Pacific Railroad and Caltrain right-of-way, the Blossom Hill Caltrain Station, and Monterey Highway are located to the north, with medium to medium-low density residential, a commercial shopping area, and US Route 101 beyond.
- Highway 85 and the Cottle Road Light Rail Station are located to the south, with a hospital/medical center, library, and single-family residential area beyond.

2.3 FUTURE LAND USE

As previously discussed, Hitachi GST has moved its R&D and administrative office operations to a different location in San Jose (3403 Yerba Buena Road). In turn, most of the R&D and administrative office buildings at the Site (Buildings 010, 012, 018, 026, 028, 028J, and 051) have been demolished. Two buildings on the Redevelopment Property, Buildings 009 (office) and 011 (cafeteria), are considered historically significant and will remain intact.

The Redevelopment Property, which covers approximately 143 acres, has been divided into five “outer” parcels (Parcels O-1 through O-5) and includes Endicott Boulevard/Tucson Way, as shown on Figure 1.4. Following building demolition, rough grading and main utility/roadway installation by Hitachi GST, Parcels O-1 through O-5 will be sold and redeveloped into a mixed residential, commercial, and recreational open space area. In addition, Hitachi GST will be transferring ownership of Endicott Boulevard/Tucson Way and newly constructed public roadways on Parcels O-1 through O-5 to the City of San Jose. Prior to property transfer, Hitachi GST is working with DTSC to remove the Redevelopment Property from the RCRA Permit.

Hitachi GST plans to continue industrial operations (developing and manufacturing of computer storage devices) on the Core Area. The Core Area contains all of the current manufacturing, chemical storage, waste storage, and wastewater treatment buildings/areas on the Site. All activities previously located on Parcels O-1 through O-5 have been moved to the Core Area under the redevelopment plan. There are no current RCRA-permitted sources in the Redevelopment Property.

2.4 GROUNDWATER USE

The Site is a non-community, non-transient drinking water supplier and maintains a Water Supply Permit issued by the California Department of Health Services (DHS) Drinking Water Program. Six groundwater production wells currently provide drinking and process water for use on the Core

Area. The drinking and process water wells, which are all located on the Core Area, are screened primarily in the lower B- and deeper aquifers, in the range of approximately 100 to 350 feet below ground surface (bgs). Based on documentation reviewed by ENVIRON, these aquifers have not been impacted by on-site releases. Groundwater sampling has indicated that the production wells are upgradient of the documented groundwater impacts. Two approximately 100,000-gallon water storage tanks, which hold water from the Site's water production wells for domestic use, are located east of Building 021 (on the Core Area).

Five additional groundwater production wells were previously used to provide water for irrigation at the Site. Three of these irrigation wells were closed in 2006 and the remaining two wells are planned to be closed in September 2007.

The Site also maintains a connection with the Great Oaks Water Company, which utilizes groundwater from deep wells; however, facility personnel reported that the Site does not currently receive water from off-site sources.

As described in Section 3.0 (Summary of Investigations), IBM operates an on-site groundwater extraction and treatment systems as part of its remediation activities. Groundwater, which is treated at IBM's on-site groundwater treatment facility, is reused on-site. On-site reuse activities include the use of treated groundwater for irrigation and recharge into the aquifer. Two recharge wells (BR-1 and BR-2) are located near the northeastern Site boundary (on Parcel O-6, which was formerly part of the Site). IBM also maintains coverage under a National Pollutant Discharge Elimination System (NPDES) General Permit No. CAG912003 from the RWQCB-SF. The NPDES General Permit allows IBM to discharge treated groundwater from its groundwater remediation program to on-site storm drains (RWQCB-SF 2007).

According to the RWQCB-SF Order No. R2-2002-0082 (Final Site Cleanup Requirements) issued to IBM, institutional constraints are required to limit on-site exposure to acceptable levels. The institutional constraints include a deed restriction that notifies future owners of subsurface contamination and prohibits the use of shallow groundwater beneath the Site as a source of drinking water until cleanup standards are met (RWQCB-SF 2002). IBM is in the process of developing a Soils Management Plan (SMP) for the Site to address these restrictions.

2.5 PHYSICAL DESCRIPTION

2.5.1 Topography

Based on a review of the United States Geological Survey (USGS) topographic map for the Santa Teresa Hills (California quadrangle), ground surface elevations at the Site range from approximately 195 feet above mean sea level (msl) in the eastern portion to about 187 feet to the west near Cottle Road. The Site is situated on flat terrain, and the surrounding area is gradually sloped to the north. According to Hitachi GST, there will likely be some grading and leveling during redevelopment, however, no significant changes to the topography are anticipated.

Based on ENVIRON's review of Federal Emergency Management Agency (FEMA) electronic floodplain data, the Site is located in a 500-year flood zone.

2.5.2 Geology and Hydrogeology

The Site is located within the Santa Teresa Basin in the southern end of the Santa Clara Valley. To the north and east are the Yerba Buena Hills and to the south and west are the Santa Teresa Hills. A geologic study was conducted on the Santa Teresa Basin, where the Site is located, and the San Jose Plain, which is located downgradient of the Santa Teresa Basin. Edenvale Gap is the geographic boundary and hydraulic connection between the Santa Teresa Basin and the San Jose Plain.

The geology in the Santa Teresa Basin consists of alluvium extending below the ground surface to bedrock, which is present at depths ranging up to approximately 400 feet. The alluvium is about 140 feet thick at Coyote Narrows, 350 feet thick at Edenvale Gap, and may be more than 400 feet thick in the center of the basin. Most of the bedrock consists of consolidated sandstones, shales, cherts, serpentinite, and ultrabasic rocks. The region is tectonically active and faults are common in the bedrock. However, compared with the overlying alluvium, the bedrock can be considered impermeable. No significant bedrock aquifers are known within the basin.

Exploratory borings on the Site reveal alluvial deposits of clays and silts interbedded with sand and gravel layers (aquifers). The alluvium generally contains more than five silty-clay layers, which vary from a few feet to more than 30 feet in thickness separating more than six aquifers.

Fill materials at the Site are of variable thickness and properties. Moderately compacted fill ranging from depths of one to 18 feet have been encountered on-site. Beginning at the ground surface (or underlying surficial fill), there is a layer of medium plasticity clay that extends to a depth of about 5 to 10 feet bgs. Underlying deposits down to the A-aquifer vary across the Site, but primarily consist of additional clays and silts.

The aquifers are referred to as A, B, C, D, E, F, and G aquifers, with the A aquifer being the most shallow. The general depths of these aquifers below ground surface are as follows: A occurs between 20 to 50 feet; B lies between 50 and 95 feet; C is between 90 and 125 feet; D is between 140 and 160 feet; E is between 170 and 205 feet; F is between 230 and 260 feet; and G is between 270 and 275 feet. In some locations, the individual aquifers merge. All of these aquifer zones are hydraulically interconnected to some degree.

Groundwater measurements indicate that depths to shallow groundwater are currently approximately 30 feet or deeper, however, historically the recorded groundwater has been as shallow as 17 feet. This groundwater lowering is attributed to additional groundwater extraction in the Basin, including on-site groundwater extraction for treatment. A map of recent A-aquifer groundwater elevations is provided in Figure 2.1. The groundwater contours are based on elevation measurements conducted between July 1 and December 31, 2006 by MACTEC Engineering and Consulting, Inc. (MACTEC) (MACTEC 2007).

Groundwater flow directions in aquifer zones vary across the Site. Groundwater movement in the A-aquifer zone varies from south to northwest, while groundwater flow directions in the deeper aquifer zones are generally to the northwest.

3.0 SUMMARY OF INVESTIGATIONS

Numerous investigations have been conducted at the Site to characterize the nature and extent of chemicals in groundwater, soil gas, and soil. Section 3.1 discusses potential sources of chemicals in Site-wide groundwater, Site-wide groundwater investigations conducted to date and current groundwater conditions. Section 3.2 is divided into nine subsections. Section 3.2.1 provides an outline of the applicable historical soil data that was collected on the Redevelopment Property prior to 2004. This soil data was collected primarily in the 1980s by Harding Lawson Associates (HLA). Section 3.2.2 provides an outline of the more recent soil, soil gas, and groundwater data that has been conducted on the Redevelopment Property by ENVIRON between 2004 and 2007. Sections 3.2.3 through 3.2.8 provide background information concerning the current and/or former buildings located on each parcel, along with related activities and the results of the soil, soil gas, and/or groundwater investigations for Parcels O-1, O-2, O-3, O-4, O-5, and Endicott Boulevard/Tucson Way, respectively. Section 3.2.9 discusses naturally-occurring asbestos (NOA) on the Redevelopment Property.

3.1 SITE-WIDE GROUNDWATER

In this section, the groundwater plume originating on the Core Area, crossing the Redevelopment Property, and extending beyond the Site boundary is referred to as the Site-wide groundwater plume. As discussed in Section 2.1, IBM is in the process of remediating this groundwater. Localized areas of groundwater investigation are discussed in Section 3.2 under the individual Parcels that were investigated.

3.1.1 Previous Investigations

IBM initiated a groundwater protection program at the Site in 1978 as part of a corporate-wide review of IBM's environmental protection plan. IBM's groundwater protection program included analysis of existing data on local groundwater quality and movement, identification of chemicals handled on-site, identification of on-site activities that could create a potential groundwater problem, and a review of past on-site chemical handling practices. In October 1980, the presence of chemicals in soil and groundwater at the Site was confirmed during removal of underground storage tanks (USTs) from Tank Farm 001 (on the Core Area). The RWQCB-SF was notified of the discovery of the release. Subsequent to the discovery, a comprehensive site-wide investigation program was initiated at the request of the RWQCB-SF, which included extensive soil and groundwater sampling both within and outside the boundaries of the Site. The investigation resulted in an extensive groundwater monitoring network consisting of over 400 wells, over 1,000 soil borings being drilled with almost 4,000 soil samples collected and analyzed (Kennedy/Jenks/Chilton [K/J/C] 1987).

The soil and groundwater investigations, which were conducted by HLA, revealed elevated chemical concentrations in soil and groundwater on-site and in groundwater off-site. In 1988, the off-site groundwater plume extended more than three miles to the northwest, past the intersection of Monterey Road and Capitol Expressway, and exceeded a depth of 180 feet bgs. Currently, in general, the extent of chemicals in the shallow A-aquifer is limited to on-site and near-site to the northwest (downgradient). Chemicals in off-site groundwater are primarily present only in the deeper B-aquifer.

No specific events have been identified that caused the release of chemicals to soil and/or groundwater at the Site; rather, IBM determined that the releases to soil and groundwater were due to tank and pipeline fitting failures, tank and sump overflows, spillage from drum handling, and other slow chemical releases to soil and groundwater from a number of source areas over an extended period of time. The primary chemicals in groundwater are four VOCs: Freon 113, TCA, 1,1-DCE, and TCE, although other chemicals have been detected in on-site soil and groundwater, including chloroform, tetrachloroethene (PCE), benzene, toluene, xylenes, diesel fuel, Shell Sol 140, petroleum naphtha, acetone, methyl ethyl ketone (MEK), isopropyl alcohol (IPA), and n-methyl-2-pyrrolidone (NMP). Based on the results of the soil and groundwater investigations, extensive interim remedial measures were conducted in the early 1980s, including removal of 65 USTs and excavation and off-site disposal of over 23,000 cubic yards of on-site soil. The majority (over 98%) of the soil excavated from the Site was located on the Core Area.

Based on Site investigations, six areas were identified where chemicals were found in the subsurface at levels that may warrant remediation (K/J/C 1987). The locations of these areas are shown on Figure 3.1.

Five of these areas are located on the Core Area of the Site:

- 1) Building 001/100 Area;
- 2) Shell Sol 140 Release Area;
- 3) Tank Farm 067/Building 006 Area;
- 4) Building 004 Area; and
- 5) Building 002/021 Area.

One area is located on the Redevelopment Property, the Building 010/025 Area.

Investigations conducted in these six areas are described in detail below:

- **Building 001/100 Area (Core Area)**. Extensive soil and groundwater investigations conducted between 1980 and 1987 indicated several source areas that could have contributed to detected chemicals in groundwater existed in the Building 001/100 area. Three of these source areas include 1) Tank Farm 001, which was located east of Building 001; 2) three waste storage USTs, which were located near the southeastern corner of Building 001; and 3) the Building 001 Sumps, which were located in the Eastern Annex of Building 001, as described below.

Tank Farm 001 formerly consisted of 18 USTs ranging in size from 1,000 to 5,000 gallons and contained petroleum naphtha, kerosene, sodium hydroxide, acetone, TCA, isophorone, xylenes, ethyl amyl ketone (EAK), IPA, and mixed solvent waste. All 18 USTs were removed in September 1980. Soil and groundwater investigations conducted until May 1984 found detectable levels of chemicals, primarily TCA, petroleum naphtha, xylenes, acetone, IPA, and kerosene in soil beneath and surrounding the buried tanks and in the shallow groundwater. The source of the chemicals was determined to be from leaking tanks and chemical handling procedures. In 1981, approximately 11,800 cubic yards of soil were excavated from Tank Farm 001 to a depth of approximately 45 feet bgs. Confirmatory soil

sampling did not indicate the presence of detectable levels of tank-related chemicals in remaining soils, and the excavation was backfilled with clean, compacted soil.

Three waste storage USTs, which were formerly located near the southeastern corner of Building 001, are described as follows: A 6,000-gallon UST contained mixed solvent wastes including acetone, xylenes, isophorone, and EAK; this UST also historically contained kerosene. A 6,000-gallon UST contained petroleum naphtha wastes; this UST also historically contained Shell 36, a petroleum-based solvent. A 2,000-gallon UST contained mixed solvents including acetone, xylenes, isophorone, and EAK. Soil and groundwater investigations were conducted from 1981 through 1984 in the vicinity of the three waste USTs. Investigations showed that the buried waste tanks were the source of kerosene, xylenes, and petroleum naphtha in soil and groundwater. In May 1984, the three USTs were removed, as well as approximately 475 cubic yards of soil to a depth of approximately 25 feet. Confirmatory sampling indicated some residual chemicals concentrations in soil in the excavation walls (up to 21,000 milligrams per kilogram [mg/kg] xylenes, up to 490 mg/kg petroleum naphtha, and up to 16 mg/kg kerosene). The excavation was backfilled with clean, compacted fill.

In September 1986 through February 1987, investigations were conducted to characterize chemical concentrations in soils beneath two below-grade solvent sumps prior to abandonment. These sumps were located in the Eastern Annex of Building 001. Chlorinated solvents were detected in both unsaturated and saturated soils (e.g., TCA up to 6,300 micrograms per kilogram [$\mu\text{g}/\text{kg}$]; TCE up to 390 $\mu\text{g}/\text{kg}$; 1,1-DCE up to 140 $\mu\text{g}/\text{kg}$; and PCE up to 680 $\mu\text{g}/\text{kg}$). Hitachi GST personnel reported that the sumps and surrounding soil were excavated.

During initial investigations in 1980 in the Building 001/100 area, depth to groundwater in the A-aquifer zone was approximately 20 feet bgs, and localized groundwater flow was generally towards the southwest in the A-aquifer zone. As part of groundwater remediation, an extraction well (A-22) was installed downgradient of Tank Farm 001. Petroleum naphtha was detected as free-floating product in this well. The extraction well was operated from May 1982 to November 1984 at an average discharge rate of less than 0.5 gallon per minute (gpm). Water was pumped to a tank for subsequent off-site disposal. Pumping ceased when the water level in the A-aquifer zone declined. In addition, a pump was installed in Well A-17, located downgradient of the waste storage USTs to extract groundwater. Pumping between 50 and 100 gpm began in July 1983 and ceased in August 1984 when the water level in the A-aquifer zone declined. Extracted groundwater was treated in an on-site granular activated carbon (GAC) filtration unit. The pump was removed from Well A-17 on October 31, 1986.

IBM found that continued groundwater extraction in this location was not feasible, due to declining groundwater elevations in the A-zone aquifer. In addition, by 1987, it was no longer feasible to excavate the remaining soil because access would require removing buildings and utilities. Consequently, soil vapor extraction (SVE) was proposed as an alternative to remediate the Building 001/100 Area and the Building 001 Sump Area.

A SVE pilot study was conducted at Building 001/100 in 1989, with additional tests conducted between May 1990 and August 1991. Based on successful results, full-scale operation of the SVE system was initiated in January 1992. In February 1993, the Building 001/100 remediation system was expanded with the addition of 16 new SVE wells and six new dual-phase extraction wells. By November 1995, total petroleum hydrocarbon (TPH) concentrations at each well met the corresponding shutdown criteria, and full-scale SVE at the Building 001/100 area was discontinued. Closure of the SVE and dual-phase extraction systems at the Building 001/100 area was approved by the RWQCB-SF in a letter dated October 31, 1996.

For the Building 001 Sump Area, a full-scale SVE system was operated from July 1991 until November 1996. During this time, concentrations remained below the shutdown criteria for both TPH and total VOCs. Closure of the SVE system in the Building 001 Sump Area was approved by the RWQCB-SF on October 24, 1997.

In 1995/1996, IBM considered operating a SVE system at the southeast corner of Building 001, where the three waste USTs were located. This consideration was prompted, in part, by anomalous concentrations of xylenes and toluene in a groundwater sample from a nearby extraction well in early 1995. Soil data indicated that residual chemical concentrations in soil in this area were small. Subsequent data and current groundwater conditions in and downgradient of the southeast corner of Building 001 suggest that additional soil remediation is not necessary (HLA 1996). According to documentation reviewed, if groundwater concentrations of kerosene or xylenes were to increase in this area in the future, the potential sources would be evaluated and SVE would be considered as a possible remediation measure (HLA 1996).

- **Shell Sol 140 Release Area (Core Area).** An accidental release of 8,100 gallons of Shell Sol 140, which is a refined light aliphatic hydrocarbon that also contains benzene, toluene, and xylenes, into a pipe tunnel connecting Tank Farm A to Building 001 was reported to have occurred between November 25 and December 3, 1985. An initial emergency response investigation began on December 3, 1985, once the release location was identified. Approximately 200 gallons of Shell Sol 140 was pumped from the pipe tunnel upon discovery. As a result of this spill, the RWQCB-SF issued Complaint No. 86-01 for Administrative Civil Liability on February 25, 1986.

From December 1985 through April 1986, investigations and interim remedial measures were conducted to characterize the chemical extent and remediate Shell Sol 140 in soil and groundwater. Investigations indicated Shell Sol 140 (reported as kerosene) detected in unsaturated soils beneath the tunnel at concentrations up to 3,400 mg/kg. Investigations also indicated a large areal extent of free product (Shell Sol 140 floating on the water table), as well as toluene (up to 600 micrograms per Liter [$\mu\text{g/L}$]) and xylene (up to 900 $\mu\text{g/L}$) in groundwater.

A product recovery system was installed which consisted of product recovery skimmers in 10 wells and skimmer/water depressant pumps for increased hydraulic control. In addition, a subsurface drain system with five sumps was installed and equipped with water depressant

pumps. This system functioned to intercept the flow of product that could migrate off-site. Groundwater from the water depressant pumps and drain was collected in an aboveground storage tank (AST) and treated by a GAC treatment system, prior to being reused in the Site's cooling tower. The product recovery systems were shut down in October 1986 due to low incremental recovery rates (less than one gallon per day).

In July 1988, pilot-scale SVE was conducted in the Shell Sol 140 area; however, the pilot testing was unsuccessful. In 1992, IBM initiated operation of a Shell Sol hydraulic control system, which was a network of seven extraction wells intended to prevent lateral migration of Shell Sol in groundwater. In addition, in May 1993, the pilot-scale SVE system was converted to a dual-phase extraction system. Full-scale system operation of the dual-phase extraction system began in June 1993. By June 1994, Shell Sol 140 concentrations in soil met the cleanup criteria of one mg/kg and the dual-phase extraction system was shut down. Closure of the dual-phase extraction system in the Shell Sol 140 area was approved by the RWQCB-SF in March 1995. The hydraulic control system was shut down in September 1995, but was reactivated in December 1995, when Shell Sol 140 concentrations in several monitoring wells exceeded the cleanup standard. Shell Sol 140 was only detected sporadically in this area between 1995 and 1998.

RWQCB-SF believes that residual concentrations of Shell Sol 140 in this area will naturally attenuate and are unlikely to migrate (RWQCB-SF 1998). Closure of the Shell Sol hydraulic control system was approved by the RWQCB-SF in June 1998.

- **Tank Farm 067/Building 006 Area (Core Area)**. An approximately two-acre area encompassing Tank Farm 067 and the southwest corner of Building 006 has been under investigation since 1982. Initial investigations revealed the two primary sources of chemical releases in the area to be Tank Farm 067 and an area near the southwest of Building 006.

Tank Farm 067 formerly consisted of fifteen USTs of various sizes (1,000 to 5,000 gallons) in a 50 by 100 foot area. Virgin chemicals in the tanks included acetone, IPA, Freon 113, methylene chloride and NMP. Liquid wastes included acetone, IPA and mixed solvent waste. The tanks were excavated during November and December 1982 to the depth of the concrete slab beneath them (about 14 feet deep). During removal of the tanks, a leak was discovered in a pipe fitting on Tank 8, which formerly held mixed solvent waste. Investigations undertaken in areas beneath and around Tank Farm 067 from November 1982 to March 1983 revealed the buried tanks to be sources of several chemicals, primarily acetone, IPA, NMP, methylene chloride and Freon 113. The concentrations of Freon 113 in the A-aquifer zone near Tank Farm 067 initiated subsequent investigations in 1984 and 1985 to characterize the A/B aquitard and investigate possible dense non-aqueous phase liquid (DNAPL) (or free product) in the A-aquifer zone in the vicinity of Tank Farm 067. No evidence of DNAPL was found during these investigations. At the time, it was determined that Freon 113 and TCA concentrations in unsaturated soils beneath the former tanks had attenuated since tank removal, and that concentrations of acetone and IPA were unchanged since the prior investigation. HLA recommended additional excavation of soils containing acetone and IPA down to the water table. The excavation was performed to 37 feet bgs in mid-1985, bringing the total volume of excavated soil at Tank Farm 067 to an estimated 1,000 cubic yards.

Initial investigations near the southwest corner of Building 006 concerned a waste IPA collection sump and a polypropylene pipe in a clay pipeline that ran along the west side of Building 006 and connected the sump to Tank Farm 067. Investigations undertaken in this area from November 1982 to March 1983 revealed that chemicals associated with the pipeline and sump (IPA, acetone, NMP, Freon 113 and methylene chloride) were present in soils and groundwater. The buried pipeline and the waste IPA sump were excavated in 1983, and approximately 4,000 cubic yards of soil were removed. Additional investigation was performed between July and December 1986 to evaluate whether Freon 113 waste had leaked from an abandoned buried Freon 113 waste tank located near the southwestern corner of Building 006. On the basis of five borings drilled at that time, it did not appear that the Freon 113 waste tank had leaked (HLA 1988a).

In July 1986, two borings were drilled inside the southwest corner Building 006 Annex to evaluate whether Freon 113 waste had leaked from a former aboveground tank. Results of this investigation concluded that a minor surface release had occurred. This area was further investigated between February and December 1987 to evaluate the lateral extent of possible DNAPL. The results indicated Freon 113 (46,000 µg/kg to 110,000 µg/kg) in soil samples collected near the bottom of the A-aquifer zone from several borings. Soil samples collected from one boring contained concentrations of TCE (up to 690 µg/kg) and methylene chloride (up to 16,000 µg/kg). TCE was also detected in soil samples from three other borings. During this investigation, two groundwater samples were collected from each boring, one at first groundwater contact and one at termination of the boring. The first-encountered groundwater sample collected from one boring contained a concentration of Freon 113 (1,100,000 µg/L) exceeding its aqueous solubility (170,000 µg/L). Since Freon 113 is denser than water, HLA concluded that the source of high Freon 113 levels in shallow groundwater was likely related to DNAPL retained in pore space at the upper interface of the B and A aquifers in the saturated zone. Other chemicals detected in groundwater were TCE, methylene chloride, 1,1-DCE, acetone, IPA and xylenes. All chemicals except 1,1-DCE were found above respective action levels for drinking water in water samples taken from soil borings. These compounds were not detected in samples from nearby wells. Based on the measured moisture content of saturated zone soil samples and Freon 113 concentrations in soil at these locations, HLA estimated that Freon 113 concentrations in pore fluid were in the range of 290,000 µg/L to 550,000 µg/L. Since these values exceed the aqueous solubility of Freon 113, HLA estimated that DNAPL was present near the interface of the A-aquifer zone and the A/B aquitard. HLA concluded that the areas of concern noted in this investigation might warrant remediation.

After the initial investigation in 1982, groundwater extraction downgradient of Tank Farm 067 was initiated at Well A-29, located near the southwest corner of Building 006. Pumping was discontinued after several months due to a drop in the water table. Well A-29 was plugged and destroyed in 1984 in preparation for excavation on the west side of Building 006. Three additional extraction wells were installed in 1983 but were not used due to a drop in the water table. These wells were later used for groundwater monitoring. Pilot-scale SVE began in the Tank Farm 067/Building 006 Area in June 1989. The SVE system was operated on a full-scale basis during August 1992, February 1993 and March 1993. Approximately 300 pounds of Freon 113 were removed during the pilot- and full-

scale operations. During full-scale operation, the mass-removal rate dropped below 2 pounds per day (lbs/day), the shut-off criteria. Since data acquired from Site investigations indicated that most of the mass of Freon 113 was below the water table, it was decided to cease operation of the SVE system. A note from the RWQCB-SF indicates that the SVE system was operating in July 1996. Facility personnel indicated to ENVIRON that the SVE system is not currently operating (Interview with Marian Duncan/Hitachi GST during Phase I site visit on February 27, 2004).

- **Building 004 Area (Core Area)**. During the Site-wide shallow aquifer characterization, the concentration of Freon 113 in a monitoring well near Building 004 increased dramatically in 1983 and led to extensive subsurface investigations in the Building 004 Area through 1989 to identify the source and to delineate chemical extent. Possible source areas investigated included waste vaults WV-20, WV-25, the concrete trench leading to WV-25, the WV-25 spill containment trench, the Freon scrubber area in the “Air Pollution Annex”, the scrubber drain line, the Clean Line Room, the Coating Preparation Room, the Coating Dispensing Rooms, the Disc-Coating Rooms, the Parts Washer Room, the Cure Bake Room, and the Clean Rooms. Equipment, chemical trenches, chemical piping, and sumps were targeted in these potential source areas. Equipment identified as using Freon 113 in Building 004 included the large tronic cleaner and parts washer, the manual parts cleaner, and the two Freon stills. Although Freon 113 was previously used in Building 004, a specific source of the Freon 113 in groundwater was not identified.

Results of the subsurface investigations indicated that the highest concentrations of Freon 113 in soil gas, soil, and groundwater were near the southwestern corner of Building 004. The highest concentration of Freon 113 in unsaturated soils was 70,000 µg/kg found beneath a crack in the WV-25 trench. The trench has since been removed and underlying soils excavated due to this localized source area. Freon 113 concentrations in remaining soil samples ranged from 1 µg/kg to 11,000 µg/kg. Shallow groundwater underlying this area had Freon 113 concentrations up to 55,000 µg/L. Shallow groundwater approximately 500 feet to the southwest (downgradient) had no detectable concentrations of Freon 113.

SVE was selected to remediate the Building 004 area, and a SVE pilot study was conducted at Building 004 in mid-1989. Based on the successful results of the pilot study, full-scale operation of the SVE system was initiated in July 1991. By late 1991, extraction rates at individual SVE wells were below the closure criterion of 2 pounds of total VOCs per day per well, and operation of the SVE system was discontinued in January 1992. A test of the SVE system was conducted in 1993 that confirmed that soil vapor concentrations had not increased. In September 1993, confirmation borings were drilled in the area where soil concentrations had been the highest. Freon 113 was not detected in any of the samples. In addition, groundwater sampling showed that all shallow monitoring wells, near where soil concentrations had been highest, had Freon 113 concentration below the drinking water standard of 1,200 µg/L. Closure of the SVE system at the Building 004 area was approved by the RWQCB-SF in a letter dated March 24, 1994.

- **Building 002/021 Area (Core Area)**. As part of the 1982 site-wide investigation, groundwater samples collected contained concentrations of Freon 113 (up to 1,700 µg/L),

TCA (up to 240 µg/L), and TCE (up to 86 µg/L) in the area between Buildings 021 and 002 with the localized plumes apparently extending to the west-southwest.

Investigations were subsequently conducted in 1983 to attempt to locate the source, if any, of these chemicals in groundwater. Known chemical handling areas and possible migration pathways identified included: 1) industrial wastewater (IW) pipelines between Building 021 and 002 and east of Building 002; 2) surface releases during drum handling and perhaps former drum disposal near the southeast corner of Building 002; 3) former contractor's equipment storage yard east of Building 021; and 4) two former dry wells used to drain surface water from agricultural lands prior to the installation of storm sewers. Soil investigations indicated only one boring with an organic chemical (Freon 113) concentration exceeding one µg/kg. Based on a report reviewed, some of the chemicals in groundwater are likely from potential upgradient sources (e.g., Tank Farm A and Building 110); however, locally high concentrations suggest the existence of additional source(s) between Buildings 021 and 002.

A soil gas survey was performed in May 1986 as a screening tool to evaluate the extent of Freon 113 and TCA in shallow groundwater. Elevated concentrations were found in areas between Buildings 021 and 002. Routine monitoring of water levels and water quality is continuing; however, based on documentation provided, no soil remediation was conducted in this area. The specific source of chemicals in groundwater in this area is still unknown.

- **Building 010/025 Area (Redevelopment Property)**. During the site-wide shallow aquifer characterization, which was conducted from March to August 1982, TCE was identified in groundwater samples up to 560 µg/L in the vicinity of Buildings 010 and 025. In February to April 1983, a second investigation was conducted to define the areal extent of the TCE in groundwater in the vicinity of Buildings 010 and 025, to identify possible sources, and to recommend remedial measures.

TCE was detected in six of 21 soil samples at concentrations up to 3.7 µg/kg. Two groundwater samples were collected from each boring, one when water was encountered and one at completion of the boring, and analyzed for TCE. TCE was detected up to 460 µg/L and three apparently distinct TCE plumes were identified: 1) North of Building 010, which contained TCE concentrations in groundwater greater than 100 µg/L; 2) West of Building 025, which contained TCE concentration in groundwater greater than 100 µg/L; and 3) Near the corner of Endicott and Boulder Boulevard, which contained TCE concentrations up to 74 µg/L.

Extraction wells, which were installed in 1983, were expected to contain the three TCE plumes in the vicinity of Buildings 010 and 025. However, by early 1984 these extraction wells could no longer be operated due to low water levels. Currently, routine monitoring of groundwater quality and elevations is being conducted. In addition, operating extraction wells located downgradient in the area near Building 025 control the potential migration of the TCE plumes. The source of the TCE plume in the vicinity of Buildings 010 and 025 has not been identified.

Site investigations also identified 10 areas that either did not require remediation or where remediation had already been carried out. For most of these areas, only the unsaturated zone soils were affected and not the underlying groundwater (K/J/C 1987). Two of these areas are located on the Building 025 parcel, which is currently not part of the Site.

Four of the areas are located on the Core Area of the Site:

- 1) Tank Farms A and B;
- 2) Sump (WV-18 next to Building 067);
- 3) Building 014; and
- 4) Hydraulic fluid releases in elevator shafts – Buildings 014 and 015.

Four of the areas are located on the Redevelopment Property:

- 1) Building 026;
- 2) Building 028;
- 3) Hydraulic fluid releases in elevator shafts – Building 028; and
- 4) Diesel fuel releases associated with the Hitachi GST electrical substation.²

Several soil investigations and some excavations were conducted at these potential minor source areas between 1980 and 1987, as described in Section 3.2.

In December 1984, the RWQCB-SF ordered IBM (RWQCB-SF Order 84-90) to submit an overall long-term plan for remedial action. The State Water Resources Control Board (SWRCB) affirmed the order in May 1986 (SWRCB Order WQ 86-8). The remediation plan, entitled the “IBM Comprehensive Plan” dated June 1987 (the Comprehensive Plan), was developed in accordance with the requirements contained in RWQCB-SF Order 84-90, SWRCB Order WQ 86-8, and the DHS RCRA Permit. Based on the Comprehensive Plan, the RWQCB-SF issued Site Cleanup Requirements (SCR) Order 88-157, which established remediation goals for soil and groundwater cleanup at the Site, and specified that the remedial action plan should consist of groundwater extraction on-site, at the Site boundary, and off-site; treatment of the extracted groundwater in a continuously operating air stripper; and re-use of the treated water via irrigation or recharge (RWQCB-SF 1988). The USEPA subsequently issued a Record of Decision (ROD) dated December 15, 1988, based on the RWQCB-SF Order 88-157.

In August 2002, the RWQCB-SF adopted Order R2-2002-0082, “Final Site Cleanup Requirements and Rescission of Order No. 88-157,” which established new groundwater cleanup standards and criteria. IBM is required under RWQCB-SF Order R2-2002-0082 to remediate groundwater at the subject site for chemicals including chlorinated hydrocarbons, petroleum naphtha, aromatic hydrocarbons, ketones, and alcohols (RWQCB-SF 2002). RWQCB-SF Order R2-2002-0082 was amended with RWQCB-SF Order No. R2-2007-0002 in January 2007. The amendment rescinded IBM’s individual NPDES Permit for the Site (NPDES Permit No. CA0027961) and required IBM

² Although the Hitachi GST electrical substation is part of the Core Area, the diesel fuel releases actually occurred on the Redevelopment Property (Parcel O-5).

to file a Notice of Intent (NOI) for coverage under a General Permit (General NPDES Permit No. CAG912003) (RWQCB-SF 2007).

In addition, IBM is preparing a Soils Management Plan (SMP) for the Site. The IBM SMP, which must be approved by the RWQCB-SF and DTSC, must be complied with for any construction activities on the Site that disturb the soil or have the potential to encounter groundwater. Some of the elements of the IBM SMP include notifications to the RWQCB-SF and IBM in the case of earthworks that have the potential to encounter soils containing certain substances or could potentially impact on-going groundwater cleanup activities at the Site.

3.1.2 Current Conditions

IBM operates an on-site (and near-site) groundwater extraction and treatment system, which include shallow and deep aquifer extraction wells, conveyance piping, and air stripping via an air-stripping column. RWQCB-SF approved a request from IBM to cease off-site groundwater extraction. The last two off-site extraction wells (ORB-1 and ORB-7) stopped pumping on October 31, 2005. According to the *Annual Report to the RWQCB, Second Semi-Annual July 1, 2006 Through December 31, 2006, Groundwater Self-Monitoring Program*, dated February 2007 (“2006 Annual Report”) (MACTEC 2007), a total of approximately 11,527 pounds of chemicals have been removed by the groundwater treatment system. A summary of on-site historical and current (2006) maximum concentrations for the primary chemicals of concern and current cleanup standards is provided in Table 3.1.

Figure 3.2 shows the locations of the on-site (and near-site) shallow (A-aquifer) groundwater monitoring and extraction wells, and Figure 3.3 shows the locations of the on-site shallow (A-aquifer) observation wells. Currently, a total of 108 groundwater wells are sampled on a quarterly, semiannual, or annual basis. Forty-one (41) of these wells are located off-site and sixty-seven (67) of these wells are located on-site (or near-site).

According to the 2006 Annual Report, 26 on-site and near-site A-aquifer wells currently exceed the cleanup standards (MACTEC 2007). Eight of these A-aquifer wells (A-30, A-39, A-41, RA-04, RA-24, RA-27, RA-29, and RA-30) are located on the Redevelopment Property. The A-aquifer wells exceed the cleanup standards primarily for TCE (5 µg/L), as well as 1,1-dichloroethane (1,1-DCA) (5 µg/L) and 1,1-DCE (6 µg/L). No on-site B-aquifer wells currently exceed the cleanup standards.

A summary of the shallow (A-aquifer) monitoring, extraction, and observation wells located on the Redevelopment Property is provided in Table 3.2. There were 23 shallow monitoring, 8 shallow extraction, and 36 observation wells on the Redevelopment Property (see Figures 3.2 and 3.3). Seven of the monitoring wells are currently monitored for groundwater levels and chemicals as part of the Order; the remaining 16 monitoring wells have been destroyed. Five shallow extraction wells on the Redevelopment Property (RA-02, RA-24, RA-27, RA-29, and RA-30) are currently extracting shallow ground water; the remaining three shallow extraction wells have been destroyed. In addition to monitoring and extraction wells, there were also many observation wells (piezometers) located on the Redevelopment Property; all of these observation wells have been destroyed either in the past or as part of redevelopment activities (see Figure 3.3).

The following chemicals were detected at least once on the Redevelopment Property in shallow groundwater in the last three years (i.e., 2004, 2005, and 2006): acetone, benzene, 2-butanone, carbon tetrachloride, chloroethane, chloroform, dibromofluoromethane, 1,1-DCA, 1,2-DCA, 1,1-DCE, cis-1,2-DCE, trans-1,2-DCE, Freon 12, Freon 113, isopropanol, methyl chloride, methylene chloride, PCE, toluene, 1,1,1-TCA, 1,1,2-TCA, TCE, vinyl chloride, xylenes, TPH as diesel, TPH as motor oil, Shell Sol 140 (TPH as C6 to C22), chromium, and hexavalent chromium. Table 3.3 shows the maximum concentrations detected in the A- and B-aquifers for these chemicals on the Redevelopment Property for the last three years. As depicted in Table 3.3, concentrations of chemicals in the B-aquifer are approximately the same or are much lower than concentrations of chemicals detected in the A-aquifer.

A review of the most recent 2007 groundwater monitoring data shows that the conclusions described above do not change with the most recent monitoring results. According to IBM personnel, on-site (and near-site) remedial action is expected to continue for at least 10 years.

Groundwater plume maps (2006) showing the extent of Freon 113, TCA, TCE, and 1,1-DCE in shallow groundwater at the Site are provided as Figures 3.4, 3.5, 3.6 and 3.7, respectively. Appendix A includes 2004 – May 2007 shallow groundwater monitoring data (detected chemicals only) for the Redevelopment Property.

3.2 INVESTIGATIONS IN SOIL, SOIL GAS, AND GROUNDWATER

This section is divided into nine subsections. Section 3.2.1 provides an outline of the historical soil data that was collected on the Redevelopment Property prior to 2004. This soil data was collected primarily in the 1980s by HLA. Section 3.2.2 provides an outline of the more recent soil, soil gas, and groundwater data that has been conducted on the Redevelopment Property by ENVIRON between 2004 and 2007. Sections 3.2.3 through 3.2.8 provide background information concerning the current and/or former buildings located on each parcel, along with related activities and the results of the soil, soil gas, and/or groundwater investigations for Parcels O-1, O-2, O-3, O-4, O-5, and Endicott Boulevard/Tucson Way, respectively. Section 3.2.9 discusses NOA on the Redevelopment Property.

3.2.1 Historical Investigations

ENVIRON conducted Phase I Environmental Site Assessments (ESAs) of the Site in 2003 and 2004. The Phase I ESAs for the Site were conducted in three phases and three separate reports were written, dated October 2003, February 2004, and April 2004. Much of the background information provided in Sections 3.2.3 through 3.2.8 was obtained through interviews conducted as part of ENVIRON's Phase I ESA review.

In 2004, ENVIRON requested from Hitachi GST all the soil analytical data for borings located on the Redevelopment Property. Hitachi GST responded that the majority of soil investigations for the Site are summarized in Appendix A of the 1987 Comprehensive Plan (K/J/C 1987). ENVIRON was provided with the soil data summarized in the 1987 Comprehensive Plan and several additional soil investigation reports, including the 1988 Draft Chemical Data Report (HLA 1988b).

ENVIRON identified data gaps in the CCR (ENVIRON 2005a) from the Site data that was known to exist prior to 2004. These data gaps were addressed in the SI/SP and its associated attachments (ENVIRON 2005b). Much of the data collected prior to 2004 on the Redevelopment Property has been superseded by data recently collected by ENVIRON to implement the SI/SP. As such, much of this prior data is not presented in this report.

3.2.2 Current Investigations – 2004 to 2007

Between October 2004 and April 2007, ENVIRON conducted soil, soil gas, and groundwater investigations on Parcels O-1, O-2, O-3, O-4, O-5, and Endicott Blvd/Tucson Way on the Redevelopment Property. The investigations were conducted primarily to implement the SI/SP (ENVIRON 2005b), which investigated data gaps that were identified in the CCR (ENVIRON 2005a). Some investigations were also conducted for due diligence purposes, as well in accordance with the CMS Report for the Redevelopment Property (ENVIRON 2006a). As discussed above, the CMS Report for the Redevelopment Property was prepared to address the presence of potential contamination in soil that may have been encountered during building demolition and/or earthwork activities and/or discovered during implementation of the SI/SP. In accordance with the CMS Report for the Redevelopment Property, a representative from ENVIRON was on-site to oversee the redevelopment activities. Redevelopment activities (including building demolition, and earthwork activities such as grading, utility removal/installation and roadway demolition/construction) were performed by California certified contractors. During the course of redevelopment activities, several areas were identified by ENVIRON as requiring additional sampling and, in some cases, soil removal in accordance with the CMS Report for the Redevelopment Property.

Details concerning the results of the soil, soil gas, and groundwater investigations are provided in Section 3.2.3 through 3.2.8 for Parcels O-1, O-2, O-3, O-4, O-5, and Endicott Boulevard/Tucson Way, respectively. Section 3.2.9 discusses NOA on the Redevelopment Property.

3.2.3 Parcel O-1

The layout of Parcel O-1 prior to redevelopment activities is provided on Figure 3.8. Parcel O-1, which covers approximately 20 acres, formerly consisted primarily of asphalt parking lots, orchard trees, landscaped areas, sidewalks, Building 011 (Cafeteria), a small portion of Buildings 009 (Hitachi GST Office Building) and a small portion of Building 010 (IBM Office Building). The majority of Buildings 009 and 010 were on Parcel O-2. Building 010 was removed as part of the redevelopment activities. Both Buildings 009 and 011 are considered historically significant and will remain on the Site. In addition, four modular office trailers (designated as Buildings 070A through 070D) were historically present near the northeastern corner of Parcel O-1. ENVIRON did not identify any current or former permitted RCRA units on Parcel O-1. A description of the buildings on Parcel O-1 with a discussion of relevant soil and soil gas data is provided below.

Soil Gas Investigations over the Site-Wide Groundwater Plume

- Soil Gas Sampling Near Monitoring Well RA-24. Because Parcels O-1 and O-2 overlay a portion of the Site-wide groundwater plume, ENVIRON conducted a soil gas investigation on Parcels O-1 and O-2 in October 2004. The soil gas investigation on Parcel O-1 focused

on the southeast corner (near monitoring well RA-24, see Figure 3.2) where high variations in detected concentrations of vinyl chloride and TPH-Shell Sol 140 had been identified during recent rounds of groundwater sampling. Soil gas samples were taken approximately every 100 feet, starting at the well of concern and stepping out. At each sampling location, soil gas samples were collected typically from a depth of five and 15 feet bgs via temporary probes. A total of 28 locations (SJ-SG-1 through SJ-SG-20, SJ-SG-30 through SJ-SG-33, and SJ-SG-41 through SJ-SG-44) were sampled on Parcel O-1.³ All soil gas samples were analyzed for VOCs and total volatile hydrocarbons (TVH) via USEPA Method 8260B by mobile laboratory. Ten percent of the samples were collected as duplicate samples in Summa™ canisters and sent to a fixed laboratory for analysis using USEPA Method TO-14.

The soil gas sampling locations for Parcel O-1 are shown on Figure 3.9. Results of the soil gas investigation in this area are summarized in Tables 3.4 and 3.5, for the five-foot and 15-foot bgs samples, respectively. The leak check compound (1,1-difluoroethane) was not detected in any of the samples analyzed by the mobile or fixed laboratory at or above the DTSC recommended leak check compound reporting limit of 10 milligrams per cubic meter (mg/m^3) of vapor. As shown in Tables 3.4 and 3.5, low concentrations of VOCs were detected in all samples. Generally, the concentrations of VOCs in soil gas increased with depth (i.e. the concentrations at 15 feet bgs were generally higher than the concentrations at 5 feet bgs). The concentrations in soil gas also generally decreased with increasing distance from monitoring well RA-24. Vinyl chloride was detected in only one sample on Parcel O-1, at 15 feet bgs at a concentration of $0.017 \text{ mg}/\text{m}^3$.

- Due Diligence Soil Gas Sampling. At the request of the future developer of the Redevelopment Property, ENVIRON conducted a soil gas investigation on Parcels O-1, O-4, and O-5 for due diligence purposes on May 16 and 17, 2006. A total of five locations at two depths, five feet and 10 feet bgs, were sampled on Parcel O-1. Three soil gas sample locations (SG-DD-01 through SG-DD-03) were located in the eastern portion of Parcel O-1, near monitoring well RA-24. Two soil gas sample locations (SG-DD-04 and SG-DD-05) were located in the northern portion of Parcel O-1. These five locations are shown on Figure 3.9. The soil gas samples were analyzed on-site using a mobile laboratory for VOCs and TVH via USEPA Method 8260B. Ten percent of the samples were collected as duplicate samples in Summa™ canisters and sent to a fixed laboratory for analysis using USEPA Method TO-14.

Sample results are summarized in Tables 3.4 and 3.5, for the five-foot and 10-foot bgs samples, respectively. The leak check compound (1,1-difluoroethane) was not detected in any of the samples analyzed by the mobile or fixed laboratory at or above the DTSC recommended leak check compound reporting limit of $10 \text{ mg}/\text{m}^3$ of vapor. For the three sample locations collected near monitoring well RA-24, the results were similar to the results of the October 2004 soil gas sampling event. For the other sample locations (SG-DD-04 and SG-DD-05) on Parcel O-1, the compounds detected were primarily benzene, toluene, ethylbenzene, and xylenes (BTEX) and TVH.

³ Four of the soil gas sample locations on Parcel O-1 were associated with the step-out soil gas sampling around monitoring well A-30, which is located on Parcel O-2.

Building 011

Building 011, which was developed in 1957, was the main cafeteria for the Site. Building 011, which was operated by Hitachi GST, is an approximately 38,000 square-foot single-story building with partial basement and mezzanine levels for mechanical and utility space. Building 011 primarily consisted of a large industrial kitchen with walk-in refrigerators and freezers, an industrial dish washer, and industrial stoves and ovens, food and supply storage rooms, restrooms, a few offices, and dining areas. A loading dock was located on the eastern side of Building 011. Chemical storage and use in Building 011 was limited to small containers of industrial dishwashing detergent, deep-frying cooking oils, lighter fluid and charcoal for barbeques, refrigerant for walk-in refrigerators and freezers, and custodial cleaning supplies. A small wooden shed labeled as “Chemical Storage” was located adjacent to the loading dock on the eastern side of Building 011. Hitachi GST personnel reported that lighter fluid, soap products, trichloroisocyanic acid, and other cleaning products were stored in the shed. Five-gallon containers of a corrosion inhibitor were used and stored in the basement of Building 011 for operation and maintenance of the building’s condensate system. Building 011 had no associated current or former waste vaults (WVs). Besides renovations to the dining areas, Hitachi GST personnel reported no major changes in operations in Building 011 over time. As stated above, Building 011 is considered historically significant and was not demolished as part of redevelopment activities.

- Diesel Fuel AST (FT-12). Building 011 had a diesel-powered emergency generator with associated 1,000-gallon diesel fuel AST (Fuel Tank 12 [FT-12]). The approximate location of FT-12 is shown on Figure 3.8. The emergency generator and AST were located on the eastern side of Building 011. FT-12 was located within a below-grade epoxy-coated concrete vault, with sufficient secondary containment to contain the contents of the tank. The concrete vault was equipped with a roof to prevent collection of precipitation.

As part of the SI/SP (Attachment II), ENVIRON recommended that an environmental engineer inspect the area surrounding the AST (FT-12) and associated piping adjacent to Building 011 once they have been removed. FT-12 was removed on November 3, 2006. No staining or cracks were present on the epoxy-coated concrete vault surface beneath FT-12, when the AST was removed under permit by the City of San Jose. Hitachi GST has determined that the concrete pad beneath former FT-12 at Building 011 would not be removed due to its location within the historical preservation area of the Redevelopment Property.

Diesel fuel for the emergency generator was previously stored in a UST (Tank 011-N). As discussed below, the diesel fuel UST, which was installed in 1968, was removed in April 1986 and replaced with the current diesel fuel AST.

- Former Diesel Fuel UST and Associated Underground Pipelines. ENVIRON was provided with soil data from April 1986 associated with removal of the 1,000-gallon diesel fuel UST at Building 011 (HLA 1986a, 1988b). The UST was excavated and removed on April 11, 1986 as part of a routine upgrade of IBM facilities. Based on the soil sampling results, no further action was recommended.

In addition, soil investigations were previously conducted in the parking lot located east of Building 011 on Parcel O-1. Soil investigation reports for these soil borings were not located in IBM or MACTEC files. The reason for these investigations, the dates of these investigations, and the chemicals analyzed are unknown. IBM personnel recalled that the only soil investigations conducted in the Building 011 vicinity were related to diesel fuel associated with the former diesel fuel UST (discussed above) and associated underground pipelines. IBM personnel guessed that the investigations were conducted when a buried diesel fuel pipeline was removed. These samples were likely only analyzed for TPH as diesel.

As part of the SI/SP (Attachment V), ENVIRON recommended collecting a limited number of soil samples in the area of the former diesel fuel UST (Tank 011-N) at Building 011. In addition, because the location of the former buried diesel fuel pipeline associated with the former diesel fuel UST was unknown; collecting confirmatory soil samples in the vicinity of the former buried diesel fuel pipeline was not possible. Therefore, in the SI/SP, ENVIRON recommended that if any indications of a historic diesel fuel release were identified during redevelopment/grading activities, soil sampling should be conducted.

On November 10, 2006, ENVIRON conducted soil sampling in the area of the former diesel fuel UST at Building 011. Samples were collected from a total of two locations on the western and eastern ends of the former UST (T011-N-1 and T011-N-2) at depths of 10 and 15 feet bgs. Soil sample locations are shown on Figure 3.10. The samples were analyzed for TPH as diesel and motor oil using USEPA Method 8015B, and for BTEX and TPH as gasoline using USEPA Method 8260B. There were no constituents detected above laboratory reporting limits, as summarized in Table 3.6. In addition, an environmental engineer from ENVIRON was on-site during grading activities in the vicinity of the potential former buried diesel fuel pipeline.⁴ There were no indications of a historical diesel fuel release (visual staining, odor) identified in this area.

Building 010 (A small portion of Building 010 is on Parcel O-1)

Building 010, which was an approximately 75,000 square-foot single-story building, was leased by IBM and consisted of office space, conference rooms, lecture rooms, and classrooms. Building 010 was originally constructed in 1957 as an Education Center for IBM clients. Hitachi GST personnel reported no major operational changes to Building 010. Given the nature of operations in Buildings 010, there was minimal chemical use and chemical waste storage within this building. Building 010 had no current or former associated WVs. Building 010 was demolished as part of redevelopment activities in December 2006.

One previous soil investigation was conducted on Parcel O-1 in the vicinity of Building 010.

- Old Septic Tank. An investigation was conducted in July 1990 adjacent to a possible septic tank in an orchard northeast of Building 010 (HLA 1990a). According to the soil

⁴ The portion of the parking lot within the historically significant area surrounding Building 011 was not removed as part of redevelopment activities. Therefore, ENVIRON could not inspect the soil beneath the parking lot in this area.

investigation report, the tank had not been used for several decades and was thought to be associated with a farm that existed on the Site prior to construction of the first IBM facilities. The bottom was approximately three feet bgs, and the tank appeared to have been filled in with soil to this depth. It is possible that it may have also been a dug water well (HLA 1990a).

The investigation, referred to as Boring Series 570-01, was conducted to evaluate if the septic tank was a source of chemicals identified in groundwater in the vicinity. Two borings (570-01-0001 and 570-01-0002) were advanced to a maximum depth of 37.5 feet bgs, and soil samples were collected one-foot bgs and approximately every six feet to the total depth of each boring. The soil boring locations are shown on Figure 3.8. Groundwater was encountered at a depth of 28 feet bgs. The soil samples were analyzed for VOCs using USEPA Method 8010 and for BTEX using USEPA Method 8020.

The soil sample results are summarized in Table 3.7. All analytes listed for USEPA Method 8010 were below their respective detection limits, except TCA in the soil samples. TCA was detected in three soil samples ranging from 0.006 to 0.008 mg/kg; between depths of seven and 13 feet bgs. BTEX were not detected in the soil samples. Based on these results, HLA concluded that neither further investigation nor remediation of the tank appeared necessary (HLA 1990a).

In addition, during grading activities for new road construction, a previously unknown well was found in January 2007 on Parcel O-1.

- Previously Unknown Well. The previously unknown well was found during road construction on the Redevelopment Property. The well was found on January 9, 2007; approximately one to two feet beneath the asphalt and road base material on Boulder Boulevard near Concord Drive (see Figure 3.10). The well was approximately three feet in diameter and appeared to be of a brick-lined construction. Soil was visible in the well, approximately 10 feet from the top of the well construction. It is unknown if this soil had been placed (or had fallen) inside the well or if the soil denoted the total depth of the well. No liquid was observed inside the well.

Hitachi GST was aware that potential unknown wells existed in this area. As part of groundwater investigations conducted by IBM on the Site in the 1980s, a well survey was conducted to locate old wells (e.g., irrigation wells for former orchards) that could serve as conduits. Based on the findings of the well survey, a number of potential old wells were identified, including three wells in the vicinity of this unknown well that was recently discovered. At the time of the well survey, the status of all three of these wells was “unknown” (i.e., wells not previously known to exist or borings whose approximate locations are known, but may now be covered; unknown status wells may or may not have been properly destroyed).

Based upon the unknown status of the well, ENVIRON recommended collecting a sample of the soil observed inside the well. In accordance with the CMS Report for the Redevelopment Property, a shallow soil sample was collected from the top six inches of soil

inside the previously unknown well on January 25, 2007. The sample (identified as sample OLDWELL-S1) was submitted for analysis of VOCs by USEPA Method 8260B, TPH as diesel and motor oil by USEPA Method 8015B, CAM 17 metals by USEPA Method 6010B and 7470/7471, and potential of hydrogen (pH) by USEPA Method 9045.

The soil sample results are summarized in Table 3.6. VOCs and TPH were not detected in the soil. Some metals, including arsenic, barium, chromium, cobalt, copper, lead, mercury, nickel, vanadium, and zinc, were detected. All detected concentrations were below the residential soil RGs developed in the CMS Report for the Redevelopment Property. The pH result was 7.36, which is within the range for naturally-occurring soils.

Hitachi GST contacted the Santa Clara Valley Water District (SCVWD) regarding closure of the previously unknown well. According to the SCVWD, the well structure was believed to be a “pit-privy” or early septic system. Most of these “pit-privies” are very shallow, to the point that the SCVWD does not deem them as a potential threat to groundwater resources. The SCVWD indicated that no permits were required with their office to close this well. Subsequently, the well was backfilled and compacted to meet Site requirements (90% compaction) following standard procedures for the Site.

Orchards

Much of the Redevelopment Property is current or former orchards. Investigations of current and former orchards conducted on Parcel O-1 include the following:

- Current Orchard Areas⁵. In October 2004, ENVIRON conducted soil sampling in current orchard areas on the Redevelopment Property for organochlorine pesticides (OCPs) and metals. On Parcel O-1, ENVIRON collected discrete soil samples at a total of 20 locations (1-1 through 1-16 and 1-15A through 1-15D) on approximately ½-acre centers at depths of zero to six inches bgs and between two and three feet bgs. The locations of these soil samples are shown on Figure 3.10. Samples were analyzed for OCPs by USEPA Method 8081A and for metals by USEPA Methods 6010B and 7470/7471.

Initially only the soil samples collected at zero to six inches bgs were analyzed. For this investigation (conducted prior to the development of the RGs in the CMS Report for the Redevelopment Property [ENVIRON 2006a]), the OCPs and metals soil sampling results were compared to the following screening criteria for residential soil: 1) RWQCB-SF Environmental Screening Levels (ESLs) (RWQCB-SF 2005), 2) the Office of Environmental Health Hazard Assessment (OEHHA) screening numbers (CalEPA 2005a), and 3) USEPA Region 9 Preliminary Remediation Goals (PRGs) (USEPA 2004a). In addition, metals were also compared to literature background concentrations for California soils. If the shallow samples exceeded the criteria, then the deeper samples at these locations were analyzed.

⁵ “Current Orchard Areas” existed in 2004, at the time of the soil sampling investigation. All orchard areas on the Redevelopment Property were removed as part of redevelopment activities in 2006/2007.

Table 3.6 presents a summary of the OCPs and metals results. Of the OCPs, dichlorodiphenyltrichloroethane (DDT), dichlorodiphenyldichloroethylene (DDE), dichlorodiphenyldichloroethane (DDD), chlordane (technical), alpha-chlordane, gamma-chlordane, dieldrin, endrin, and toxaphene were detected. DDT and DDE were detected the most frequently, but all detections were below the screening criteria. For metals, arsenic, barium, chromium, cobalt, copper, lead, mercury, nickel, vanadium and zinc were detected. Arsenic and cobalt exceeded the screening criteria.

Arsenic concentrations on Parcel O-1 ranged from 4.5 to 10 mg/kg. Cobalt concentrations on Parcel O-1 ranged from 9.4 to 16 mg/kg. The maximum background concentration of arsenic in California soil ranges from 11 mg/kg (Bradford 1996) to 69 mg/kg (Dragun and Chiasson 1991). The maximum background concentration of cobalt in California soil ranges from 29 mg/kg (Lawrence Berkeley National Laboratory [LBNL] 2002) to 50 mg/kg (Dragun and Chiasson 1991). The results of the soil samples collected on Parcel O-1 and analyzed for arsenic and cobalt were within the range of typical background concentrations. Therefore, no additional sampling or analyses were performed related to the arsenic or cobalt detections.

- **Former Orchard Areas.** In accordance with the SI/SP (Attachment VI), 80 native soil samples were collected on October 10 through 17, 2005, beneath roads and parking lots throughout the Redevelopment Property to investigate whether residual OCPs and/or arsenic were present in former orchard areas of the Site. Ten of the native soil sample locations (B03 and B68 through B76) were located on Parcel O-1. The sample locations are depicted on Figure 3.10.

Samples of the native soil (zero to six inches) were collected by first coring through the asphalt and road base material and then collecting a sample of the native soil located immediately below using a macrocore sampler. The samples were analyzed for OCPs using USEPA Method 8081A and arsenic using USEPA Method 6010.

Sample results are summarized in Table 3.6. DDE was detected in two of the 10 samples at concentrations of 0.050 and 0.071 mg/kg. DDT was detected in one sample at a concentration of 0.013 mg/kg. Arsenic was detected in all 10 samples ranging from 4.0 to 11 mg/kg.

3.2.4 Parcel O-2

The layout of Parcel O-2 prior to redevelopment activities is provided on Figure 3.11. Parcel O-2, which covers approximately 35 acres, consisted primarily of asphalt parking lots, orchard trees, landscaped areas, fountains, and sidewalks, Building 010 (IBM Office Building), Building 009 (Hitachi GST Office Building), Building 012 (Hitachi GST Office Building), and Building 026 (IBM Global Services Building). In addition, modular office trailers (designated as Building 060) were formerly present west of Building 026. A description of the buildings on Parcel O-2 with a discussion of relevant soil, soil gas, and groundwater data is provided below.

Soil Gas Investigations over the Site-Wide Groundwater Plume

- TCE in Groundwater. As part of the 1982 Site-wide investigation, TCE was detected in groundwater samples collected in the vicinity of the Building 010 (and Building 025⁶) (K/J/C 1987). A discussion of the groundwater investigation is provided in Section 3.1.1. In February to April 1983, a soil and groundwater investigation was conducted to define the areal extent of the TCE in groundwater in the vicinity of Buildings 010 and 025, to identify possible sources, and to recommend remedial measures. Based on the results of the investigation, potential TCE source areas were not identified.
- Soil Gas Sampling Near Monitoring Well A-30. Because Parcels O-1 and O-2 overlays a portion of the groundwater plume, ENVIRON conducted a soil gas investigation on Parcels O-1 and O-2 in October 2004. This soil gas investigation on Parcel O-2 focused on the northwest corner (near monitoring well A-30) where the highest detected concentrations of TCE were found in the Redevelopment Property. Well A-30 is also downgradient of a potential TCE source area. Soil gas samples were taken approximately every 100 feet, starting at the well of concern and stepping out. At each sampling location, soil gas samples were collected typically from a depth of five and 15 feet bgs via temporary probes. A total of 11 locations (SJ-SG-21 through SJ-SG-29, SJ-SG-34 and SJ-SG-35) were sampled on Parcel O-2. The soil gas sampling locations for Parcel O-2 are shown on Figure 3.12. All soil gas samples were analyzed for VOCs and TVH via USEPA Method 8260B using a mobile laboratory. Ten percent of the samples were collected as duplicate samples in SummaTM canisters and sent to a fixed laboratory for analysis using USEPA Method TO-14.

Results of the soil gas investigation in this area are summarized in Tables 3.8 and 3.9, for the five-foot and 15-foot bgs samples, respectively. Low concentrations of VOCs were detected in all samples. The VOCs detected most frequently on Parcel O-2 included TCA, TCE, benzene, toluene, xylenes and TVH. As with Parcel O-1, the concentrations of these VOCs in soil gas increased with depth, although the difference was not as pronounced as Parcel O-1. This is primarily because the concentrations of VOCs in soil gas were generally lower on Parcel O-2 compared to Parcel O-1. The concentrations in soil gas also generally decreased with increasing distance from Well A-30. Vinyl chloride was not detected in any samples from Parcel O-2.

- Soil Gas Step Out Sampling Around Sample SJ-SG-26. In accordance with the SI/SP (Attachment IX), soil gas samples were collected from eight locations (SG-26-1 through SG-26-8) which were placed to form a 25-foot grid surrounding former soil gas sample SJ-SG-26 on May 15 and 16, 2006. Soil gas sampling locations are shown on Figure 3.12. Originally, it was proposed that soil gas samples would be collected from depths of five and 15 feet bgs. However, in several of the locations, vapor could not be obtained at 15 feet bgs. This could be due to tight formation in the subsurface or saturated soil conditions at 15 feet. As a result, the deeper samples were collected at depths ranging from nine to 15 feet bgs. The soil gas samples were analyzed on-site using a mobile laboratory for VOCs and TVH via USEPA

⁶ Building 025, which is located northeast of Building 010, is currently not part of the Site. Hitachi GST did not acquire the Building 025 parcel as part of its transaction with IBM in 2002. ENVIRON understands that the Building 025 parcel, which is currently owned by IBM, is the proposed location of a future Lowe's Store.

Method 8260B. Ten percent of the samples were collected as duplicate samples in Summa™ canisters and sent to a fixed laboratory for analysis using USEPA Method TO-14.

Sample results are summarized in Tables 3.8 and 3.9, for the five-foot and 15-foot bgs samples, respectively. In general, the VOC concentrations increase with sample depth. In addition, the area of soil gas sampling overlays the TCE plume currently being remediated by IBM. It is most likely that the source of the elevated concentrations of VOCs in soil gas in this area is the groundwater. Further investigation and subsequent remediation of groundwater contamination will be conducted by Golder Associates, Inc. (Golder) on behalf of IBM.

According to the *In Situ* Remedial Technologies Feasibility Study for Source Area Remediation prepared by Golder in June 2007 (Golder 2007), groundwater remediation in the area of monitoring well A-30 will involve a modified pump and treat system (or extraction/injection system) with accelerated bioremediation, and a targeted *in situ* source zone treatment. In preparation of groundwater remediation, Golder will also conduct a supplemental Site characterization to assess biogeochemical conditions, source zone delineation, residual source zone characteristics, and a detailed characterization of the contaminant flow paths.

Building 010

Building 010 use and setting are discussed in the previous section on Parcel O-1 (Section 3.2.3).

- Diesel Fuel AST (FT-11). Building 010 had a diesel-powered emergency generator with associated 1,000-gallon diesel fuel AST (FT-11). The emergency generator and AST were located north of Building 010. FT-11 was located within a below-grade epoxy-coated concrete vault, with sufficient secondary containment to contain the contents of the tank. The concrete vault was equipped with a roof to prevent collection of precipitation. As part of the SI/SP (Attachment II), ENVIRON recommended that an environmental engineer should inspect the area surrounding the diesel fuel AST (FT-11) and associated piping adjacent to Building 010 once they were removed.

FT-11 was removed under permit by the City of San Jose in November 2006. No staining or cracks were present on the epoxy-coated concrete vault surface beneath FT-11, with the exception of minor surficial staining. The slab was removed on November 29, 2006 and ENVIRON conducted an inspection of the soils in the immediate vicinity of FT-11 and its associated piping on the same day. No indications of leaking (visual staining, odors) were present.

Diesel fuel for the emergency generator at Building 010 was previously stored in a UST (Tank 010-N). As discussed below, the diesel fuel UST, which was installed in 1968, was removed in April 1986 and replaced with the diesel fuel AST (FT-11).

- Former Diesel Fuel UST. ENVIRON was provided with soil data from April 1986 associated with removal of the 1,000-gallon diesel fuel UST at Building 010 (HLA 1986b,

1988b). The soil borings are referred to as Soil Boring Series 311-01 and are shown on Figure 3.11. The UST was excavated and removed on April 22, 1986 as part of a routine upgrade of IBM facilities. Two soil samples were collected from 9.5 feet bgs on either side of the excavation pit. Both samples (311-01-010E and 311-01-010W) were analyzed for TPH using a diesel fuel standard, which was not detected (<10 mg/kg) in either sample. No hydrocarbon odors or stains were noted in the native soils in the excavation floor or walls.

- Emergency Diesel Generator. A soil investigation was conducted in December 1988 through February 1989 adjacent to the diesel fuel emergency generator associated with Building 010 (HLA 1989a). According to the soil investigation report, IBM personnel noticed staining on the concrete pad beneath the generator. Based on the investigation results, HLA recommended that the soil beneath the Building 010 emergency generator concrete pad be excavated to a depth of 10 feet, and confirmatory soil samples be collected from the walls and floor of the excavation to confirm that soil concentrations of diesel fuel are below 10 mg/kg. No information was found in the documentation received to confirm that the excavation and confirmation sampling was conducted. As part of the SI/SP (Attachment VIII), ENVIRON recommended that a limited number of soil samples be collected in the area beneath the Building 010 emergency generator concrete pad.

ENVIRON conducted soil sampling in the area of the B010 emergency generator on November 27, 2006. Samples were collected from a total of four boring locations from each side of the former concrete pad which housed the emergency generator (identified as sample locations B010-B1 through B010-B4). Soil sample locations are shown on Figure 3.13. Samples were collected from each boring at five-foot intervals to a maximum depth of 20 feet bgs. Samples were submitted for analysis of TPH as diesel and motor oil by USEPA Method 8015B.

The sample results are summarized on Table 3.11. TPH as diesel was detected in one sample collected from 5 feet bgs in boring B010-B2 at a concentration of 4.4 mg/kg. TPH constituents were not detected above their laboratory reporting limits in any of the other samples collected as part of this investigation.

In addition, during excavation activities to install a new domestic water line, a previously unknown well was found on Parcel O-2. As discussed above, Hitachi GST was aware that potential unknown wells existed in this area.

- Previously Unknown Well. The previously unknown well was located on Boulder Boulevard near Poughkeepsie Road, northwest of Building 010. The well was approximately 10 inches in diameter and had a steel casing. The depth of the well was measured to be approximately 168 feet. In accordance with SCVWD requirements, the well was destroyed in May 2007 with a SCVWD well destruction permit.

Building 009

Building 009, which was developed in 1957, is located to the west of Building 011 (the former Cafeteria). Building 009 is an approximately 5,000 square-foot structure formerly containing

offices and conference rooms. The Building 009 mechanical room houses a former fire water system. Given the nature of operations in Buildings 009, there was minimal chemical use and chemical waste storage within this building. Building 009 had no associated current or former WVs. Building 009 is considered historically significant and was not demolished as part of redevelopment activities. Based on information reviewed, ENVIRON did not identify any soil investigations related to Building 009.

Building 012

Building 012, which was developed in 1969, was the main Hitachi GST administrative office building for the Site. In approximately 1985, additions to the east and west of Building 012 were constructed. Building 012 contained approximately 400,000 square feet of office space on five floors. A penthouse containing air handlers was located on the top (sixth) floor. Besides office space, Building 012 contained conference rooms, break rooms, reprographic rooms, a mailroom, document storage rooms, and one utility core. A loading dock for mail, office furniture, and office supplies was located on the southern side of the building. Building 012 had no current or former associated WVs. Given the nature of operations in Building 012, there was minimal chemical use and chemical waste storage within this building. As part of redevelopment activities, demolition of Building 012 was completed in June 2007.

- 1985 Addition to Building 012. In approximately 1985, additions to the east and west of Building 012 were constructed. Prior to commencing construction activities in 1985, a soil investigation was conducted to determine if any restrictions or special procedures needed to be implemented during construction activities (HLA 1985a). On September 12, 1985, six borings were drilled to 16 to 25 feet bgs, and three soil samples were collected from each boring. These samples are labeled as Soil Boring Series 012- and are shown on Figure 3.11. The 18 soil samples were analyzed for Freon 113, TCA, and TCE. Sample results are summarized on Table 3.10. No discernible levels of Freon 113, TCA, or TCE were detected (< 0.001 mg/kg) during the September 1985 investigation. The 1985 HLA report concludes that no restrictions or special procedures were required for excavation or pre-drilling for piles.
- Diesel Fuel AST (FT-13). Building 012 had a diesel-powered emergency generator with an associated 500-gallon diesel fuel AST (FT-13). The emergency generator was located inside Building 012 in the first floor core room. FT-13, which was a double-walled AST, was staged on a concrete pad located outside Building 012 to the south. As part of the SI/SP (Attachment II), ENVIRON recommended that an environmental engineer inspect the area surrounding the diesel fuel AST (FT-13) and associated piping adjacent to Building 012 once they have been removed.

FT-13 was removed under permit by the City of San Jose on November 3, 2006. No staining or cracks were present on the epoxy-coated concrete vault surface beneath FT-13, when the AST was removed. When the slab was removed on April 3, 2007, ENVIRON conducted an inspection of the soils in the immediate vicinity of former FT-13 and its associated piping. No indications of leaking (visual staining, odors) were present.

- Former Diesel Fuel UST and Former Diesel Fuel AST. Typically, across the Site, diesel fuel for emergency generators was previously stored in USTs. According to Hitachi personnel, a diesel fuel UST was formerly located approximately 100-200 feet northeast of the existing diesel fuel AST (FT-13). This UST, which was installed in 1969, was removed in 1978 and replaced with an AST located in a below-grade concrete vault. IBM personnel indicated that it is unlikely soil sampling was conducted when this UST was excavated in 1978. The AST in the below-grade concrete vault was located at the eastern end of the current driveway area, to the east and south of the existing FT-13. This AST was subsequently replaced with the current FT-13. IBM personnel could not recall the year in which the vaulted tank was removed, but indicated that it is likely that a soil investigation was conducted. No soil investigations concerning diesel fuel at Building 012 have been identified. Because the exact locations of the former diesel fuel UST and former vaulted diesel fuel AST associated with Building 012 are unknown, collecting confirmatory soil samples in the vicinity of the former tanks was not possible. As part of the SI/SP (Attachment V), ENVIRON recommended that if any indications of a historic diesel fuel release (visual staining, odor) are identified during Building 012 demolition or redevelopment/grading activities in the vicinity of the building, soil sampling should be conducted.

An environmental engineer from ENVIRON was on-site during demolition of Building 012 and redevelopment/grading activities in the vicinity of the building. There were no indications of a historic diesel fuel release (visual staining, odor) identified during Building 012 demolition.

Buried Concrete Trench

An out-of-use buried concrete trench was located west of Building 026 and ran in a north-south direction along the entire length of Parcel O-2. The concrete trench formerly contained pipes that transferred wastewater (e.g., industrial wastewater and heavy metals wastewater) from waste vaults at the Site. No soil investigation involving the removal of these pipes was identified. Given the history of this trench, after it is removed as part of redevelopment activities, ENVIRON recommended in the SI/SP (Attachment III) that an environmental engineer inspect the area surrounding the concrete trench.

- Buried Concrete Trench Soil Gas Sampling. On November 16 through 18, 2005, soil gas samples were collected from 20 locations on Parcels O-2 and O-4 along the buried concrete trenches and around Building 028J. Eight of the locations along the buried concrete trench (SG-TR-1 through SG-TR-8) were located on Parcel O-2. Soil gas sampling locations are shown on Figure 3.12. The soil gas samples were collected from depths of five and 10 feet bgs at each location using a Geoprobe™-type direct push drilling rig. The soil gas samples were analyzed on-site using a mobile laboratory for VOCs and TVH via USEPA Method 8260B. Ten percent of the samples were collected as duplicate samples in Summa™ canisters and sent to a fixed laboratory for analysis using USEPA Method TO-14. One additional sample was submitted for TO-14 analysis due to equipment failure in the mobile laboratory.

The results of the soil gas sampling are summarized in Tables 3.8 and 3.9 for the five-foot and 10-foot bgs samples, respectively. Freon 113, Freon 12, TCE, PCE, TCA, 1,1-DCA, 1,1-DCE, cis-1,2-DCE, trans-1,2-DCE, chloroform, methylene chloride, BTEX, and TVH were detected.

Buried Concrete Trench Soil Sampling. An environmental engineer from ENVIRON was present on-site during the removal of the buried concrete trenches to inspect the surrounding area for evidence of leaking (i.e. cracking, visual staining) and to collect soil samples. Soil samples were collected from 11 locations along the concrete trench lines on Parcels O-2, O-3, and O-4. Five of the soil samples (TR-1 through TR-5) were collected on Parcel O-2 to the west of Building 026 and are shown on Figure 3.13. Samples were collected from native soil as close to the bottom of the trenches/pipes as physically possible (between approximately three and four feet bgs). The samples were submitted for analysis of CAM 17 metals by USEPA Method 6010B and 7470/7471, VOCs by USEPA Method 8260B, and pH by USEPA Method 9045.

In general, the buried concrete trenches were observed to be intact and no staining was observed in the surrounding soils. However, during the removal of a section of the trench on Parcel O-2 near sample location TR-1, some pink liquid was observed spilling out of one of the pipes. According to Hitachi personnel, at one time, pink dye was added to Building 002 cooling tower water to differentiate it from domestic water. ENVIRON was unable to collect an adequate volume of liquid to submit for laboratory analysis. However, it appears likely that the liquid was dyed cooling tower water.

Soil sampling results from former concrete trench areas on Parcel O-2 are summarized in Table 3.11. There were no VOCs detected above reporting limits. Low levels of metals were detected. Results for pH were within the range of native soil conditions.

- Possible Former Buried Pipeline. ENVIRON identified a soil investigation that was conducted north of Building 026; however, IBM and MACTEC personnel were unsure why this soil investigation was conducted. Based on the locations of the soil borings, it appears that this investigation was conducted as part of a pipeline removal. A soil investigation report for these soil borings was not located in IBM or MACTEC files. Because the location of the possible former buried pipeline located north of Building 026 was unknown, collecting confirmatory soil samples in the vicinity of the possible former buried pipeline was difficult. Therefore, as part of the SI/SP (Attachment VIII), ENVIRON recommended that if any indications of a historic release (visual staining, odor) are identified during site redevelopment/grading activities, soil sampling should be conducted.

An environmental engineer from ENVIRON was on-site during demolition and redevelopment/grading activities in the vicinity of parking lot north of Building 026. There were no indications of a historic release from a possible buried pipeline (visual staining, odor) identified during demolition or redevelopment/grading activities.

Building 026

Building 026 was constructed in 1967 and was formerly used for pilot-scale product development. Sometime in the late-1980s/early-1990s, the development labs were converted into computer labs and chemical use within Building 026 was largely curtailed. The majority of Building 026, which was an approximately 180,000-square-foot single-story building, was leased by IBM and consisted of office space and vacant computer labs. A small portion of Building 026 was used by Hitachi GST. Given the nature of operations in Buildings 026 just prior to demolition, there was minimal chemical use or chemical waste storage within this building. Building 026 was demolished in September through October 2006.

- Diesel Fuel AST (FT-18). Building 026 had a diesel-powered emergency generator with associated 2,500-gallon diesel fuel AST (FT-18). The emergency generator and AST were located west of Building 026. FT-18 was located within a below-grade epoxy-coated concrete vault, with sufficient secondary containment to contain the contents of the tank. The concrete vault was equipped with a roof to prevent collection of precipitation. As part of the SI/SP (Attachment II), ENVIRON recommended that an environmental engineer inspect the area surrounding the diesel fuel AST (FT-18) and associated piping adjacent to Building 026 once they have been removed.

FT-18 was removed under permit by the City of San Jose on November 16, 2006. No staining or cracks were present on the epoxy-coated concrete vault surface beneath FT-18, with the exception of minor surficial staining, when the AST was removed. No indications of leaking were present (visual staining, odors) in soils in the immediate vicinity of FT-18 or its associated piping when the concrete slab was removed and inspected on November 30, 2006.

Diesel fuel for the emergency generator was previously stored in a UST (Tank 026-W). The diesel fuel UST, located west of Building 026 was installed in 1968. In April 1986, the diesel fuel UST was removed and replaced with the diesel fuel AST (FT-18).

- Former Diesel Fuel UST. ENVIRON was provided with soil data from April 1986 associated with removal of the 2,500-gallon diesel fuel UST at Building 026 (HLA 1986c, 1988b). The UST was excavated and removed on April 4, 1986 as part of a routine upgrade of IBM facilities. No hydrocarbon odors or stains were detected in the native soils on the excavation floors or walls. Two soil samples (311-01-026N and 311-01-026S) were collected from the bottom of the excavation at a depth of 10.5 feet bgs and analyzed for TPH. The soil sample locations are shown on Figure 3.11. TPH was not detected (<10 mg/kg) in either of the soil samples.

As discussed above, Building 026 was constructed in 1967 and was formerly used for pilot-scale product development. As part of development operations, organic solvents, isopropyl alcohol, and other chemicals were historically used in Building 026. Laboratory operations generated dilute hydrofluoric (HF) acid wastewater. Sometime in the late-1980s/early-1990s, the development labs were converted into computer labs and chemical use within Building 026 was largely curtailed. Former waste vaults, WV-02 (original), WV-02 (second), and WV-15, associated with pilot-scale

product development were previously located on the western side of Building 026, as described below.

- Former WV-02 (Original). According to information reviewed, there were two former waste vaults designated as WV-02 at Building 026. The original WV-02 was located approximately 300 feet north of the second WV-02 on the western side of Building 026. The original WV-02 was used for storage of heavy metal waste (HLA 1986d). Wastewater from product development laboratories was transported through a cast iron pipe beneath Building 026 into a clay pipe beneath the loading dock and into WV-02 (HLA 1988c). Based on a figure provided by Hitachi GST, piping from the original WV-02 appears to have been connected to the underground concrete trench system, leading to the on-site wastewater treatment plant (Building 110) on the Core Area. In April 1986, this waste vault was removed and the clay pipe was abandoned by pressure grouting. Total depth of the vault excavation was approximately 14 feet bgs. The original WV-02 was replaced with a new WV-02 (discussed below) and the cast iron pipe was connected to the new WV-02.

Former WV-02 (Original) Soil Sampling. Subsequent to the excavation and backfill, on May 7, 1986, a soil investigation was conducted to determine whether any chemicals from the former vault had leaked into the soil. Four soil samples were collected at depths of 15.5 or 16.0 feet bgs from four soil borings. The soil samples were analyzed for TCE, TCA, total chromium, hexavalent chromium, copper, nickel, fluoride, nitrate, and pH. Notably, TCE was detected in all four borings at concentrations ranging from 0.019 to 0.035 mg/kg. The pH of the samples ranged from 7.1 to 10.0.

As part of the SI/SP (Attachment III), ENVIRON recommended sampling for TCE and other VOCs, including TCE breakdown products, in the area of WV-02 (original). Further, given the nature of former operations at WV-02 (original), ENVIRON recommended sampling for total chromium, nickel, and other metals in the WV-02 (original) and associated pipeline areas. Fluoride and nitrate were not proposed in this sampling event as the concentrations detected in the 1986 investigation were well below the RGs developed in the CMS Report for the Redevelopment Property.

Between October 17 and 18, 2006, two soil borings were advanced in the area of WV-02 (original) (WV-02-1 and WV-02-2), and two soil borings were advanced approximately 100 feet apart along the associated clay pipeline (WV-02-3 and WV-02-4). Soil sample locations are shown on Figure 3.13. Samples were collected every five feet to a depth of 20 feet bgs. No evidence of contaminated soil was observed during sample collection. Samples were submitted for analysis of CAM 17 metals by USEPA Method 6010B and 7470/7471, VOCs by USEPA Method 8260B, and pH by USEPA Method 9045.

Results from soil sampling in the vicinity of WV-02 (original) and the associated clay pipeline are summarized in Table 3.11. TCE was detected in one boring (WV-02-1) up to 0.012 mg/kg. Some metals were detected, but at concentrations below the residential soil RGs developed in the CMS Report for the Redevelopment Property. Results for pH were within the range of native soil conditions, except in one location (WV-02-4 at 5 ft bgs), which showed a pH of 10.4.

Based upon the elevated pH result, ENVIRON conducted step-out sampling in the vicinity of the sample location WV-02-4 on November 9, 2006. Samples were collected from four locations (identified as sample locations WV-02-4-A through WV-02-4-D) located five feet to the north, east, south, and west of WV-02-4. Sample locations are shown on Figure 3.13. Samples were collected from depths of one and two feet bgs and submitted for pH analysis via USEPA Method 9045. The pH results of the step-out samples ranged from 7.18 to 7.95, within the range of native soil conditions. The elevated pH result in sample WV-02-4 could indicate a localized release of caustic material from piping associated with WV-02 (original).

Former WV-02 (Original) Soil Gas Sampling. On November 9, 2006, a soil gas investigation was conducted in the vicinity of the former WV-02 (original). An approximately 25-foot by 25-foot grid (labeled A through D) was created in the vicinity of former WV-02 (original). Soil gas samples were collected from 4 locations at the nodes of the grid (WV-02-A through WV-02-D). Samples were collected from each location at a depth of five feet bgs. The soil gas sample locations are shown on Figures 3.12.

The soil gas samples were collected in one-liter Summa™ canisters and for analysis of VOCs using USEPA Method TO-14. The leak check compound (1,1-difluoroethane) was not detected at or above the DTSC recommended leak check compound reporting limit of 10 mg/m³ of vapor in these samples. The results of the soil gas sampling are shown on Table 3.8. Compounds detected include chloroform, 1,1-DCA, TCA, TCE, PCE, Freon 11, Freon 113, BTEX compounds, 1,2,4-trimethylbenzene, and 1,3,5-trimethylbenzene.

- Former WV-02 (Second). The new WV-02 (“WV-02 (second)”), which was installed in 1986, replaced the original WV-02. The second WV-02 was located near the loading dock on the western side of Building 026 to the north of WV-15. Hitachi GST personnel reported that WV-02 (second) is no longer present. Hitachi GST personnel could not recall when the WV-02 (second) was closed and were unsure if WV-02 was previously a permitted RCRA unit. According to an April 1988 HLA report, WV-02 (second) was abandoned sometime between August 1986 and April 1988 (HLA 1988c). Given this information, it is unlikely that WV-02 (second) was ever permitted, since it was abandoned prior to IBM permitting units handling heavy metals wastewater.

In May through August 1986, an investigation was conducted to evaluate whether chemicals had migrated into soils through pipe backfill in the vicinity of the WV-02 (second) (K/J/C 1987). Soil and near-surface groundwater samples were analyzed for certain VOCs (Freon 113, TCE, and TCA), certain metals (total chromium, hexavalent chromium copper, and nickel), and fluoride. Elevated concentrations (up to 0.80 mg/kg) of TCE were detected in near-surface soil. The Comprehensive Plan indicates that the TCE in the soil appeared to be related to a localized near-surface release. Freon 113 was detected in soil near the water table (between 30 and 37 feet bgs) up to 0.34 mg/kg. The Comprehensive Plan indicates that the Freon 113 was likely related to upgradient sources (K/J/C 1987).

According to the Comprehensive Plan, remedial actions were being evaluated for WV-02 (second) at that time (June 1987). According to an April 1988 HLA report, WV-02 (second)

was abandoned sometime between August 1986 and April 1988. At the time of abandonment, the cast iron pipe was pressure grouted, and the soil surrounding the pipe in the loading dock area was excavated (HLA 1988c). No additional information provided to ENVIRON indicates that soil was remediated in this area. ENVIRON requested the closure report, if any, for the second WV-02 from Hitachi GST/IBM and attempted to locate the closure report during a regulatory file review; however, no closure report was found for WV-02 (second).

As part of the SI/SP (Attachment III), ENVIRON recommended sampling for TCE and other VOCs, including TCE breakdown products, in the area of WV-02 (second). Further, given the nature of former operations at WV-02 (second), ENVIRON recommended sampling for total chromium, nickel, and other metals in the WV-02 (second) and associated pipeline areas. Fluoride was not proposed in this sampling event as concentrations detected in the 1986 investigation were well below the RGs developed in the CMS Report for the Redevelopment Property.

Former WV-02 (Second) Soil Sampling. On October 17, 2006, two soil borings were advanced in the area of WV-02 (second) (WV-02-5 and WV-02-6). Soil boring locations are shown on Figure 3.13. Samples were collected every five feet to a depth of 20 feet bgs. No evidence of contaminated soil was observed during sample collection. Samples were submitted for analysis of CAM 17 metals by USEPA Method 6010B and 7470/7471, VOCs by USEPA Method 8260B, and pH by USEPA Method 9045.

Results from soil sampling in the vicinity of WV-02 (second) are summarized in Table 3.11. No VOCs were detected above laboratory detection limits. Some metals were detected, but at concentrations below the residential soil RGs developed in the CMS Report for the Redevelopment Property. Results for pH were within the range of native soil conditions.

Former WV-02 (Second) Soil Gas Sampling. On November 8 through 10, 2006, a soil gas investigation was conducted in the vicinity of the former footprint of Building 026, including in the vicinity of WV-02 (second). A discussion of this soil gas investigation is provided later in this section.

- Former WV-15. WV-15 consisted of a large enclosed area on the western side of Building 026, comprising five sections: 1) a waste mixed solvent storage area containing one 250-gallon aboveground storage tank (T-1) and a sump; 2) a diesel generator; 3) a DI water area containing a 10,000-gallon DI water tank (T-6) and twelve smaller DI water storage tanks; 4) a waste treatment area containing a 1,200-gallon HF acid neutralization tank (P-1); and 5) an industrial waste storage area containing four aboveground 2,000-gallon fiberglass reinforced plastic (FRP) tanks (T-2, T-3, T-4, and T-5) for the collection of concentrated and diluted heavy metal and brine industrial waste. Tank P-1 within WV-15 was formerly a permitted RCRA unit. (It is unknown whether the other tanks within WV-15 were formerly permitted RCRA units). Solvent wastes were formerly collected and transferred off-site. Brine and heavy metal waste streams were formerly transferred via underground pipelines within concrete trenches to the on-site wastewater treatment plant (Building 110) on the Core Area.

Former WV-15 Soil Sampling. HF acid wastewater was formerly collected in tank P-1 in WV-15 and neutralized under IBM's RCRA Permit. In September 1985, a soil investigation was conducted to evaluate whether chemicals had migrated into soils beneath the concrete vault associated with the HF acid neutralization tank (P-1) within WV-15 (K/J/C 1987). Soil samples from three borings up to 12 feet bgs were analyzed for pH, fluoride, and total chromium. Based on the results of the investigation, HLA concluded that chemicals had not migrated into underlying soils.

In July 1988, an additional soil investigation was conducted beneath the tank P-1 vault (IT 1990). Two cores were drilled through the floor of the concrete vault that contained Tank P-1, one at the fill end of the tank and the other beneath the vault sump. Two soil samples were collected from native soils and analyzed for pH, fluoride, and metals. Based on the results of the investigation, no further action was recommended.

As a result of a DHS inspection of the IBM facility on July 27, 1989, DHS identified several hazardous waste violations at the facility, including the improper notification and closure of tank P-1. On January 29, 1990, the DHS and IBM signed a Corrective Action Order and Complaint for Penalty (Docket HWCA 89/90-029), which ordered IBM to submit a certification that the HF acid neutralization tank was closed in accordance with the approved Closure Plan. IBM submitted a "Waste Hydrofluoric Acid Storage Tank Closure Report" prepared by International Technology Corporation (IT) dated March 5, 1990 to the DHS (IT 1990). The closure report indicated that tank P-1 was properly closed in April/May 1988. Based on IBM's submittals, the DHS stated in a letter dated July 30, 1990, that the HF acid tank is officially closed.

Pursuant to IBM's Closure Plan associated with the Site's RCRA Permit, tanks T-1, T-2, T-3, and T-4 were closed in August 1993 and tank T-5 was closed in February 1994. According to the closure reports dated August 1993 and February 1994, respectively, all five tanks were drained, cleaned, and properly disposed. No soil sampling was conducted as part of closure activities. Hitachi GST personnel were unaware of when tank T-6 (DI water tank) was removed. Hitachi GST personnel reported that all tanks, sumps, and associated piping were removed from WV-15.

As part of the SI/SP (Attachment VIII), ENVIRON recommended that an environmental engineer inspect the area near former tank T-1 (waste mixed solvent tank) and associated sump.

On September 13, 2006, an environmental engineer from ENVIRON was on-site to inspect the concrete slab of WV-15 following the removal of all of the equipment and tanks formerly located in the area. The concrete slab of the waste vault appeared in good condition and no major cracks or areas of staining of the concrete were observed.

Building 026 and the associated WV-15 were demolished in September through October 2006. An environmental engineer from ENVIRON was on-site to oversee the demolition activities. Following the concrete slab removal of WV-15, the soil immediately below the waste vault area was inspected by an environmental engineer from ENVIRON. A small area

of black soil was observed beneath the former waste vault slab in the vicinity of the waste mixed solvent storage area that formerly contained one 250-gallon AST (Tank T-1). On October 19, 2006, a grab sample of this material (identified as sample WV-15-1) was collected and submitted for analysis of VOCs by USEPA Method 8260B, TPH as diesel and motor oil by USEPA Method 8015B, CAM 17 metals by USEPA Method 6010B and 7470/7471, and pH by USEPA Method 9045. The sample location is shown on Figure 3.13.

The results of the WV-15 sample are summarized on Table 3.11. Acetone, TPH as diesel, and metals were detected in the soil sample, but at levels below the residential soil RGs developed in the CMS Report for the Redevelopment Property. The pH result was 7.08, which is within the range for naturally-occurring soils.

Former WV-15 Soil Gas Sampling. On November 8 through 10, 2006, a soil gas investigation was conducted in the vicinity of the former footprint of Building 026, including in the vicinity of former WV-15. A discussion of this soil gas investigation is provided later in this section.

A previously unidentified clarifier was discovered on the western side of Building 026 in October 2006 during redevelopment activities.

- Building 026 Clarifier. During utility removal, a previously unidentified manhole in the former landscaping area immediately to the west of Building 026 was identified, approximately 148 feet from the former northwest corner of the building. Once the manhole cover was opened it was discovered that the manhole provided access to a concrete vault. The exact dimensions of the vault could not be determined at the time; however, liquid was observed at the bottom of the vault. A later review of historical documents provided by IBM indicated that the vault may have been a clarifier used at Building 026, prior to installation of the industrial wastewater treatment system in the early 1970s. The vault, herein after referred to as “the clarifier”, had not been shown on any previous building plans reviewed by ENVIRON.

Building 026 Clarifier Soil Sampling. On January 15, 2007, the soil from above and around the clarifier was removed. Once the clarifier was exposed, it was determined that the clarifier was approximately six feet long, four feet wide, and 10 feet deep. Three pipes, each approximately four inches in diameter, were observed emanating from the clarifier. One pipe was connected to the north side of the clarifier and two other pipes were observed heading out of the south side of the clarifier. The pipe runs were approximately six feet in length and had been cut and filled with grout. It is unknown as to who had cut and filled these pipes and when this event had occurred. The concrete clarifier and pipes were removed from the ground.

Soil samples were collected from the bottom of the clarifier grave and from the bottom of the excavated pipe runs. Soil samples were also collected from the four sidewalls of the clarifier grave. Confirmation sample locations (026 CLARIFIER-A through 026 CLARIFIER-H) are shown on Figures 3.13 and 3.14. The excavation samples were submitted for analysis of VOCs by USEPA Method 8260B, TPH as diesel and motor oil by

USEPA Method 8015B, CAM 17 metals by USEPA Method 6010B and 7470/7471, and pH by USEPA Method 9045.

The results of the confirmation soil samples are summarized in Table 3.11. TCE was the only VOC detected in the soil. TCE was detected in the sample collected from the bottom of the excavation (identified as 026 Clarifier-H) at a concentration of 0.0071 mg/kg. TPH as diesel was detected in five of the eight samples collected, with concentrations ranging from 2.3 to 41 mg/kg. TPH as motor oil was detected in one sample (026 Clarifier-E) at a concentration of 79 mg/kg. Some metals were detected, but at levels below the residential soil RGs developed in the CMS Report for the Redevelopment Property. The results of the pH analyses ranged from 8.30 to 9.08, which is within the range for naturally-occurring soils.

Building 026 Clarifier Soil Gas Sampling. On November 10, 2006, soil gas samples were collected in the vicinity of the clarifier identified at Building 026. At the time of the soil gas sampling, the clarifier had not been removed from the ground. Soil gas samples were collected from one location (identified as B026-CLARIFIER-A) at five and 10 feet bgs. The soil gas sample location is shown on Figure 3.12.

The soil gas samples were collected in one-liter Summa™ canisters for analysis of VOCs using USEPA Method TO-14. Results from the five-foot sample indicated that the leak check compound, 1,1-difluoroethane, was detected at a concentration of 27 mg/m³, above the DTSC recommended leak check compound reporting limit of 10 mg/m³. Therefore, the data from this sample was deemed invalid.

The results of the soil gas sampling are shown on Tables 3.8 and 3.9 for the five-foot and 10-foot sample, respectively. Compounds detected include Freon 11, Freon 113, TCA, TCE, PCE, BTEX compounds, 1,2,4-trimethylbenzene, and 1,3,5-trimethylbenzene.

Building 026 Footprint Soil Sampling

In addition to investigations associated with the former WVs at Building 026, a number of soil investigations were conducted in the 1980s beneath the footprint of Building 026. In general, these investigations were conducted to evaluate whether chemicals had seeped through concrete and into underlying fill material beneath Building 026 due to spills or in the vicinity of sumps or floor drains. The soil investigations are described below:

- HF Acid Release. In February 1984, a soil investigation (Boring Series 111-01) was conducted beneath Building 026 near the southwestern corner to assess whether an above-grade release of HF acid had penetrated soil (K/J/C 1987). The soil sample locations are shown on Figure 3.11 and sample results are summarized in Table 3.10. Fluoride was detected up to 38 mg/kg, and nitrate was detected up to 8,500 mg/kg, below their respective RGs developed in the CMS Report for the Redevelopment Property. The pH of the samples ranged from 2.8 to 9.0 (K/J/C 1987).

- Chemicals Penetrating Floor in Laboratory. In September 1984, a soil investigation (Boring Series 172-01) was conducted beneath Building 026 to assess whether chemicals used in a laboratory had penetrated into soil through the floor where crumbling of floor tile mortar and seepage were observed (K/J/C 1987). Seven soil samples from four borings up to 1.5 feet bgs were collected and analyzed for Freon 113, TCA, methylene chloride, total chromium, hexavalent chromium, copper, fluoride, and pH. The soil sample locations are shown on Figure 3.11 and sample results are summarized in Table 3.10. According to the Comprehensive Plan, no evidence was found that chemicals had penetrated the floor, and no remedial action was planned (K/J/C 1987).
- Liquid Seepage in Room 400. A soil investigation was conducted in February 1987 in Room 400 of Building 026 (HLA 1987a, 1988b). According to the soil investigation report, liquid had periodically migrated upward through the concrete floor and accumulated between the linoleum and concrete in this room for several years. This investigation, referred to as Boring Series 406-01, was conducted to evaluate the possible source areas of the liquid observed on the floor in Room 400 and to evaluate whether the liquid contained organic chemicals. Three samples each from eight borings that were spaced throughout the room, were collected and analyzed for TCE, Freon 113, TCA, PCE, total chromium, hexavalent chromium, copper, nickel, fluoride, nitrate and pH. The soil sample locations are shown on Figure 3.11 and sample results are summarized in Table 3.10. According to the soil investigation report, the investigation results did not indicate a source area for the observed surface liquid seeps, and HLA concluded that additional soil sampling was not necessary at that time. The soil investigation report does recommend that when the linoleum in the room is removed, the concrete floor be inspected for loss of integrity, including cracking, crumbling, staining, and possible routes for liquid migration (HLA 1987a). As part of the SI/SP (Attachment VIII), ENVIRON recommended that this inspection be performed.

On September 19, 2006, an environmental engineer from ENVIRON was on-site to inspect the concrete floor slab of Building 026 in the vicinity of Room 400 following the removal of all of the furniture, equipment, and floor tiles formerly located in the area. Areas of dark staining of the concrete were visible during the time of inspection. Although no major cracks were noted in the floor slab, it was noted that screws had been drilled into the concrete slab throughout the room. Following the concrete slab removal of Building 026, the soil immediately below the area of Room 400 was inspected by an environmental engineer from ENVIRON. A small area of black soil was observed beneath the floor slab adjacent to a concrete footing used to support the slab. On October 19, 2006, a grab sample of this material (identified as sample 026-400-1) was collected and submitted for analysis of VOCs by USEPA Method 8260B, TPH as diesel and motor oil by USEPA Method 8015B, CAM 17 metals by USEPA Method 6010B and 7470/7471, and pH by USEPA Method 9045. The soil sample location is shown on Figure 3.13.

The results of this sample are summarized on Table 3.11. VOC constituents and TPH as motor oil were not detected in the sample above the laboratory reporting limits. TPH as diesel was detected at a concentration of 8.1 mg/kg. Some metals were detected, but at concentrations below the residential soil RGs developed in the CMS Report for the

Redevelopment Property. The pH result was 10.3. The results of the soil sampling do not indicate a source area for the liquid seepage through the concrete floor that was observed in the past. A representative from ENVIRON was present throughout demolition of Building 026 and did not observe any indication as to what may have caused the historical liquid seepage.

Based upon the elevated pH results, ENVIRON conducted step-out sampling in the vicinity of the sample location 026-400-1 on November 9, 2006. Samples were collected using a Geoprobe™-type direct push drilling rig. Samples were collected from four locations (identified as sample locations 026-400-A through 026-400-D) located five feet to the north, east, south, and west of 026-400-1. Refer to Figure 3.13 for sample locations. Samples were collected from depths of one and two feet bgs and submitted for pH analysis via USEPA Method 9045. The pH results of the step-out samples ranged from 7.29 to 8.31, within the range of native soil conditions. The elevated pH result in sample 026-400-1 could indicate a localized release of caustic material from Room 400.

- Sumps in Rooms 113C and 114A. Prior to abandonment in 1986, Rooms 113C and 114A were used to manufacture computer circuit board “cards” (HLA 1987b). Chemicals used in the manufacturing process included acids, bases, oxidizers, and solvents. During manufacturing activities in each room, chemicals accumulated in a trench and were transported into a sump. A soil investigation, referred to Boring Series 406-02, was conducted in March and April 1987 to evaluate whether chemicals used in Rooms 113C and 114A had penetrated through the concrete slab into the underlying soils. Samples were analyzed for chromium, nickel, lead, iron, fluoride, nitrate, sulfate, chloride, and pH. In addition, a gas chromatograph (GC) scan for organics (using USEPA Test Methods 8010, 8015, and 8020) was performed on these soil samples. The soil sample locations are shown on Figure 3.11 and sample results are summarized in Table 3.10. According to the soil investigation report, sampling results suggest that there has not been seepage through the concrete floor and into the underlying soils (HLA 1987b).
- Soil Beneath Building 026, including the Chemical Storage Room. An investigation of soil conditions beneath Building 026 was conducted in July 1987 (HLA 1988d). The investigation was performed in Rooms 103, 104, 105, 106, 110, 112, 402, 403, 404, 405, and the Chemical Storage Room. These rooms were part of pilot-scale product development and were used for several purposes, including plating, soldering, etching, and chemical storage. This investigation, referred to as Boring Series 414-01, was conducted to evaluate whether chemicals used in the rooms had migrated through the concrete floor into the underlying soils.

Initially 19 soil borings (Borings 414-01-0001 through 414-01-0019) were drilled inside Building 026 and one boring (414-01-0020) was drilled outside at the southeastern corner of the building as a background location. Two soil samples were collected from most borings (directly beneath the slab and at a depth of two to four feet). The shallow sample from each boring was analyzed and the lower sample was held for possible analysis at a later date. The samples were analyzed for different chemicals, including TCE, Freon 113, TCA, NMP, chromium, copper, nickel, lead, arsenic, tin, fluoride, nitrate, sulfate, chloride, and pH. The

soil sample locations are shown on Figure 3.11 and sample results are summarized in Table 3.10.

TCE was detected at 0.014 mg/kg in Boring 414-01-0008 and at 0.050 mg/kg in Boring 414-01-0009. Both of these borings were located in the Chemical Storage Room. Therefore, the deeper sample from each of these two borings was analyzed for TCE, although the holding time for analysis had been exceeded. TCE was detected at 0.20 mg/kg in the deeper sample from Boring 414-01-0008 and was not detected (<0.010 mg/kg) in the deeper sample Boring 414-01-0009. Due to the elevated detections of TCE in the Chemical Storage Room, six additional borings (414-01-0021 through 414-01-0026) were advanced in the Chemical Storage Room and loading dock area in September and October 1987. Soil samples were collected and analyzed for TCE and pH. TCE was detected in four of the samples up to 0.230 mg/kg. HLA recommended excavation of TCE-containing soils (above 0.5 mg/kg) within the Chemical Storage Room.

HLA estimated that up to 23 cubic yards of soil should be removed from the trench backfill beneath the Chemical Storage Room on either side of the cast iron pipe that was formerly used to transfer wastewater to WV-02 (original) and WV-02 (second). ENVIRON was not provided with information that any soil had been remediated in the Chemical Storage Room.

As part of the SI/SP (Attachment VIII), ENVIRON recommended sampling for VOCs, total chromium, nickel, and other metals beneath the former Chemical Storage Room in the vicinity of the cast iron pipe. On October 17, 2006, ENVIRON conducted soil sampling in the area of the former cast iron pipe located below the former chemical storage room in Building 026. Samples were collected from a total of three boring locations along the former pipe location (identified as sample locations B026-B1, B026-B2, and B026-B3). Soil sample locations are shown on Figure 3.13. Samples were collected from each boring at five-foot intervals to a maximum depth of 20 feet bgs. Samples were submitted for analysis of VOCs by USEPA Method 8260B, CAM 17 metals by USEPA Method 6010B and 7470/7471, and hexavalent chromium by USEPA Method 7196.

Sampling results are summarized on Table 3.11. Low levels of TCE (0.0051 mg/kg and 0.0074 mg/kg) were detected in two samples collected from the top six inches of soil in borings B026-B1 and B026-B2. Hexavalent chromium was not detected above the reporting limit. Some metals were detected, but at concentrations below the residential soil RGs developed in the CMS Report for the Redevelopment Property.

- Sump in Photographic Laboratory – Room 808u. A soil investigation was conducted in April 1988 adjacent to a sump in Room 808u of Building 026, a photographic laboratory (HLA 1988b, 1988e). One soil boring was drilled adjacent to the sump and buried pipe to a depth of five feet below the concrete floor. Three soil samples were collected from the boring. Based on the detection of hydroquinone in the one of the soil samples, additional sampling was recommended.

A follow-up investigation was conducted in June 1989 to evaluate whether hydroquinone and other chemicals potentially contained in the sump fluid may have migrated into the soil

adjacent to the sump and floor drain line. Two soil borings (527-01-0001 and 527-01-0003) were drilled adjacent to the sump and drain line to depths of 4.0 feet and 6.5 feet below the concrete floor, respectively. Soil samples, which were collected approximately every foot in each boring, were analyzed for hydroquinone, TCA, TCE, PCE, and BTEX. These soil sample locations are shown on Figure 3.11 and sample results are summarized in Table 3.10. The results of the chemical analyses indicated that none of the chemicals of concern were present in the underlying soils. Based on these results, HLA recommended no further investigation (HLA 1990b).

- Staining near Drains in Kodak Processing Room 149. In December 1988, a soil investigation was conducted in Kodak Processing Room 149 in Building 026 (HLA 1989b). This investigation, referred to as Boring Series 500-01, was conducted to evaluate whether hydroquinone migrated through the concrete floor near the floor drains. Soil samples were collected at a depth of 1.1 feet below the floor in all three borings and analyzed for hydroquinone and pH. The soil sample locations are shown on Figure 3.11 and sample results are summarized in Table 3.10. Hydroquinone was not detected at a detection limit of 5 mg/kg; pH ranged from 7.1 to 7.2. Based on the investigation results, HLA concluded that no further investigation was necessary in this area (HLA 1989b).
- Sump in Photographic Laboratory – Room 305u. In March 1989, a soil investigation was conducted beneath and adjacent to a sump in Room 305u, a photographic laboratory in Building 026 (HLA 1989c). The investigation was conducted to evaluate whether chemicals, primarily hydroquinone, in the sump had migrated into surrounding soil. Borings 504-01-0001 and 504-01-0002 were drilled adjacent to the sump to depths of 3.3 and 2.8 feet below the concrete floor, respectively. Soil samples were collected at two depths from each boring. Boring 504-01-0003 was advanced through the bottom of the concrete sump to a depth of 4.5 feet below the concrete floor, and a soil sample was collected at a depth of 4.0 feet below the concrete floor. A gas chromatograph scan (using USEPA Test Methods 8010, 8015, and 8020) was conducted on all five soil samples. In addition, the samples were analyzed for hydroquinone and pH. The soil sample locations are shown on Figure 3.11 and sample results are summarized in Table 3.10. None of the parameters analyzed were detected, and the pH of the soil samples ranged from 6.6 to 7.1. Based on the investigation results, HLA concluded that no further action was necessary in this area (HLA 1989c).
- Cut Hydraulic Fluid Pipeline at Loading Dock. In November 1990, a direct-buried hydraulic fluid pipeline was cut during construction activities at the Building 026 loading dock, and hydraulic fluid was released to the soil (HLA 1991a). The area was subsequently excavated to an approximate depth of 2.7 feet below the loading dock surface and the pipeline was removed. A soil investigation, referred to as Boring Series 577-01, was conducted to evaluate whether hydraulic fluid remained in the soil below the bottom of the excavation. Soil samples from each boring were collected 0.5 foot below the bottom of the excavation and analyzed for TPH as diesel and total oil and grease (TOG). The soil sample locations are shown on Figure 3.11. TPH as diesel and TOG were not detected in any of the soil samples collected at a detection limit of 10 mg/kg. Based on these results, HLA concluded that no further investigations were necessary (HLA 1991a).

Building 026 Footprint Soil Gas Sampling

- Building 026 Footprint Soil Gas Sampling. On November 8 through 10, 2006, a soil gas investigation was conducted beneath the former footprint of Building 026. An approximately 25-foot grid was drawn surrounding former soil sampling locations at Building 026. One 75-foot by 150-foot grid (labeled A through D and 1 through 7, respectively) was created in the southwestern corner of former Building 026 in the vicinity of soil samples collected from the former chemical storage room, Room 400, WV-15, and WV-02 (second). Soil gas samples were collected from 28 locations at the nodes of the grid (B026-A1 through B026-D7). Samples were collected from each location at a depth of five feet bgs. The soil gas sample locations are shown on Figure 3.12.

The soil gas samples were collected in one-liter Summa™ canisters for analysis of VOCs using USEPA Method TO-14. The leak check compound (1,1-difluoroethane) was not detected at or above the DTSC recommended leak check compound reporting limit of 10 mg/m³ of vapor in these samples.

The results of the soil gas sampling are shown on Table 3.8. Compounds detected include Freon 11, Freon 12, Freon 113, bromomethane, carbon tetrachloride, chloroethane, chloroform, methyl chloride, methylene chloride, 1,1-DCA, 1,1-DCE, cis-1,2-DCE, TCA, TCE, PCE, BTEX compounds, 1,2,4-trimethylbenzene, and 1,3,5-trimethylbenzene.

Building 026 Groundwater Sampling

- Building 026 Grab Groundwater Sampling. At the request of the future developer of the Redevelopment Property, ENVIRON collected two grab groundwater samples (026-GW-A3 and 026-WV02-GW-01/17/07) from the former Building 026 vicinity in January 2007. Sample 026-GW-A3 was located west of Building 026 near former WV-02 (second) and near the November 2006 soil gas sample B026-A3. Sample 026-WV02-GW-01/17/07 was also located west of Building 026 near former WV-02 (original) and near the November 2006 soil gas samples WV-02-A through WV-02-D. The locations of the two grab groundwater samples are shown on Figure 3.15. The grab groundwater samples were submitted for analysis of VOCs by USEPA Method 8260B and hexavalent chromium by USEPA Method 7196A.

Sample results are summarized in Table 3.12. The only VOC detected in Sample 026-GW-A3 was Freon 113 at a concentration of 0.0067 milligrams per liter (mg/L). Hexavalent chromium was not detected in Sample 026-GW-A3. VOCs detected in Sample 026-WV02-GW-01/17/07 include Freon 113 (0.0052 mg/L), TCE (0.033 mg/L) and TCA (0.00093 mg/L). Hexavalent chromium was also detected in Sample 026-WV02-GW-01/17/07 at a concentration of 0.015 mg/L.

Orchards

Much of the Redevelopment Property is current or former orchards. Investigations of current and former orchards conducted on Parcel O-2 include the following:

- Current Orchard Areas. In October 2004, ENVIRON conducted soil sampling in current orchard areas on the Redevelopment Property for OCPs and metals. On Parcel O-2, ENVIRON collected discrete soil samples at a total of four locations (3-4 through 3-7) on approximately ½-acre centers in the orchard area on Parcel O-2. Samples were collected at depths of zero to six inches bgs and between two and three feet bgs. Sample locations are shown on Figure 3.13. Samples were analyzed for OCPs by USEPA Method 8081A and for metals by USEPA Methods 6010/7471.

Initially only the soil samples collected at zero to six inches bgs were analyzed. For this investigation (conducted prior to the development of the RGs in the CMS Report for the Redevelopment Property [ENVIRON 2006a]), the OCPs and metals soil sampling results were compared to the following screening criteria for residential soil: 1) RWQCB-SF ESLs; 2) OEHHA screening numbers, and 3) USEPA Region 9 PRGs. In addition, metals were also compared to literature background concentrations for California soils. If the shallow samples exceeded the criteria, then the deeper samples at these locations were analyzed.

Table 3.11 presents a summary of the results. Of the OCPs, only dieldrin, DDT and DDE were detected. No OCPs were detected above the screening criteria, and as a result, no deeper samples were analyzed. For the metals, arsenic, barium, chromium, cobalt, copper, lead, mercury, nickel, vanadium and zinc were detected. Arsenic concentrations on Parcel O-2 ranged from 3.7 to 11 mg/kg. Cobalt concentrations on Parcel O-2 ranged from 12 to 25 mg/kg. The maximum background concentration of arsenic in soil ranges from 11 mg/kg (Bradford 1996) to 69 mg/kg (Dragun and Chiasson 1991). The maximum background concentration of cobalt in soil ranges from 29 mg/kg (LBNL 2002) to 50 mg/kg (Dragun and Chiasson 1991). The results of the soil samples collected on Parcel O-2 and analyzed for arsenic and cobalt were within the range of typical background concentrations. Therefore, no additional sampling or analyses were performed related to the arsenic or cobalt detections.

- Former Orchard Areas. In accordance with the SI/SP (Attachment VI), 80 native soil samples were collected beneath roads and parking lots throughout the Redevelopment Property to investigate whether residual OCPs and/or arsenic were present in former orchard areas of the Site on October 10 through 17, 2005. Twenty three of the native soil sample locations (B01, B02, B04, B42 through B58, and B77 through B79) were located on Parcel O-2. The sample locations are depicted on Figure 3.13.

Samples of the native soil (zero to six inches) were collected by first coring through the asphalt and road base material and then collecting a sample of the native soil located immediately below using a macrocore sampler. The samples were sent for analysis of OCPs using USEPA Method 8081A and arsenic using USEPA Method 6010.

Sample results from the October 2005 sampling event on Parcel O-2 are summarized in Table 3.11. In one boring (B44), three OCPs were detected above the residential soil RGs defined in the CMS Report for the Redevelopment Property. The OCPs exceeding the RGs in B44 included dieldrin, DDT, and DDE. Arsenic concentrations were below the site-specific background concentration (a mean concentration of 8 milligrams per kilogram

[mg/kg)] with a maximum concentration of 12 mg/kg). As shown on Figure 3.13, location B44 was located adjacent to an orchard area in Parcel O-2. Based on these results, step-out sampling was recommended in the area of boring B44 (ENVIRON 2005c).

Step Out Soil Sampling Near Boring B44. Step-out sampling around boring B44 was conducted on December 12 through December 15, 2005. As part of this investigation, ENVIRON collected a deeper sample in the same location as B44 (approximately 2.5 to 3 feet below the native soil surface) and then moved out 25 and 50 feet to the north, east, south, and west of B44 and collected a shallow sample (from the top six inches of the native soil) and a deeper sample (approximately two to three feet below native soil surface) from each boring. The samples were sent for analysis of OCPs by USEPA Method 8081A and arsenic by USEPA Method 6010. Sampling locations are depicted in Figures 3.13 and 3.16. The locations are identified as B108 through B115.

Sample results from the December 2005 sampling event are summarized in Table 3.11. Concentrations of dieldrin were above the Remedial Goal (RG) developed in the CMS Report for the Redevelopment Property in the shallow sample of borings B109, B110, B112, and B113, and in the deeper sample of B109. Concentrations of aldrin were also above the RG developed in the CMS Report for the Redevelopment Property in the shallow samples of borings B112 and B113. Based on these results, additional step-out sampling was recommended beyond boring B44 to further define the boundary of the area exceeding the RGs developed in the CMS Report for the Redevelopment Property.

Additional Step Out Soil Sampling Near Boring B44. The second round of step-out sampling was conducted on April 25, 2006. Several borings were advanced in order to form a grid at 25-foot increments surrounding boring B44, as shown in Figures 3.13 and 3.16. Locations B108 through B115 were renamed according to their placement within the new grid system.

A shallow sample (the top six inches of native material located below the asphalt) and a deeper sample (approximately 2.5 to 3 feet below native soil surface) were collected from each boring. The shallow samples immediately adjacent to locations where OCPs had previously been detected above the RGs were submitted for analysis of OCPs using USEPA Method 8081A. The remaining samples were analyzed based on the following criteria:

- If OCPs were not detected or were present at levels below the RGs in the shallow sample, the deeper sample was not analyzed.
- If OCPs were detected in the shallow sample above the RGs, the deeper sample was analyzed. In addition, the shallow samples collected from the next adjacent boring were then analyzed for OCPs. The process was continued along the step-out grid until OCPs were not detected above the RGs or all applicable samples were analyzed.

Sampling results are summarized in Table 3.11. During this sampling event, only dieldrin was detected above the RG.

Based upon the sampling results from the three sampling rounds, ENVIRON recommended performing limited removal of the soil exhibiting concentrations of OCPs above the RGs identified during the soil investigation events. Soil removal was conducted in accordance with the guidelines outlined in the “Pesticide Investigation Results and Soil Removal Plan – Former Orchard Areas Beneath Roads/Parking Lots” (ENVIRON 2006b).

Soil Removal Action Implementation. Soil removal activities were implemented at the former orchard area between November 8 and November 27, 2006. Figure 3.16 shows the approximate extent of the soil excavation. The 25-foot sampling grid established during the April 2006 sampling event was used and extended for excavation purposes. In general, excavation in each grid was conducted in one-foot lifts. Excavation at node B2 was extended to a depth of three feet below the native soil surface during the first lift, as previous sampling had indicated OCPs were present at depths of 2.5-3 feet below native soil surface. After each lift, confirmation samples were collected from the grid nodes at the base of the excavation. Confirmation samples were also collected from the southern sidewalls of nodes C6 and D6 (EXC-C6-SWSOUTH, EXC-D6-SW, and EXC-D6-SWSOUTH) as the horizontal extent of OCP in soil in these directions had not been previously defined. All confirmation samples were analyzed for OCPs using USEPA Method 8081A.

Confirmation sampling results are summarized in Table 3.11. During the confirmation sampling and excavation procedures, dieldrin was the only chemical detected above its RG. Dieldrin was detected at node B4 during the first and second confirmation sampling events at concentrations of 0.062 mg/kg and 0.038 mg/kg, respectively, compared to its RG of 0.030 mg/kg. Dieldrin was also detected at 0.060 mg/kg in the sample collected from the southern sidewall of node C6.

Dieldrin results from all samples that were not excavated ranged from non-detect to 0.060 mg/kg. It should be noted that excavation did not extend to the east past node D6 due to use of this area as a truck haul route during on-site demolition activities. After excavation, a sidewall sample was collected in this location. As such, the original sample, D6 (at 0-0.5 feet bgs), was not flagged as an excavated sample.

3.2.5 Parcel O-3

The layout of Parcel O-3 prior to redevelopment activities is provided on Figure 3.17. Parcel O-3, which covers approximately 10 acres, formerly consisted of asphalt parking lots, sidewalks, a landscaped lawn, and orchard trees. In addition, modular trailers (Buildings 061A through 061F) used as office space were historically located on Parcel O-3. A description of relevant soil data on Parcel O-3 is provided below.

Buried Concrete Trench

An out-of-use buried concrete trench formerly ran in a north-south direction through Parcel O-3. The concrete trench formerly contained pipes that transferred wastewater (e.g., industrial wastewater and heavy metals wastewater) from waste vaults at the Site. Hitachi GST personnel

believed that the pipes had been removed, but the concrete trench was still in-place. No soil investigation involving the removal of these pipes was identified.

As part of the SI/SP (Attachment III), ENVIRON recommended that Hitachi GST confirm that the wastewater pipes have been removed from the trench. ENVIRON also recommended that an environmental engineer inspect the area surrounding the concrete trench once it has been removed.

- Buried Concrete Trench Soil Sampling. In accordance with the SI/SP (Attachment III), an environmental engineer from ENVIRON was present on-site during the removal of the buried concrete trenches to inspect the surrounding area for evidence of leaking (i.e. cracking, visual staining) and to collect soil samples. The buried concrete trench on Parcel O-3 was observed to be intact and no staining was observed in the surrounding soils.

Soil samples were collected from 11 locations along the concrete trench lines on Parcels O-2, O-3 and O-4 (TR-1 through 11). One sample, TR-6, was located on Parcel O-3. The location of this sample is shown on Figure 3.18. The sample was collected from native soil as close to the bottom of the trench as physically possible. TR-6 was collected at approximately four feet bgs. TR-6 was analyzed for CAM 17 metals by USEPA Method 6010B and 7470/7471, VOCs by USEPA Method 8260B, and pH by USEPA Method 9045.

Soil sampling results for TR-6 are summarized in Table 3.13. There were no VOCs detected above reporting limits. Some metals, including arsenic, barium, beryllium, chromium, cobalt, copper, lead, nickel, vanadium, and zinc were detected. All detections were below the residential soil RGs developed in the CMS Report for the Redevelopment Property. The pH result for TR-6 was 7.97, which is within the range of native soil conditions.

Orchards

Much of the Redevelopment Property is current or former orchards. Investigations of current and former orchards conducted on Parcel O-3 include the following:

- Current Orchard Areas. In October 2004, ENVIRON conducted soil sampling in current orchard areas on the Redevelopment Property for OCPs and metals. ENVIRON collected discrete soil samples at a total of five locations (3-1 through 3-3; 3-8 and 3-9) on approximately ½-acre centers in the orchard areas on Parcel O-3. Samples were collected at depths of zero to six inches bgs and between two and three feet bgs. Sample locations are depicted on Figure 3.18. Samples were analyzed for OCPs by USEPA Method 8081A and for metals by USEPA Methods 6010B and 7470/7471.

Initially only the soil samples collected at zero to six inches bgs were analyzed. For this investigation (conducted prior to the development of the RGs in the CMS Report for the Redevelopment Property [ENVIRON 2006a]), the OCPs and metals soil sampling results were compared to the following screening criteria for residential soil: 1) RWQCB-SF ESLs; 2) OEHHA screening numbers, and 3) USEPA Region 9 PRGs. In addition, metals were also compared to literature background concentrations for California soils. If the shallow samples exceeded the criteria, then the deeper samples at these locations were analyzed.

Table 3.13 presents a summary of the OCPs and metals results. Of the OCPs, DDD, DDE and DDT were detected. No OCPs were detected above the screening criteria. For the metals, arsenic, barium, beryllium, chromium, cobalt, copper, lead, mercury, molybdenum, nickel, vanadium and zinc were detected. Only arsenic and cobalt exceeded the screening criteria. Arsenic concentrations on Parcel O-3 ranged from 2.3 to 7.5 mg/kg. Cobalt concentrations on Parcel O-3 ranged from 10 to 27 mg/kg. The maximum background concentration of arsenic in California soil ranges from 11 mg/kg (Bradford 1996) to 69 mg/kg (Dragun and Chiasson 1991). The maximum background concentration of cobalt in California soil ranges from 29 mg/kg (LBNL 2002) to 50 mg/kg (Dragun and Chiasson 1991). The results of the soil samples collected on Parcel O-3 and analyzed for arsenic and cobalt were within the range of typical background concentrations. Therefore, no additional sampling or analyses was conducted.

Based on these results, no additional investigation appeared warranted in the orchard area within Parcel O-3. However, as part of a NOA soil sampling investigation conducted on the Redevelopment Property, it was determined that NOA-containing road base was present beneath the surface soil of the orchard where samples 3-8 and 3-9 were collected. It was later determined that this area had previously been a parking lot and that the asphalt had been removed prior to redevelopment as an orchard, however, the subsurface road base remained. As part of the NOA Management Plan, the soil/road base from this orchard was excavated to a depth of three feet bgs and disposed off-site at the Altamont Landfill in Livermore, California.

- **Former Orchard Areas.** In accordance with the SI/SP (Attachment VI), 80 native soil samples were collected on October 10 through 17, 2005, beneath roads and parking lots throughout the Redevelopment Property to investigate whether residual OCPs and/or arsenic were present in former orchard areas of the Site. Six of the native soil sample locations (B33 and B37 through B41) were located on Parcel O-3. The sample locations are depicted on Figure 3.18. Samples of the native soil (zero to six inches) were collected by first coring through the asphalt and road base material and then collecting a sample of the native soil located immediately below using a macrocore sampler. The samples were analyzed for OCPs using USEPA Method 8081A and arsenic using USEPA Method 6010.

Sample results are summarized in Table 3.13. The only OCP detected was DDE, which was detected in two of the six samples at concentrations of 0.032 and 0.120 mg/kg. Arsenic was detected in five of the six samples ranging from 6.3 to 8.3 mg/kg.

Parking Lot South of Building 026

- **Black Soil in Parking Lot.** During the demolition activities of the currently existing parking lot area south of Building 026, an area of black soil was observed beneath the asphalt and road base material. The black soil had a slight organic odor and appeared to be associated with the removal of an abandoned clay pipeline from beneath the parking lot. The soil was screened in the field using a photoionization detector (PID) and pH paper. PID readings

were not detected and pH screening of the soil indicated the soil pH was within the neutral range.

In accordance with the CMS Report for the Redevelopment Property, a sample (026S-Parking Lot) of the black material was collected using a hand-hammered ARTS-brand sampling device on October 12, 2006. The location of the sample is shown on Figure 3.18. The sample was submitted for analysis of VOCs by USEPA Method 8260B, semi-volatile organic compounds (SVOCs) by USEPA Method 8270, TPH as diesel and motor oil by USEPA Method 8015B, CAM 17 metals by USEPA Method 6010B and 7470/7471, and pH by USEPA Method 9045.

The sample results are summarized in Table 3.13. TPH as diesel was detected at a concentration of 68 mg/kg, and TPH as motor oil was detected at a concentration of 560 mg/kg. Acetone was the only VOC constituent detected at a concentration of 0.055 mg/kg. Diethyl phthalate was the only SVOC constituent detected at a concentration of 0.17 mg/kg. Some metals, including arsenic, barium, chromium, cobalt, copper lead, nickel, vanadium, and zinc, were detected, but at concentrations below the residential soil RGs developed in the CMS Report for the Redevelopment Property. The pH result was 7.12, which is within the range for naturally-occurring soils.

3.2.6 Parcel O-4

The layout of Parcel O-4 prior to redevelopment activities is provided on Figure 3.19. Parcel O-4, which covers approximately 33 acres, consisted primarily of asphalt parking lots, sidewalks, orchard trees, landscaped areas, landscaped lawns, Homestead Lake, Building 028 (Hitachi GST Laboratory Building), Building 028J (Landscaping Contractors' Storage), and Building 018 (Hitachi GST Executive Conference Rooms). An out-of-use cooling tower associated with Building 028 was also located on Parcel O-4. In addition 10 "bungalows" (Buildings 017 and 019, which were overnight individual guestrooms), an "executive bungalow" (Building 020), a swimming pool, and an 18-hole golf chipping green were formerly located on Parcel O-4 adjacent to Building 018. Hitachi GST personnel reported that the bungalows were demolished, the pool was filled-in, and the golf green was re-landscaped in approximately 1990. A description of the buildings on Parcel O-4 with a discussion of relevant soil data is provided below.

Building 028

Building 028 was an approximately 150,000 square-foot, two-story building with a partial basement. IBM constructed Building 028 in 1971 as a research building. Starting in approximately 1985, the research division was moved to IBM's 690-acre Almaden Research Center located at 650 Harry Road in San Jose. In approximately 1992, Building 028 was converted into a laboratory building, including materials laboratories. Chemical and chemical waste storage areas associated with research operations conducted in Building 028 from 1971 through the late 1980s were located in Building 028J (discussed under Building 028J below). Building 028 was demolished as part of redevelopment activities between January and April 2007.

Hitachi GST formerly housed its materials laboratories in Building 028. In addition, Building 028 had an out-of-use cafeteria. Building 028 chemical storage primarily consisted of typical laboratory chemicals, including various flammable/combustible liquids (i.e., solvents) stored in one-gallon containers or smaller. In addition, a number of compressed gases were stored on-site for use in the Building 028 laboratories, including compressed air, liquid nitrogen, argon, helium, carbon dioxide, methane, krypton, and sulfur hexafluoride. In addition, ENVIRON observed a five-gallon bucket of oil and a drum of corrosion inhibitor in the mechanical room in the 'C' basement of Building 028. Five radioactive sources, which were used periodically for instrument calibration and quality control within the laboratories, were present within Building 028. The radioactive sources were registered with the DHS and were tested annually to evaluate the integrity of the sources.

- Diesel Fuel AST (FT-19). Building 028 had a diesel-powered emergency generator with associated 2,000-gallon diesel fuel AST (FT-19). The emergency generator and AST were located near the northwestern corner of Building 028. FT-19 was located within a below-grade epoxy-coated concrete vault, with sufficient secondary containment to contain the contents of the tank. The concrete vault was equipped with a roof to prevent collection of precipitation. As part of the SI/SP (Attachment II), ENVIRON recommended that an environmental engineer inspect the area surrounding the AST (FT-19) and associated piping adjacent to Building 028 once they have been removed.

FT-19 was removed under permit by the City of San Jose on November 16, 2006. No staining or cracks were present on the epoxy-coated concrete vault surface beneath FT-19, with the exception of minor surficial staining, when the AST was removed. No indications of leaking were present (visual staining, odors) in soils in the immediate vicinity of FT-19 or its associated piping when the concrete slab was removed and inspected on December 5, 2006.

- Former Diesel Fuel UST. ENVIRON was not provided with documentation indicating a former UST associated with Building 028, however Hitachi GST personnel indicated that a former diesel fuel UST associated with Building 028 was removed and closed between approximately 1993 and 1995. ENVIRON is not aware of the former location of this UST or any soil investigations related to this former UST. Because the location of the UST is unknown, collecting confirmatory soil samples is not possible. Therefore, as part of the SI/SP (Attachment V), ENVIRON recommended that if any indications of a historic release (visual staining, odor) are identified during redevelopment/grading activities, soil sampling should be conducted.

An environmental engineer from ENVIRON was on-site during demolition of Building 028 and redevelopment/grading activities in the vicinity of the building. During demolition activities in January 2007, a suspected former UST location was discovered in the northern area of Building 028. The location of the suspected former UST is shown on Figures 3.20 and 3.21.

In accordance with the CMS Report for the Redevelopment Property, visibly colored and odorous (diesel-impacted) soil identified by an environmental engineer from ENVIRON was excavated. On January 5, 2007, approximately 200 to 300 cubic yards of visually-impacted

soil were excavated from the location of the suspect former UST. The final excavation depth was approximately three feet at the eastern side and sloped up towards the ground surface towards the west. The extent of the excavation measured approximately 29 feet on the east, 24 feet on the west, and 69 feet on both the north and south sides.

On January 5, 2007, confirmation samples were collected by ENVIRON from in-place soils at the limits of the excavation in accordance with Section 6.5 of the CMS Report for the Redevelopment Property. Confirmation sample locations are shown on Figures 3.20 and 3.21. Two bottom samples (028-D2-B and 028-G2-B), six discrete sidewall samples (028-A2-SW, 028-D1-SW, 028-D3-SW, 028-G1-SW, 028-G3-SW, 028-H2-SW), and two composite sidewall samples (028-SW1-COMPOSITE, and 028-SW3-COMPOSITE) were collected from the excavation pit. Samples were analyzed for TPH by USEPA Method 8015B, and for VOCs, SVOCs, and CAM 17 metals by USEPA Methods 8260B, 8270C, and 6010B and 7471A, respectively.

Confirmation soil sampling results are summarized in Table 3.14. No VOCs or SVOCs were detected in the confirmation samples. TPH as diesel was detected at concentrations ranging from 2.0 to 26 mg/kg. TPH as motor oil was detected in one discrete sidewall sample (028-H2-SW, 68 mg/kg). Various metals were detected in the confirmation samples including arsenic, barium, chromium, cobalt, copper, lead, mercury, nickel, vanadium, and zinc. No metals were detected above their residential soil RG developed in the CMS Report for the Redevelopment Property.

In addition, hydraulic fluid was stored in hydraulic elevators in Building 028. There were three hydraulic elevators in Building 028 referred to here as the freight elevator (Elevator No. 3), the passenger elevator in the lobby (Elevator No.1), and the passenger elevator at C side of building (Elevator No. 2). The oil reservoir capacity of each hydraulic elevator varied, but ranged from 30 to 75 gallons. All of the oil reservoirs were equipped with secondary containment. Hitachi GST personnel reported that the elevator contractor inspected the elevator pits monthly. Several soil investigations associated with hydraulic elevators in Building 028 were conducted in the past, as described below:

- Freight Elevator (Elevator No. 3). A soil investigation was conducted from June 1986 through December 1987 to evaluate the chemical content of soil beneath the hydraulic elevator shaft in Building 028 following discovery of a hydraulic fluid (Shell Tellus 32) leak (HLA 1986e). Twenty eight soil samples were collected from five borings and analyzed for oil and grease (O&G), which was detected up to 11,000 mg/kg. HLA concluded that soils containing O&G in concentrations above 1,000 mg/kg should be removed. Soil in the vicinity of these five borings was excavated (HLA 1988f). Because of structural integrity of the building, the elevator support, and the foundation footings, limits were placed on the extent of excavation. Residual O&G concentrations remaining after the excavation appear to be up to 250 mg/kg.

Additional soil sampling in this elevator shaft was conducted approximately one year later (October through December 1987) and analyzed for O&G, as well as benzene (HLA 1988f).

It appeared that residual petroleum in soil existed in this area. IBM personnel did not recall any additional excavation having been performed in this area.

As part of the SI/SP (Attachment IV), ENVIRON recommended conducting additional sampling and remediation, if necessary, beneath the freight elevator (Elevator No. 3) in Building 028 after the building's demolition.

Soil Sampling and Excavation. Once the elevator pit slab was removed, ENVIRON inspected the soil immediately beneath the slab. No staining or odors were observed in the soil. In accordance with Attachment IV of the SI/SP, soil was sampled beneath the former Freight Elevator on January 17, 2007. Three borings (028-EL3-B1, 028-EL3-B2, and 028-EL3-B3) were advanced beneath the Freight Elevator pit to a depth of 10 feet below the pit floor (32 feet bgs). The soil sample locations are shown on Figures 3.20 and 3.22. Soil samples were collected from each boring at depths of zero feet, four feet and eight feet below the pit floor (due to the depth of the pit, these soil samples would correspond to depths of approximately 22, 26, and 30 feet bgs, respectively). Saturated soils were encountered at approximately 10 feet beneath the pit (32 feet bgs). Samples were submitted for analysis of TPH as diesel and motor oil by USEPA Method 8015B.

Table 3.14 summarizes the soil sampling results. TPH as diesel was detected in seven of the nine soil samples ranging from 1.0 to 250 mg/kg. TPH as motor oil was detected in four of the nine soil samples ranging from 83 to 760 mg/kg. In accordance with Attachment IV of the SI/SP, all samples with positive detections for TPH were analyzed for polyaromatic hydrocarbons (PAHs) by USEPA Method 8270. In addition, sample 028-EL3-B1-1 (the sample with the highest detected TPH concentration) was submitted for polychlorinated biphenyls (PCB) analysis by USEPA Method 8082. Table 3.14 summarizes the soil sampling results. PCBs were not detected in the 028-EL3-B1-1 sample. PAHs were detected in the shallow soil of the Freight Elevator pit (samples collected at zero feet beneath the pit or 22 feet bgs), but were not detected in any of the deeper samples.

In order to facilitate the backfilling of the Freight Elevator pit, the soil containing PAHs was excavated on January 31, 2007 in the vicinity of soil boring 028-EL3-B1. The excavation extended from the west wall of the elevator pit to borings 028-EL3-B2 and 028-EL3-B3 to the east and to the north and south walls of the elevator pit. The excavation was approximately four feet deep as the previous sample results had shown that PAHs were not detected at this depth. Soil removed from the excavation was stockpiled on visqueen and sampled for eventual off-site disposal.

Confirmation sidewall samples were collected from the north, west, and south sidewalls of the excavation (028-EL3-SW NORTH, 028-EL3-SW WEST, and 028-EL3-SW SOUTH) and analyzed for PAHs by USEPA Method 8270 and TPH as diesel and motor oil by USEPA Method 8015B. The approximate excavation extent and confirmation soil sample locations are shown on Figure 3.22. The soil sample results are summarized in Table 3.14. TPH and PAHs were not detected in two of the samples. The third sample (028-EL3-SW SOUTH) had low detections of TPH as diesel and a few PAHs.

Groundwater Sampling. To assess impacts from the hydraulic piston on groundwater in the vicinity of the caisson, two grab groundwater samples were collected from beneath the Freight Elevator pit on January 25, 2007. Samples were labeled GW-028-EL3-A and GW-028-EL3-B and were collected in the vicinity of soil borings 028-EL3-B1 and 028-EL3-B3, respectively. The locations of these samples are shown on Figures 3.22 and 3.23. Grab groundwater samples were submitted for analysis of TPH by USEPA Method 8015B, PAHs by USEPA Method 8270, and VOCs by USEPA Method 8260.

Groundwater sampling results are summarized in Table 3.15. Sample results indicated that both TPH as diesel (at concentrations of 2.3 mg/L and 0.3 mg/L) and TPH as motor oil (at concentrations of 3.5 mg/L and 0.52 mg/L) are present in the groundwater in the immediate vicinity of the elevator caisson. PAHs and VOCs were not detected in groundwater. ENVIRON recommended additional groundwater sampling in order to characterize TPH in groundwater in the vicinity of the former Freight Elevator.

Following excavation of soil containing PAHs and backfilling of the Freight Elevator pit (and Building 028 basement), six additional grab groundwater samples were collected in the vicinity of the former Freight Elevator on March 1 and 2, 2007. Samples were collected from five locations to the north, west and south of the former groundwater sample location GW-028-EL3-A on an approximately 50-foot radius. One sample was also collected approximately 100 feet northwest of GW-028-EL3-A. The sample locations were labeled GW-028-EL3-C through -H and are shown on Figures 3.22 and 3.23. Grab groundwater samples were submitted for analysis of TPH by USEPA Method 8015B.

Groundwater sampling results are summarized in Table 3.15. TPH as diesel was detected at levels ranging between 0.051 and 1.1 mg/L. The results indicate a decrease in the concentration of TPH in groundwater with distance from the former Freight Elevator.

- Passenger Elevator in Lobby (Elevator No. 1). In June 1989, HLA investigated the soil beneath the passenger elevator in Building 028 (HLA 1989d). The results of the chemical analyses indicated that O&G was present in the underlying soils up to 14,000 mg/kg to a depth of approximately six feet beneath the floor of the elevator. The chemical analysis revealed that the oily substance was not Shell Tellus 32, but likely a heavier mixture of oil and grease. Because O&G is not used as the hydraulic fluid in the elevator ram cylinder, the presence of O&G is most likely the result of a surface release prior to installation of the elevator pit floor. IBM excavated the soil beneath the elevator pit floor to a depth of approximately 10 feet (HLA 1989d). Subsequent to the excavation, HLA concluded that no further investigation was warranted.

As part of the SI/SP (Attachment IV), ENVIRON recommended that an environmental engineer inspect the area surrounding the elevator shaft and associated hydraulic fluid reservoir once they have been removed. On January 11, 2007, Ferma removed the hydraulic piston and the concrete slab of the passenger elevator in the lobby (Elevator No. 1) from the Building 028 basement. ENVIRON observed some hydraulic oil to remain in the piston after it was removed. Although ENVIRON did not observe any indications of leaking (visual staining, odor), one sample (028-EL1-S1) was collected from beneath the elevator

pit. The location of the sample is shown on Figure 3.20. The sample was submitted for analysis of TPH by USEPA Method 8015B. Sampling results are summarized on Table 3.14. TPH was not detected in the sample.

- Passenger Elevator on C Side (Elevator No. 2). In July 1989, HLA investigated the soil beneath the southeastern elevator in Building 028 (HLA 1989e). Three borings (Boring Series 528-01) were drilled to a maximum depth of 36 feet beneath the floor of the elevator pit, and soil samples were collected to evaluate whether the soil beneath the concrete elevator pit floor contained hydraulic oil (Shell Tellus 32). Samples were collected from each boring at approximately six-foot intervals. Sample locations are depicted on Figure 3.19. Ten soil samples were analyzed for Shell Tellus Oil 32, which was not detected (<50 mg/kg) in any of the samples (HLA 1989e). HLA concluded that no further investigation was warranted.

As part of the SI/SP (Attachment IV), ENVIRON recommended that an environmental engineer inspect the area surrounding the elevator shaft and associated hydraulic fluid reservoir once they have been removed. On January 26, 2007, the concrete slab of the passenger elevator at C side of Building 028 (Elevator No. 2) was removed. Elevator No. 2 had an aboveground piston that had been removed previously during the demolition of the building. ENVIRON observed the concrete slab to be intact. Following removal of the pit, ENVIRON inspected the soil beneath Elevator No. 2 and did not observe any staining or odors. The soil beneath the pit was also observed to be dry.

In addition to soil investigations concerning hydraulic elevators in Building 028, additional soil investigations were conducted concerning chemical use in Building 028, as described below.

- Investigation Beneath Building. A soil investigation was conducted in February 1984 beneath Building 028 (HLA 1988b). IBM is unaware of the exact reason for this investigation. Three soil samples were collected from one soil boring (112-01-0001) at depths of 0.0, 1.0, and 2.0 feet bgs. The sample location is shown on Figure 3.19. The soil samples were analyzed for Freon 113, TCA, PCE, methylene chloride, acetone, IPA, xylenes, and NMP. Sampling results are summarized in Table 3.16. Freon 113 was detected up to 0.004 mg/kg; methylene chloride was detected up to 0.058 mg/kg; and acetone was detected up to 0.005 mg/kg. All other chemicals (TCA, PCE, IPA, xylenes, and NMP) were not detected. No further action or excavation of soil is indicated as being conducted in this area.
- Former Industrial Wastewater Sump. Industrial wastewater from various laboratories was previously collected in a sump in the basement of Building 028. Wastes from the sump were pumped overhead to a pipeline leading to the on-site wastewater treatment plant (Building 110) on the Core Area. The sump does not appear to be a current or former RCRA-permitted unit. No reports are available documenting completion of soil investigation beneath the sump. The sump appears to have been abandoned in-place by filling with concrete.

In the SI/SP (Attachment VIII), ENVIRON recommended that once removed, an environmental engineer should inspect the area surrounding the sump in Building 028. If any indications of leaking are present (visual staining, odor), soil sampling should be conducted. Following the completion of demolition activities of Building 028, an environmental engineer from ENVIRON inspected the soils beneath the slab, including beneath the portion of the building where the Building 028 sump was believed to be located. There were no indications of a historic release (visual staining, odor) identified in the soil in the vicinity of the former Building 028 sump location.

A cooling tower associated with Building 028 was operated from 1971 until it was abandoned in approximately 1994. Between 1994 and 2006, Building 028 ran off of the Site's main cooling tower located adjacent to Building 002 on the Core Area. Cooling tower blowdown was formerly collected in WV-04, as described below.

- Former Waste Vault 04. WV-04, which was located adjacent to the Building 028 cooling tower, was an approximately 1,200-gallon concrete sump with a polyvinyl chloride (PVC) liner (referred to as tank T-1). The blowdown was transferred via a series of underground pipes within underground concrete trenches to Building 110 on the Core Area. In 1994, WV-04 – tank T-1 was closed under a permit (No. C48874) issued by the City of San Jose Hazardous Materials Program (Antrim 1995). Closure activities included decontaminating the sump, conducting confirmatory surface wipe sampling for certain metals, backfilling with compacted soil, and installing a concrete cap.

Former WV-04 Soil Sampling. In addition, underground piping in the concrete trench system located between WV-04 and the east side of Building 028 was excavated and removed in 1994 (Antrim 1995). The buried trench system included pipes containing industrial wastewater, heavy metal wastewater, and brine wastewater. DTSC was notified of the closure of the piping in a letter from IBM dated October 14, 1994. As part of closure activities, soil samples were collected and analyzed for metals, including antimony, barium, beryllium, chromium, cobalt, copper, lead, nickel, vanadium, and zinc, from beneath WV-04 and at four locations beneath the concrete trench (Boring Series ANT-TR). The soil sample from beneath WV-04 was collected from one foot below the top of native soil. The four soil samples from beneath the trench were collected from 1.5 feet below the trench. Soil samples ANT-TR-1 through ANT-TR-4 are shown on Figure 3.19 and results are summarized in Table 3.16. According to the sampling report, results indicated concentrations of metals below California's TTLC. Accordingly, it was concluded that soils beneath WV-04 and the trench were not impacted by metals and no additional excavation was required.

As part of the SI/SP (Attachment III), ENVIRON recommended that an environmental engineer should inspect the Building 028 Cooling Tower area, including former WV-04 and associated pipeline areas during removal activities. If any indications of leaking are present (cracking, visual staining), soil sampling should be conducted. An environmental engineer from ENVIRON was on-site during removal of WV-04 on November 1, 2006 to inspect the surrounding areas for evidence of contamination. There was no evidence of leaking observed (cracking, visual staining). Following removal of the vault, one soil sample was

collected from native soil as close to the bottom of the former WV-04 as physically possible (WV-04-1, between four and five feet bgs). The soil sample location is shown on Figure 3.20. The sample was analyzed for hexavalent chromium by USEPA Method 7196, in addition to CAM 17 metals by USEPA Method 6010B and 7470/7471, VOCs by USEPA Method 8260B, and pH by USEPA Method 9045.

The results of soil sampling beneath WV-04 are summarized in Table 3.14. There were no VOCs detected above reporting limits, and hexavalent chromium was not detected above the reporting limit. Some metals, including arsenic, barium, chromium, cobalt, copper, lead, mercury, nickel, vanadium, and zinc, were detected, but at levels below the residential soil RGs developed in the CMS Report for the Redevelopment Property. The pH result was 8.47, within the range of native soil conditions.

Building 028J (Historical)

Building 028J, which was an approximately 2,000-square foot building, was located adjacent to the west of Building 028. Building 028J was constructed in 1971 as the chemical and chemical waste storage area for Building 028. According to Hitachi GST personnel, primarily drums of solvents and cylinders of compressed gases were stored in Building 028J from 1971 until approximately 1989. According to a map of Building 028J dated 1984, the building was divided into two main chemical storage areas: “solvent storage area” and “user organics”. During the Site visit, ENVIRON observed cracks within the concrete floor leading to drains in the former solvent storage area in Building 028J. At the time of the Site visit, the cracks and drains appeared to have been sealed. Subsequent to 1989, Building 028J was vacant for several years before it was used as a staging area for the Site’s landscaping contractor. Building 028 was used by Rizzo Landscaping, Hitachi GST’s landscaping contractor, for storage and maintenance of lawn care equipment and related chemicals. Drums of motor oil, bags of fertilizer, bags of potting soil, cans of gasoline, and smaller quantities of lubricants were stored in Building 028J. The drums of motor oil were staged on drip pans to collect small drips during transfer operations. As part of redevelopment activities, Building 028J was demolished in September 2006.

According to documents reviewed, an underground spill containment tank without secondary containment was formerly located east of Building 028J. This buried tank was removed in early 1982. In addition, an underground 300-gallon solvent spill storage tank was formerly located within the northern side of Building 028J. This buried tank was removed in August 1986 as part of routine upgrading of facilities. In addition, one former waste vault, WV-03, is associated with Building 028J.

A number of soil investigations associated with Building 028J were conducted in the past, as described below.

- Spill Containment Tank Removal. In early-1982, an underground spill containment tank with no secondary containment located east of Building 028J was removed (K/J/C 1987). The tank, which was buried approximately 10 feet bgs, was less than four feet in diameter and slightly more than four feet long. In July 1982, an investigation was conducted to characterize the chemical content of soil and groundwater beneath the spill containment tank

(HLA 1982). Freon 113, TCA, TCE, PCE, chloroform, carbon tetrachloride, and acetone were detected in unsaturated soils and in groundwater. Based on information reviewed, no remedial actions appear to have been conducted.

- Solvent Tank Removal. A buried 300-gallon solvent spill storage tank was removed during routine upgrading of facilities from within the northern side of Building 028J on August 12, 1986 (HLA 1986f). When that UST was installed in approximately 1978, it was set in wet concrete, which formed a continuous saddle two to three inches thick at the base of the tank. The concrete saddle, which was approximately 3.5 feet bgs, was not removed as part of the tank excavation. The tank was intended to be used as a solvent spill storage tank, but the tank was never used. Two soil samples from two soil borings were collected from a depth of 4.5 feet bgs. The soil samples were analyzed for chromium, copper, nickel, and GC scans for chlorinated and nonchlorinated solvents. Results indicated TCE concentrations up to 0.010 mg/kg and metal concentrations within background ranges. The source of the TCE in the soil was unknown, but could be from the former nearby spill containment tank (discussed above). The report recommends investigating further the source of TCE in soils. The excavation was backfilled with clean, imported sand.
- Chemical Storage Room and WV-03. In September 1986, an investigation was conducted to determine whether the Chemical Storage Room in Building 028J or WV-03 (discussed below) were possible sources for the TCE found in the soils during previous investigations (HLA 1986g). Three soil borings were drilled to 10 feet bgs and one soil boring was drilled to 30 feet bgs beneath the Chemical Storage Room and WV-03. Eighteen soil samples from the four borings were collected and analyzed for Freon 113, TCA, TCE, methylene chloride, isophorone, and acetone. TCE was detected in samples from all four borings up to 0.033 mg/kg, and TCA was detected in samples from two of the borings up to 0.009 mg/kg. The remaining chemicals were not detected in any of the samples. According to the soil investigation report, the DHS had not established an action level for TCE in soils; however, the IBM internal guideline was 0.5 mg/kg (HLA 1986g). Based on this internal guideline, HLA concluded that no further investigations concerning TCE in soils at Building 028J were necessary.
- WV-03⁷ and Associated Pipeline Removal. Industrial wastewater from Building 028 was formerly collected in WV-03, which was located on the southeastern side of Building 028J. The industrial wastewater was pumped from a series of underground pipes in concrete trenches to the on-site wastewater treatment plant (Building 110) on the Core Area. WV-03 and associated pipes were removed in 1989 (HLA 1989f).

On April 25, 1989, four soil borings were advanced in a trench excavation located on the eastern side of WV-03. The borings in the trench excavation were advanced to a depth of approximately one foot below the trench bottom (five to seven feet bgs). On May 17, 1989, three borings were advanced through core holes in the bottom of the vault. The three borings were advanced to depths ranging from 3.5 to 3.7 feet below the vault floor.

⁷ A waste vault associated with Building 003 (RO/DI water production plant) on the Core Area, which was constructed in 1998, is named WV-03. This is a different waste vault than former WV-03 associated with Building 028J.

Additional soil samples were collected from the pipeline trench excavation to the west and north of Building 028.

Soil samples were analyzed for certain metals (total chromium, hexavalent chromium, copper, iron, nickel, and zinc). Hexavalent chromium was not detected. Total chromium was detected up to 94 mg/kg; copper was detected up to 63 mg/kg; iron was detected up to 68,000 mg/kg; nickel was detected up to 180 mg/kg; and zinc was detected up to 170 mg/kg. Metal concentrations in all samples were below the TTLC level. In addition, one sample was analyzed for organics using USEPA Test Methods 8010, 8015, and 8020; no organic chemicals were detected. HLA concluded that no further action was necessary (HLA 1989f). The majority of the excavated soil from the pipeline removal was subsequently backfilled into the excavation.

WV-03 Soil Sampling. As part of the SI/SP (Attachment III), ENVIRON recommended sampling for TCE and its breakdown products beneath the former Chemical Storage Room and former WV-03, after demolition of Building 028J. Although an approximate location of WV-03 was known, no evidence of the WV-03 location was visible prior to demolition activities. To observe for subsurface evidence of the waste vault, an environmental engineer from ENVIRON was on-site during the demolition of Building 028J and the subsequent utility removal surrounding the building. During the Building 028J demolition, an area of buried sand was observed in the vicinity of the assumed WV-03 location. It appeared this sand may have been used as backfill after the waste vault was removed in 1989. Neither the sand nor the native soil around the sand appeared stained or contained an odor.

In accordance with the SI/SP (Attachment III), on December 8, 2006, two soil borings were advanced in the vicinity of the WV-03 location. Samples were collected from each boring (WV-03-1 and WV-03-2) from the native soil present immediately beneath the buried sand (a depth of approximately five feet bgs). Soil sample locations are shown on Figures 3.20 and 3.24. The samples were submitted for analysis of CAM 17 metals by USEPA Method 6010B and 7470/7471, VOCs by USEPA Method 8260B, and pH by USEPA Method 9045.

The results of soil sampling beneath the former WV-03 are summarized in Table 3.14. There were no VOCs detected above reporting limits. Some metals, including arsenic, barium, beryllium, chromium, cobalt, copper, lead, mercury, nickel, vanadium, and zinc, were detected but at levels below residential soil RGs developed in the CMS Report for the Redevelopment Property. Results for pH were 7.89 and 7.71, within the range of native soil conditions.

Building 028J (November 2005 – March 2007)

Elevated levels of chloroform were detected in soil gas in the vicinity of Building 028J in November 2005, and ENVIRON recommended performing additional sampling in the vicinity of Building 028J and along the buried concrete trench in this area to determine the extent of any impacts. Following demolition of Building 028J on September 1, 2006, ENVIRON conducted additional investigations in its vicinity in September 2006 and from December 2006 through March 2007. During the September 2006 sampling event, chloroform was detected in soil beneath the

building footprint above its residential soil RG developed in the CMS Report for the Redevelopment Property. In December 2006 through March 2007, ENVIRON conducted additional step-out soil, groundwater, and soil gas sampling to further characterize the extent of chloroform contamination. Soil sample locations are shown on Figures 3.20 and 3.24. Groundwater sample locations are shown on Figures 3.23 and 3.25. Soil gas sample locations are shown on Figures 3.26 and 3.27. These investigations are discussed below.

Based on site-specific soil properties collected during implementation of the SI/SP and CMS Report for the Redevelopment Property, the RBTCs for volatile constituents have changed. See Chapter 4.0 for a discussion of this change. The revised residential soil RBTC for chloroform is 0.00874 mg/kg. The revised residential groundwater RBTC for chloroform is 0.380 mg/L. The residential soil gas RBTC for a depth of five feet bgs remains the same (1.09 mg/m³); the updated residential soil gas RBTCs for 10 and 15 feet bgs are 1.86 mg/m³ and 8.93 mg/m³, respectively.

- Buried Concrete Trench and Building 028J Soil Gas Sampling. On November 16 through 18, 2005, soil gas samples were collected from 20 locations on Parcels O-2 and O-4 along the buried concrete trenches and around Building 028J. Ten of the locations along the buried concrete trench (SG-TR-9 through SG-TR-18) plus two locations around Building 028J (SG-028J-1 and SG-029J-2) were located on Parcel O-4. Soil gas sampling locations are shown on Figure 3.26. The soil gas samples were collected from depths of five and 10 feet bgs at each location using a Geoprobe™-type direct push drilling rig. The soil gas samples were analyzed on-site using a mobile laboratory for VOCs and TVH via USEPA Method 8260B. Ten percent of the samples were collected as duplicate samples in Summa™ canisters and sent to a fixed laboratory for analysis using USEPA Method TO-14.

The leak check compound (1,1-difluoroethane) was not detected in any of the samples analyzed by the mobile laboratory at or above the DTSC recommended leak check compound reporting limit of 10 mg/m³ of vapor. The duplicate five foot sample collected at SG-028J-2 that was analyzed by the fixed laboratory indicated that 1,1-difluoroethane was detected at a concentration of 370 mg/m³. The discrepancy is likely due to the larger sample volume collected for analysis by the fixed laboratory (1 L Summa™ canister) versus the small grab sample collected for analysis by the mobile laboratory.

The results of the soil gas sampling are summarized in Tables 3.17 and 3.18 for the five-foot and 10-foot bgs samples, respectively. Detected constituents included Freon 113, Freon 11, TCE, TCA, 1,1-DCA, 1,1-DCE, chloroform, methylene chloride, carbon tetrachloride, benzene, toluene, ethylbenzene, m,p-xylene, o-xylene, and TVH. The only chemical that exceeded its residential soil gas RBTC was chloroform in both the five-foot and 10-foot samples collected from SG-TR-11 and SG-TR-12 near Building 028J. Chloroform was detected in other samples collected near Building 028J (specifically sample locations SG-TR-10, SG-TR-13, and SG-028J-2), but at levels below the residential soil gas RBTC.

Because of the elevated levels of chloroform detected near Building 028J, ENVIRON recommended performing additional soil and soil gas sampling in the vicinity of Building 028J and along the buried concrete trench in this area to determine the extent of any impacts.

Due to the numerous utilities that surround Building 028J, this sampling was postponed until after building demolition and was conducted in September 2006.

- September 2006 Soil Investigation. In September 2006, ENVIRON collected soil samples at varying depths between zero and 20 feet bgs from eight locations (28J-1 through 28J-8) within the former Building 028J footprint and immediate vicinity. Sample locations are shown on Figures 3.20 and 3.24. Samples were analyzed for VOCs by USEPA Method 8260B, CAM 17 metals by USEPA Method 6010B and 7470/7471, and pH by USEPA Method 9045. The analytical results are summarized in Table 3.14. The soil sampling results showed that chloroform was present at several locations above the residential soil RBTC (0.00874 mg/kg) at depths of 20 feet bgs. In one boring (28J-4) chloroform was detected above the residential soil RBTC at shallower depths (11 to 16 feet bgs). Some metals were detected, but at levels below the residential soil RGs developed in the CMS Report for the Redevelopment Property, and pH levels were in the range of native soil conditions.
- December 2006 Soil Investigation. In December 2006, ENVIRON advanced several additional borings in the vicinity of former boring 28J-4. As shown in Figures 3.20 and 3.24, the December sampling locations included four locations directly adjacent to 28J-4 (identified as borings 28J-A, 28J-B, 28J-D, and 28J-E), and six additional samples to the north, east, and south of 28J-4 in the vicinity of the buried concrete trench (borings 28J-C and 28J-F through 28J-J). Borings were advanced to 20 feet bgs and samples were generally collected every five feet. The soil samples were collected using the EnCore® sampling system and submitted for analysis of VOCs by USEPA Method 8260B. The analytical results are summarized in Table 3.14. Chloroform and 1,1,2-TCA were the only VOCs detected. With the exception of location 28J-I, all of the soil samples collected at 20 feet bgs during the December 2006 event exhibited concentrations of chloroform above the residential soil RBTC (0.00874 mg/kg). Further, with the exception of location 28J-I and 28J-J, all of the soil samples collected at 15 feet bgs during the December 2006 event exhibited concentrations of chloroform above the residential soil RBTC. Chloroform was also detected above the residential soil RBTC at a shallower depth (five feet bgs) in one boring (28J-C). 1,1,2-TCA was only detected in one sample, 28J-A, at a depth of five feet bgs at a concentration of 0.0044 mg/kg.
- January 2007 Soil and Groundwater Investigation. In January 2007, ENVIRON advanced six additional soil borings (028J-K through 028J-P) to the northwest of the former Building 028J along the former buried concrete trench. In addition, ENVIRON collected grab groundwater samples from four locations (GW-028J-C, -F and -O and GW-SG-028J-1) outside the former Building 028J. The soil and groundwater samples were submitted for analysis of VOCs by USEPA Method 8260B. The soil and groundwater sample locations are shown on Figures 3.24 and 3.25, respectively. Soil borings were advanced to depths between 20 and 25 feet bgs, with soil samples generally collected every five feet. Four grab groundwater samples were collected in the vicinity of soil borings 028J-C, 028J-F, 028J-O, and SG-028J-1, from depths ranging between 27 and 33 feet bgs.

The soil and groundwater results are summarized in Tables 3.14 and 3.15, respectively. Chloroform was detected above the residential soil RBTC (0.00874 mg/kg) in two of the soil borings, 028J-L and 028J-M, at depths between 15 and 20 feet bgs. Chloroform was not detected in groundwater above the residential groundwater RBTC (0.380 mg/L), however, chloroform was detected above the groundwater cleanup standard for chloroform (0.080 mg/L) required by the current IBM RWQCB-SF Order No. R2-2002-0082 for the Site in two locations, GW-28J-C and GW-28J-F, at 0.170 and 0.320 mg/L, respectively.⁸

- February/March 2007 Groundwater Investigation. On February 28 and March 1, 2007, ENVIRON collected 10 additional grab groundwater samples (GW-028J-Q through GW-028J-Z) to the north, east, and south of the former Building 028J. Groundwater grab samples were collected from depths ranging between 24 and 30 feet bgs. The sample locations are shown on Figures 3.23 and 3.25. The groundwater samples were submitted for analysis of VOCs by USEPA Method 8260B.

The groundwater results are summarized in Table 3.15. Chloroform was detected in groundwater above the residential groundwater RBTC (0.380 mg/L) in one location, GW-028J-U at a concentration of 0.890 mg/L. In addition, chloroform was detected in groundwater above the groundwater cleanup standard for chloroform (0.080 mg/L) required in the current IBM RWQCB-SF Order No. R2-2002-0082 for the Site at two additional locations, GW-028J-V and GW-028J-W at concentrations of 0.170 and 0.170 mg/L, respectively.

- March 2007 Groundwater Investigation. On March 12 and 13, 2007, ENVIRON collected fourteen additional grab groundwater samples to the north and east of the former Building 028J. Sixteen grab groundwater locations were proposed (GW-028J-1 through GW-028J-16), but a sufficient volume of water could not be obtained from two sampling locations (GW-028J-11 and GW-028J-14). Groundwater grab samples were collected from depths ranging between 24 and 30 feet bgs. The groundwater sample locations are shown on Figures 3.23 and 3.25. The groundwater samples were submitted for analysis of VOCs by USEPA Method 8260B.

The groundwater results are summarized in Table 3.15. Chloroform was detected in groundwater above the residential groundwater RBTC (0.380 mg/L) in one location, GW-028J-8 at a concentration of 0.810 mg/L. In addition, chloroform was detected in groundwater above the groundwater cleanup standard for chloroform (0.080 mg/L) required in the current IBM RWQCB-SF Order No. R2-2002-0082 for the Site at three additional locations, GW-028J-9, GW-028J-10, and GW-028J-13 at concentrations of 0.160, 0.130, and 0.120 mg/L, respectively.

⁸ The cleanup standard for chloroform (0.080 mg/L) included in Table 3 (Groundwater Cleanup Standards) of IBM's RWQCB-SF Order No. R2-2002-0082 is referenced as the 2001 USEPA Maximum Contaminant Level (MCL). Chloroform does not have a specific MCL; rather, the MCL of 0.080 mg/L is for total trihalomethanes (TTHMs), which includes chloroform, along with bromodichloromethane, dibromochloromethane, and bromoform.

March 2007 Soil Gas Investigation. From March 12 through 15, 2007, soil gas samples were collected from 23 locations (SG-028-3 through SG-028J-25) on an approximately 50-foot grid in the vicinity of former Building 028J on Parcel O-4. Soil gas sampling locations are shown on Figures 3.26 and 3.27. Soil gas samples were collected at depths of five and 10 feet bgs at each location using a Geoprobe™-type direct push drilling rig. The soil gas samples were analyzed on-site using a mobile laboratory for VOCs via USEPA Method 8260B. A total of four duplicate samples were collected in Summa™ canisters and sent to a fixed laboratory for analysis of VOCs by USEPA Method TO-14.

The results of the soil gas sampling are summarized in Tables 3.17 and 3.18, for the five-foot and 10-foot bgs samples, respectively. The only chemical that exceeded its residential soil gas RBTC is chloroform in both the five foot and 10 foot samples collected from SG-028J-3, SG-028J-4, SG-028J-6, SG-028J-7, and SG-028J-17. Chloroform was detected in other samples collected near Building 028J, but at levels below the residential soil gas RBTC.

Based on the presence of chloroform in soil, soil gas, and groundwater in the vicinity of the former Building 028J at levels exceeding the residential RBTCs, remedial activities are currently underway. Proposed remedial actions for this area were discussed in the CMS Report for the Chloroform Release Area at Former Building 028J (ENVIRON 2007j).

Buried Concrete Trench

An out-of-use buried concrete trench system, which was connected to former WV-03 at Building 028J and former WV-04 at the Building 028 cooling tower, was located north, west, and east of Building 028. The concrete trench formerly contained pipes that transferred wastewater (e.g., industrial wastewater and heavy metals wastewater) from waste vaults at the Site. A few soil investigations involved the removal of some of the pipes from the buried concrete trench on Parcel O-4. Soil investigations conducted along the buried concrete trench in the vicinities of former WV-03 and WV-04 are discussed above. Additional previous soil investigations conducted along the buried concrete trench on Parcel O-4 are discussed below.

- Industrial Wastewater (IW) Leak from Pipe. In October 1987, during routine testing of an IW pipe located north of Building 028, a leak was discovered. The pipe was re-routed to a spare pipe and a follow-up investigation was conducted to determine the extent, if any, of impacted soil outside the concrete containment trench in the vicinity of the pipeline leak (IT 1987). Composite soil samples were collected and analyzed for certain metals (total chromium, hexavalent chromium, copper, iron, nickel, and zinc). Results indicated that all analyzed metals were below the Total Threshold Limit Concentration (TTLC) values and less than 10 times the Soluble Threshold Limit Concentration (STLC) values. Accordingly, IT concluded that hazardous levels of the metals analyzed were not detected outside the pipe's secondary containment.

In January 1988, IBM contracted HLA to obtain background concentrations of total chromium and hexavalent chromium in soil (HLA 1988g). One boring was drilled to a depth of 5.5 feet bgs. The location of the boring is shown on Figure 3.19. Two shallow

samples were collected (at 2.0 and 2.5 feet bgs) and composited (Boring 459-01-001A) and two deeper sample were collected (at 4.5 and 5.0 feet bgs) and composited (Boring 459-01-001B). Both samples were analyzed for total chromium and hexavalent chromium. Sample results are summarized on Table 3.16. Total chromium was detected at 230 mg/kg and 75 mg/kg, respectively. Hexavalent chromium was not detected (<1 mg/kg) in either sample.

In July 1988, IBM contracted HLA to investigate the same area as IT (HLA 1989g). HLA investigated the buried chemical containment trench located north of Building 028. HLA collected soil samples at locations immediately adjacent to and at approximately the same depth as samples collected by IT to compare the analytical results. In July 1988, three borings (Borings 459-01-003, -004, and -005) were drilled along the pipeline, as well as one background boring (Boring 459-01-002) located near the north entrance of Building 028. Soil boring locations are shown on Figure 3.19. For the three borings along the pipeline, soil samples were collected at 5.5 and 9.0 feet bgs and analyzed for the same metals (total chromium, hexavalent chromium, copper, iron, nickel, and zinc). Sample results are summarized on Table 3.16. Total chromium, copper, iron, nickel, and zinc concentrations were within the background concentration range expected in soils at the Site. Hexavalent chromium was not detected (<0.5 mg/kg) in any of the samples. The results of IT's and HLA's investigations were similar except for the concentrations of hexavalent chromium found by HLA were lower. HLA's investigation followed IT's by 10 months, and this time factor may have resulted in the reduction in hexavalent chromium concentrations. HLA concluded that no further action was necessary in this area.

- Removal of IW Pipelines. In April 1989, chemical pipelines located north and west of Building 028 were excavated and removed. HLA collected and analyzed soil samples along the excavated trench to evaluate whether chemicals contained in the pipeline migrated into the surrounding soil (HLA 1989f). The east-west section of the excavation ranged in depth from 4 to 5.5 feet. The north-south section of the excavation ranged from 0.5 to 2.5 feet. The soil removed during excavation was placed on plastic tarps on the lawn. After the pipeline was removed and the soil samples collected, the excavated soil was placed back in the excavation.

Nineteen soil borings (Boring Series 498-01) were advanced in the pipeline trench excavation on April 5 and 13, 1989, as shown on Figure 3.19. Soil samples were collected from each boring and analyzed for certain metals (total chromium, hexavalent chromium, copper, iron, nickel, and zinc). A composite sample from the excavated soil was also collected and analyzed. Sampling results are shown on Table 3.16. Hexavalent chromium was detected (up to 1.8 mg/kg) and nickel was detected above the TTLC (2,000 mg/kg) in two borings (498-01-0014 and 498-01-0015) near the southern end of the excavation.

On April 18, 1989, an additional six borings (Borings 498-01-0020 through 498-01-0025) were advanced in this area to further characterize the extent of chemicals in soil. A sample from one of these borings (498-01-0021) contained nickel above the TTLC. Metals concentrations for all other soil samples were below TTLC levels. IBM further excavated the pipe backfill and native soils located along the north-south section of the trench west of Building 028 to a depth of two feet bgs. The soil was placed in six 55-gallon drums for

proper off-site disposal. HLA and IBM agreed that no additional remediation was necessary (HLA 1989f).

- Buried Concrete Trench Soil Sampling. An environmental engineer from ENVIRON was present on-site during the removal of the buried concrete trenches to inspect the surrounding area for evidence of leaking (i.e. cracking, visual staining) and to collect soil samples. An approximately 400 foot section of the trench located north and west of the former Building 028 and an approximately 10 foot section of the trench located southeast of the former Building 028J near former WV-03 were not found during trench removal activities (see Figure 3.20). These sections of the buried concrete trench were removed in the past, as discussed above. In general, the buried concrete trenches were observed to be intact and no staining was observed in the surrounding soils. However, during removal of a section of the industrial waste lines running parallel to the north of Building 028, ENVIRON observed pink staining along the bottom of a section of corrugated steel pipe that encased the industrial waste lines. The pipe was found buried in a sand trench and appeared to have formerly led to a manhole on the north side of Building 028. The pipe extended approximately 60 feet to the west of the manhole and was plugged on both ends with concrete. The pipe was removed on November 16, 2006 and several potholes were dug further to the west of the pipe to try to locate the pipe again. Although the pipe was not relocated, the same sand backfill used to bury pipes was encountered in the potholes, indicating that the corrugated pipe may have been removed at some time in the past.

No liquid was observed in the remaining section of pipe and no staining was observed in the surrounding soils. PID readings of the soil surrounding the pipe were non-detect. ENVIRON collected two additional soil samples (TR-10 and TR-11) from the bottom of the pipe excavation. The analytical results are discussed below.

Soil samples were collected from 11 locations along the concrete trench lines on Parcels O-2, O-3, and O-4. Five of the soil samples (TR-7 through TR-11) were collected on Parcel O-4 and are shown on Figure 3.20. Samples were collected from native soil as close to the bottom of the trenches/pipes as physically possible (between approximately three and six feet bgs). The samples were submitted for analysis of CAM 17 metals by USEPA Method 6010B and 7470/7471, VOCs by USEPA Method 8260B, and pH by USEPA Method 9045.

Soil sampling results from former concrete trench areas on Parcel O-4 are summarized in Table 3.14. No VOCs were detected above reporting limits. Some metals were detected, but at concentrations below the residential soil RGs developed in the CMS Report for the Redevelopment Property.⁹ Results for pH were within the range of native soil conditions, except in two locations (TR-7 and TR-8), which showed a pH of 9.18 and 10.20, respectively. This could be caused by the concrete from the trench or indicate a localized release of caustic material from the buried concrete trench piping in these areas.

⁹ Silver was detected in one sample. Because an RG was not developed for silver in the CMS, the detected concentration of silver was compared to the residential soil RBTC developed in the CCR. The detected silver concentration was below the residential soil RBTC for silver.

Building 018

Building 018, which was also referred to as the “Homestead,” was an approximately 12,000-square foot, single story building. Building 018, which was constructed in 1957, contained executive conference rooms, a lobby area, and a small cafeteria. Building 018 was demolished in March 2007 as part of redevelopment activities. Homestead Lake, an on-site man-made surface water body surrounded by a landscaped lawn, was located between Buildings 018 and 028/028J.

Hitachi GST personnel indicated that a small mobile diesel-powered emergency generator was available for use at Building 018 in case of a power outage. There was not a current emergency generator or associated diesel fuel AST associated with Building 018. In addition, Hitachi GST personnel did not indicate a former diesel fuel UST associated with Building 018. Hitachi GST personnel did indicate that a former UST containing gasoline for refueling vehicles was located near a garage to the north of Building 018. The former UST was located on Parcel O-5 and is discussed in Section 3.2.7 below.

- **Pipe Backfill.** During utility removal surrounding Building 018, a fine-grained, black material was observed around underground pipes on the west side of the building. Discussions with Hitachi GST facility personnel indicated this black material may have been a black spray foam that was used as insulation on water pipes. On January 22, 2007, a grab sample of the black pipe-backfill material was collected (B018-PIPEBACKFILL) and analyzed for TPH as diesel and motor oil by USEPA Method 8015B, CAM 17 metals by 6010B and 7470/7471, pH by USEPA Method 9045, SVOCs by USEPA Method 8270, and PCBs by USEPA Method 8080. TPH as diesel was detected in the sample at a concentration of 2,900 mg/kg, and TPH as motor oil was detected at a concentration of 6,900 mg/kg. Low levels of metals were also detected. The pH result was 7.93, close to neutral. SVOCs and PCBs were not detected above the laboratory reporting limits. Based upon the concentrations of TPH as motor oil, ENVIRON recommended excavation of the black pipe-backfill material for off-site disposal and collection of confirmation soil samples of the excavation sidewalls and bottom.

On April 16 through April 23, 2007, the black pipe-backfill material was excavated. Approximate extents of the excavation are shown on Figures 3.20 and 3.28. An environmental engineer from ENVIRON was on-site to observe the excavation activities. The excavation was deemed complete when visual evidence of the black pipe-backfill material no longer remained. Following the visual inspection, 19 confirmation samples (Sampling Series B018-EXCB and B018-EXCSW) of the excavation bottom and sidewalls were collected and submitted for analysis of TPH as diesel and motor oil by USEPA Method 8015B. Approximate sample locations are shown on Figure 3.28. Results of the confirmation samples are summarized on Table 3.14. Low levels of TPH as diesel and motor oil were detected in the confirmation samples.

- **Fuel Vault.** During utility removal surrounding Building 018, a manhole cover with the label “Fuel Vault” was discovered. Liquid was observed inside the vault. On April 9, 2007, a sample of this liquid was collected using a disposable polyethylene bailer and submitted for analysis of VOCs by USEPA Method 8260B and TPH as diesel and motor oil by

USEPA Method 8015B. The results of this sample indicated that TPH as diesel was present in the liquid at a concentration of 0.084 mg/L. Based upon the presence of TPH in the liquid, ENVIRON recommended the liquid be pumped out before the vault was removed and soils beneath the vault be inspected for evidence of a release (visual staining, odor) following the removal of the vault.

The liquid was pumped out on April 9, 2007. Following the removal of the liquid, the manhole and the concrete vault were removed. An environmental engineer from ENVIRON inspected the soils beneath the vault. No indications of a release (visual staining, odor) were observed in the soil beneath the B018 vault.

Orchards

Much of the Redevelopment Property is current or former orchards. Investigations of current and former orchards conducted on Parcel O-4 include the following:

- Current Orchard Areas. In October 2004, ENVIRON conducted soil sampling in current orchard areas on the Redevelopment Property for OCPs and metals. ENVIRON collected discrete soil samples at a total of five locations (5-32 through 5-35 and 5-39) on approximately ½-acre centers in the orchard area on Parcel O-4. Samples were collected at depths of zero to six inches bgs and between two and three feet bgs, as shown on Figure 3.20. Samples were analyzed for OCPs by USEPA Method 8081A and for metals by USEPA Methods 6010/7471.

Initially only the soil samples collected at zero to six inches bgs were analyzed. For this investigation (conducted prior to the development of the RGs in the CMS Report for the Redevelopment Property [ENVIRON 2006a]), the OCPs and metals soil sampling results were compared to the following screening criteria for residential soil: 1) RWQCB-SF ESLs; 2) OEHHA screening numbers, and 3) USEPA Region 9 PRGs. In addition, metals were also compared to literature background concentrations for California soils. If the shallow samples exceeded the criteria, then the deeper samples at these locations were analyzed. Table 3.14 presents a summary of the OCPs and metals results. Of the OCPs, only DDE and DDT were detected. DDE was detected in all five samples ranging from 0.130 to 0.210 mg/kg. DDT was detected in all five samples ranging from 0.013 to 0.017 mg/kg. No OCPs were detected above the screening criteria, and as a result, no deeper samples were analyzed for OCPs. For the metals, arsenic, cadmium, chromium, cobalt, copper, lead, mercury, nickel, vanadium and zinc were detected. Arsenic and cobalt exceeded the screening criteria. Cobalt concentrations on Parcel O-4 ranged from 12 to 13 mg/kg. The maximum background concentration of cobalt in California soil ranges from 29 mg/kg (LBNL 2002) to 50 mg/kg (Dragun and Chiasson 1991). Therefore, no additional sampling or analyses were performed related to the cobalt detections.

The maximum background concentration of arsenic in California soil ranges from 11 mg/kg (Bradford 1996) to 69 mg/kg (Dragun and Chiasson 1991). Arsenic concentrations on Parcel O-4 ranged from 5.5 to 16 mg/kg. In one sample collected on Parcel O-4 (Sample 5-33), arsenic was potentially above typical background concentrations (detected at 16 mg/kg).

As a result, the deeper sample at location 5-33 was analyzed for arsenic. In addition, four more samples 25 feet away from location 5-33 (5-33A through 5-33D) were analyzed for arsenic.

- Former Orchard Areas. On October 10 through 17, 2005, 80 native soil samples were collected beneath roads and parking lots throughout the Redevelopment Property to investigate whether residual OCPs and/or arsenic were present in former orchard areas of the Redevelopment Property. Seventeen of the native soil sample locations (B16, B17, B20 through B32, B35, and B36) were located on Parcel O-4. The sample locations are depicted on Figure 3.20.

Samples of the native soil (zero to six inches) were collected by first coring through the asphalt and road base material and then collecting a sample of the native soil located immediately below using a macrocore sampler. The samples were analyzed for OCPs using USEPA Method 8081A and arsenic using USEPA Method 6010.

Sample results are summarized in Table 3.14. For the OCPs, only DDE, DDT, and DDD were detected. DDE was detected in 12 of the 17 samples ranging from 0.0028 to 0.290 mg/kg. DDT was detected in four of the 17 samples ranging from 0.0026 to 0.043 mg/kg, and DDD was detected in only one sample at a concentration of 0.0035 mg/kg. Arsenic was detected in all 17 samples ranging from 4.2 to 8.0 mg/kg.

- Due Diligence Sampling at Homestead Lake. At the request of the future developer of the Redevelopment Property, ENVIRON conducted a soil investigation on Parcel O-4 for due diligence purposes in August 2006. The future developer requested a limited number of soil samples be collected from the Homestead Lake area to confirm that OCPs and/or arsenic are not present within this area above levels of concern.

On August 7, 2006, soil samples were collected from eight locations (SS-DD-1 through SS-DD-8), roughly one sample per acre, as shown on Figure 3.20. Samples were collected at depths of zero to six inches bgs and between two and three feet bgs (for a total of 16 samples). The shallow samples (0-6 inches) were submitted for analysis of OCPs by USEPA Method 8081A and for arsenic by USEPA Method 6010. The deeper samples (2-3 feet) were placed on hold to be analyzed if OCPs or arsenic were detected in the shallower samples at concentrations above the screening criteria or background concentration for arsenic.

Sampling results are summarized on Table 3.14. The OCP, DDE, was the only constituent detected in shallow soil in the Homestead Lake area and was detected in four of the eight samples analyzed. Concentrations of DDE ranged from 0.024 to 0.052 mg/kg. Arsenic was detected in all of the samples analyzed at concentrations ranging from 7.6 to 8.8 mg/kg. This is below the background arsenic concentration. Based on these results, the deeper samples were not analyzed.

Due Diligence Soil Gas Sampling

At the request of the future developer of the Redevelopment Property, ENVIRON conducted a soil gas investigation on Parcels O-1, O-4, and O-5 for due diligence purposes on May 16 and 17, 2006.

- Due Diligence Soil Gas Sampling. One sample (SG-DD-06) at five feet bgs was collection from Parcel O-4. The location of this sample is shown on Figure 3.26. The soil gas sample was analyzed on-site using a mobile laboratory for VOCs and TVH via USEPA Method 8260B. A duplicate sample was also collected in a Summa™ canister and sent to a fixed laboratory for analysis of VOCs using USEPA Method TO-14.

Sample results are summarized in Table 3.17. Compounds detected were BTEX compounds, TVH, 1,2,4-trimethylbenzene, and 1,3,5-trimethylbenzene. Benzene was detected up to 0.0092 mg/m³; toluene was detected up to 0.20 mg/m³; ethylbenzene was detected up to 0.082 mg/m³; and xylenes were detected up to 0.36 mg/m³. In addition, TVH was detected up to 36 mg/m³; 1,2,3-trimethylbenzene was detected at 0.18 mg/m³; and 1,3,5-trimethylbenzene was detected at 0.042 mg/m³.

3.2.7 Parcel O-5

The layout of Parcel O-5 prior to redevelopment activities is provided on Figure 3.29. Parcel O-5, which covers approximately 33 acres, consisted primarily of orchard trees, an asphalt parking lot, sidewalks, landscaped areas, and Building 051 (IBM Office Building) with an adjacent cooling tower. In addition, two electrical substations, one owned by Hitachi GST and one owned by PG&E, are located adjacent to the north of Parcel O-5. Historical diesel fuel releases from the Hitachi GST electrical substation have resulted in soil investigations on Parcel O-5. A few soil borings associated with Building 018 (on Parcel O-4) are also located on Parcel O-5. A description of Building 051 on Parcel O-5 and a description of the adjacent electrical substations with a discussion of relevant soil and soil gas data are provided below.

Building 018 (on Parcel O-4)

A description of Building 018, which is located on Parcel O-4, is provided in Section 3.2.6 above. A gasoline UST associated with Building 018 was formerly located north of Building 018 on Parcel O-5, as described below.

- Former Gasoline UST. Hitachi GST personnel reported that a former UST containing gasoline for refueling vehicles was located near a garage to the north of Building 018. According to an UST removal report, a 500-gallon gasoline UST was removed in August 1985 (HLA 1985b). A visual inspection of the tank upon removal revealed no apparent holes or indications of leakage. Further inspection of the soils on the excavation sidewalls showed no apparent staining. Confirmation samples were collected to determine if gasoline had been released from the UST to the surrounding soils. Two soil borings (257-02-0001 and 257-02-0002) were advanced and one soil sample was collected from each boring at a depth of 8.0 to 8.5 feet bgs. Sample locations are shown on Figure 3.29. Both soil samples were analyzed for benzene, toluene, xylene, and TPH. Benzene, toluene, and xylene were

not detected (<0.001 mg/kg) in either sample. TPH was also not detected (<0.05 mg/kg) in either sample.¹⁰

Raleigh Road

- Black Soil in Raleigh Road. During the demolition activities of Raleigh Road in March 2007, an area of black soil was observed underneath the asphalt and road base material. The black soil had no odor and no subsurface utilities were observed in the area of the black soil. The soil was screened in the field using a PID and pH paper. PID readings were not detected and pH screening of the soil indicated the soil pH was within the neutral range. However, because of the noted discoloration of the soil, ENVIRON recommended collecting a sample of the soil.

On March 7, 2007, in accordance with the CMS Report for the Redevelopment Property, a sample (Raleigh Rd – S1) of the black material observed in the Raleigh Road was collected using a hand-hammered ARTS-brand sampling device. The location of the sample is shown on Figure 3.30. The sample was analyzed for VOCs by USEPA Method 8260B, TPH as diesel and motor oil by USEPA Method 8015B, and CAM 17 metals by USEPA Method 6010B and 7470/7471.

The sample results are summarized in Table 3.19. VOCs were not detected at concentrations above the reporting limits. TPH as diesel was detected at a concentration of 20 mg/kg. TPH as motor oil was detected at a concentration of 69 mg/kg. Some metals, including arsenic, barium, beryllium, chromium, cobalt, copper, lead, mercury, nickel, vanadium, and zinc were detected. All metals detections were below the residential soil RGs developed in the CMS Report for the Redevelopment Property. Based on these results, the soil was left in-place.

Building 051

Building 051 was an approximately 60,000 square-foot, three-story building with a penthouse. Building 051 was formerly leased by IBM and consisted of office space and vacant computer labs.

Building 051 was constructed in 1984 as an IBM office building with computer labs, and an associated cooling tower. Given the nature of operations in Buildings 051, there was minimal chemical use and chemical waste storage within this building, although various refrigerants were present in the chillers located in the Building 051 maintenance room. Chemical storage for the Building 051 cooling tower consisted of a biocide AST, drums of sulfuric acid and sodium

¹⁰ At the time the CCR was written, ENVIRON had not obtained a copy of the UST removal report and the exact location of the former gasoline UST associated with Building 018 was unknown. Therefore, in the SI/SP, ENVIRON recommended that if any indications of a historic gasoline release (visual staining, odor) were identified during Building 018 demolition or Site redevelopment/grading activities, soil sampling should be conducted. An environmental engineer from ENVIRON was on-site during demolition of Building 018 and redevelopment/grading activities in the vicinity of the building. There were no indications of a historic gasoline release (visual staining, odor) identified during Building 018 demolition.

hypochlorite, and bags of salt for the water softener. All chemicals were stored within proper secondary containment structures adjacent to the cooling tower. Demolition of Building 051 and its associated cooling tower were completed in June 2007.

- Diesel Fuel AST (FT-29). Building 051 had a diesel-powered emergency generator with associated 2,000-gallon diesel fuel AST (FT-29). The emergency generator and AST were located within the fenced area for the Building 051 cooling tower. FT-29 was located in a covered area above an epoxy-coated concrete vault with a 7,000-gallon capacity. As part of the SI/SP (Attachment II), ENVIRON recommended that an environmental engineer inspect the area surrounding the diesel fuel AST (FT-29) and associated piping adjacent to the Building 051 cooling tower once they have been removed.

FT-29 was removed under permit by the City of San Jose in late January 2007. No staining or cracks were present on the concrete vault surface beneath FT-29, when ENVIRON conducted an inspection during the week of January 29, 2007. On April 17, 2007, the slab beneath former FT-29 was removed. No staining or odors were noted in the soil beneath the slab in the vicinity of the former tank or piping.

Typically, across the Site, diesel fuel for emergency generators was previously stored in a UST. ENVIRON was not provided with documentation indicating a former UST associated with Building 051, and Hitachi GST personnel confirmed that no such former diesel fuel UST associated with Building 051 existed.

Petroleum products were also stored in hydraulic elevators in Building 051. There were three hydraulic elevators in Building 051 referred to here as the Loading Dock Elevator, Lobby Elevator No. 1, and Lobby Elevator No. 2. The oil reservoir capacity of each hydraulic elevator varied, but ranged from 30 to 75 gallons. All of the oil reservoirs were equipped with secondary containment. Hitachi GST personnel reported that the elevator contractor inspected the elevator pits monthly. Three soil investigations associated with hydraulic elevators in Building 051 had been conducted previously, as described below:

- Lobby Elevators No. 1 and No. 2. In November 1989, HLA investigated the soil beneath Lobby Elevators No. 1 and No. 2 in Building 051 (HLA 1989h and HLA 1989i). HLA concluded that no further investigation was warranted.

In addition, on January 20, 2000, approximately 50 gallons of hydraulic fluid leaked into the concrete elevator pit of Lobby Elevator No. 1 due to pump failure. The hydraulic fluid was removed from the pit and cleanup was completed by January 24, 2000.

As part of the SI/SP (Attachment IV), ENVIRON recommended that an environmental engineer inspect the area surrounding the elevator shafts and associated hydraulic fluid reservoirs once they have been removed. On April 9, 2007, ENVIRON observed the removal of the shared elevator pit associated with Lobby Elevators No. 1 and No. 2. Prior to removal of the concrete slab, ENVIRON observed the concrete to be intact with no major depressions or holes. Following removal of a section of the slab, ENVIRON observed the

soil beneath the pit to be dark black with small areas that were purple/orange in color. A mild odor was present in the vicinity of the pit.

Based on these observations, ENVIRON collected one sample (SOIL-B051-EL1,2) from soil beneath the elevator pit at five feet bgs. The location of the soil sample is shown on Figure 3.30. The sample was submitted for analysis of TPH by USEPA Method 8015B. A low level of TPH as diesel (2.3 mg/kg) was detected in the sample. In accordance with the SI/SP, the sample was then submitted for analysis of PAHs by USEPA Method 8270. Based on the staining observed beneath the pit, the sample was also analyzed for CAM 17 metals by USEPA Method 6010B. There were no PAHs detected in the sample. Some metals, including arsenic, barium, beryllium, chromium, cobalt, copper, lead, mercury, nickel, vanadium, and zinc were detected, but at levels below the residential soil RGs developed in the CMS Report for the Redevelopment Property. The soil sample results are shown in Table 3.19.

After Building 051 was demolished and the slab was removed, an environmental engineer from ENVIRON inspected the soil in the vicinity of the former elevator pit on May 30, 2007. No staining or odors were observed in the soil, indicating that the staining and mild odor previously noted beneath the elevator pit was limited in extent. No further action for Lobby Elevators No. 1 and No. 2 is recommended.

- Loading Dock Elevator. In November 1989, HLA investigated the soil beneath the loading dock elevator in Building 051 (HLA 1989j). HLA concluded that no further investigation was warranted.

As part of the SI/SP (Attachment IV), ENVIRON recommended that an environmental engineer inspect the area surrounding the elevator shaft and associated hydraulic fluid reservoir once they have been removed. On April 9, 2007, ENVIRON observed the removal of the elevator pit associated with the Loading Dock Elevator in the former Building 051. Prior to removal of the concrete slab, ENVIRON observed the concrete to be intact with no major depressions or holes. Following removal of a section of the slab beneath the elevator pit, ENVIRON observed the soil beneath the pit to be dark black with small areas that were purple/orange in color. A mild odor was also noticed in the vicinity of the pit.

Based on these observations, ENVIRON collected one sample (SOIL-B051-EL3) from soil beneath the elevator pit at five feet bgs. The location of the soil sample is shown in Figure 3.30. The sample was submitted for analysis of TPH by USEPA Method 8015B. A low level of TPH as diesel (3.3 mg/kg) was detected in the sample. In accordance with the SI/SP, the sample was submitted for analysis of PAHs by USEPA Method 8270 and PCBs by USEPA Method 8082.¹¹ Based on the staining observed beneath the pit, the sample was also analyzed for CAM 17 metals by USEPA Method 6010B. There were no PAHs or PCBs detected in the sample. Some metals, including arsenic, barium, beryllium, chromium, cobalt, copper, lead, mercury, nickel, vanadium, and zinc were detected, but at levels below

¹¹ According to the SI/SP (Attachment IV), samples with positive detections of TPH would be further analyzed for PAHs. In addition, the soil sample with the maximum detected TPH concentration would be further analyzed for PCBs.

the residential soil RGs developed in the CMS Report for the Redevelopment Property. The soil sample results are shown in Table 3.19.

After Building 051 was demolished and the slab was removed, an environmental engineer from ENVIRON inspected the soil in the vicinity of the former elevator pit on May 30, 2007. No staining or odors were observed in the soil, indicating that the staining and mild odor previously noted beneath the elevator pit was limited in extent. No further action for the Loading Dock Elevator is recommended.

- Black Soil in Parking Lot. During the demolition activities of the parking lot area east of Building 051, an area of black soil was observed underneath the asphalt and road base material. The black material had a slight organic odor and no subsurface utilities were observed in the area of black soil. The soil was screened in the field using a PID. PID readings were not detected. However, because of the noted discoloration of the soil, ENVIRON recommended collecting a grab sample of the soil.

On April 26, 2007, in accordance with the CMS Report for the Redevelopment Property, a sample (B051-PL-S1) of the black material observed in the parking lot east of Building 051 was collected. The location of the sample is shown on Figure 3.30. The sample was submitted for analysis of VOCs by USEPA Method 8260B, TPH diesel and motor oil by USEPA Method 8015B, CAM 17 metals by USEPA Method 6010B and 7470/7471, and pH by USEPA Method 9045. The sample results are summarized in Table 3.19.

Acetone was the only VOC constituent detected at a concentration of 0.11 mg/kg. TPH as diesel was detected at a concentration of 2.6 mg/kg. Some metals, including arsenic, barium, chromium, cobalt, copper, lead, mercury, nickel, vanadium, and zinc, were detected, but at levels below the residential soil RGs developed in the CMS Report for the Redevelopment Property. The pH result was 7.20, which is within the range for naturally-occurring soils. Based on these results, the soil was left in-place.

As mentioned above, a cooling tower associated with Building 051 was located northwest of the building. Cooling tower blowdown was formerly collected in WV-11, as described below.

- Cooling Tower and WV-11. Hitachi GST personnel reported only one notable operational change to Building 051. Blow down from the Building 051 cooling tower was formerly collected in a tank (WV-11) located in a belowground vault and discharged to the on-site wastewater treatment plant (Building 110) in the Core Area. The concrete vault was approximately 14 feet wide by 22 feet long and approximately 22 feet deep. According to Hitachi GST personnel, WV-11 was a former RCRA-permitted unit. In 1994, the piping from WV-11 to Building 110 was closed consistent with IBM's Closure Plan and WV-11 was connected to the sanitary sewer. Notification of this pipeline closure was submitted to the DTSC in a letter from IBM dated September 26, 1994. As part of the SI/SP (Attachment VIII), ENVIRON recommended that an environmental engineer inspect the Building 051 Cooling Tower area, including formerly designated WV-11 and associated pipeline areas, after demolition activities.

An environmental engineer from ENVIRON was on-site during demolition of the cooling tower and WV-11 at Building 051. Prior to demolition, liquid was observed inside WV-11. A sample of the liquid was collected and submitted for analysis of VOCs by USEPA Method 8260B and TPH as diesel and motor oil by USEPA Method 8015B. Toluene was the only VOC detected at a concentration of 2.0 µg/L. TPH as diesel were detected at 1,300 µg/L, and TPH as motor oil were detected at 0.540 mg/L. Due to the elevated levels of TPH, the liquid was removed and properly treated/disposed prior to demolition of the waste vault.

On April 27 through May 2, 2007, the liquid in WV-11 was removed. Following removal of the liquid, the concrete bottom of the waste vault was demolished. After removing the concrete, an environmental engineer from ENVIRON inspected the soils immediately beneath the concrete. There were no indications of a historic release (visual staining, odor) identified in the soil beneath the waste vault.

The remainder of the concrete slab in the cooling tower area was removed by Ferma on May 14, 2007. An environmental engineer from ENVIRON inspected the soils immediately beneath the concrete. There were no indications of a historic release (visual staining, odor) identified in the soil beneath the cooling tower slab.

- Manhole and IW Line. During utility removal surrounding Building 051, a manhole cover with the label “Industrial Waste Line – PVC Abandoned in Place” was discovered. Liquid was observed inside the manhole. On March 28, 2007, a sample of this liquid was collected using a disposable polyethylene bailer and submitted for analysis of VOCs by USEPA Method 8260B, TPH as diesel and motor oil by USEPA Method 8015B, and CAM 17 metals by 6010B and 7470/7471. The results of this sample indicated that TPH as diesel was present in the liquid at a concentration of 0.054 mg/L. Based upon the presence of TPH in the liquid, ENVIRON recommended the liquid be pumped out before the manhole and associated piping was removed and soils beneath the manhole and pipes be inspected for evidence of a release (visual staining, odor) following removal.

On April 9, 2007, the liquid was removed. Following the removal of the liquid, the manhole and the PVC pipes associated with the manhole were removed. An environmental engineer from ENVIRON inspected the soils beneath the manhole and PVC pipes. No indications of a release (visual staining, odor) were observed in the soil.

Orchards

Much of the Redevelopment Property is current or former orchards. Investigations of current and former orchards conducted on Parcel O-5 include the following:

- Current Orchard Areas. In October 2004, ENVIRON conducted soil sampling in current orchard areas on the Redevelopment Property for OCPs and metals. ENVIRON collected discrete soil samples at a total of 34 locations (5-1 through 5-31 and 5-36 through 5-38) on approximately ½-acre centers in the orchard area on Parcel O-5. Samples were collected at depths of zero to six inches bgs and between two and three feet bgs as shown on Figure

3.30. All samples were analyzed for OCPs by USEPA Method 8081A and for metals by USEPA Methods 6010/7471.

Initially only the soil samples collected at zero to six inches bgs were analyzed. For this investigation (conducted prior to the development of the RGs in the CMS Report for the Redevelopment Property [ENVIRON 2006a]), the pesticides and metals soil sampling results were compared to the following screening criteria for residential soil: 1) RWQCB-SF ESLs; 2) OEHHA screening numbers, and 3) USEPA Region 9 PRGs. In addition, metals were also compared to literature background concentrations for California soils. If the shallow samples exceeded the criteria, then the deeper samples at these locations were analyzed.

Table 3.19 presents a summary of the OCPs and metals results. Of the OCPs, DDE, DDT, dieldrin, endosulfan I, and endrin were detected. No OCPs were detected above the screening criteria except for dieldrin at one location, 5-24. As a result, the deeper sample at location 5-24 was analyzed for OCPs. In addition, four more samples 25 feet away from location 5-24 (5-24A through 5-24D), were analyzed for OCPs at both shallow and deeper depths. Dieldrin was not detected in the deeper samples. Dieldrin exceeded the screening criteria in the sample at location 5-24B, but did not exceed the screening criteria in any of the other additional samples.

For the metals, arsenic, cadmium, chromium, cobalt, copper, lead, mercury, nickel, vanadium and zinc were detected. Arsenic and cobalt exceeded the screening criteria. Cobalt concentrations on Parcel O-5 ranged from 11 to 24 mg/kg. The maximum background concentration of cobalt in California soil ranges from 29 mg/kg (LBNL 2002) to 50 mg/kg (Dragun and Chiasson 1991). Therefore, no additional sampling or analyses were performed related to the cobalt detections.

The maximum background concentration of arsenic in California soil ranges from 11 mg/kg (Bradford 1996) to 69 mg/kg (Dragun and Chiasson 1991). Arsenic concentrations on Parcel O-5 ranged from 5.2 to 22 mg/kg. Arsenic in one sample (5-28) was potentially above the background ranges (detected at 22 mg/kg). As a result, the deeper sample at location 5-28 was analyzed for arsenic. In addition, four more samples 25 feet away from location 5-28 (5-28A through 5-28D) were analyzed for arsenic at both shallow and deeper depths.

- Former Orchard Areas. In accordance with the SI/SP (Attachment VI), 80 native soil samples were collected on October 10 through 17, 2005, beneath roads and parking lots throughout the Redevelopment Property to investigate whether residual OCPs and/or arsenic were present in former orchard areas of the Site. Fourteen of the native soil sample locations (B05 through B15, B18, B19 and B34) were located on Parcel O-5. The sample locations are depicted on Figure 3.30.

Samples of the native soil (zero to six inches) were collected by first coring through the asphalt and road base material and then collecting a sample of the native soil located

immediately below using a macrocore sampler. The samples were sent for analysis of OCPs using USEPA Method 8081A and arsenic using USEPA Method 6010.

Sample results are summarized in Table 3.19. DDE was detected in eight of the 14 samples at concentrations ranging from 0.0023 to 0.130 mg/kg. DDT was detected in one sample at a concentration of 0.018 mg/kg, and gamma-chlordane was detected in one sample at a concentration of 0.013 mg/kg. Arsenic was detected in all of the samples ranging from 4.7 to 11 mg/kg.

Electrical Substations (Adjacent to Parcel O-5 on Core Area)

Two electrical substations located in the central-southeastern portion of the Site provide electricity to the Site. One 115-kV substation, which contains a 50 megawatt MW electrical generator, is located on the Core Area (near the northern boundary of Parcel O-5) and is owned and operated by Hitachi GST; the other 115-kV substation is owned and operated by PG&E.

Overflows containing diesel fuel occurred in 1984 and 1985 from a (now former) rainwater/spill collection vault located at Hitachi GST's electrical substation that have required soil excavations (K/J/C 1987). The rainwater/spill collection vault, which was removed in 1990, was formerly located south of the substation fence (on Parcel O-5) (see Figure 3.29).

- **1984 Diesel Fuel Spill.** In October 1984, an overflow from the rainwater/spill collection vault impacted adjacent soil on Parcel O-5 with diesel fuel (HLA 1987c, 1988b). Subsequent to the spill, saturated soil adjacent to the concrete vault was excavated down to 10.5 feet bgs. In October 1984, confirmatory soil sampling was conducted to evaluate the lateral and vertical extent of diesel fuel in soils outside the initial 10.5-foot-deep excavation. Fifteen soil borings (Boring Series 179-01) were advanced in an approximately 40 by 50 foot area as part of this investigation. Five of the borings were located within the excavation to depths of 2.5 feet below the excavation floor, and 10 of the borings were located outside the excavation footprint to a maximum depth of 10 feet bgs. Soil boring locations are shown on Figure 3.29. Thirty-four samples were collected from the fifteen borings and analyzed for diesel fuel. Sample results are shown on Table 3.20. Diesel fuel was detected up to 15,000 mg/kg. Based on these results, additional soil (approximately 300 cubic yards) was over excavated and disposed off-site. Based on the analytical results (HLA 1988b), residual diesel fuel was left up to 14 mg/kg. The excavation was subsequently backfilled with clean, compacted fill (HLA 1987c).
- **1985 Diesel Fuel Spill.** A second overflow occurred from the rainwater/spill collection vault on September 20, 1985. Subsequent to the spill, saturated soil (approximately 250 cubic yards) adjacent to the concrete vault was excavated. Soil investigations were conducted to evaluate the lateral and vertical extent of diesel fuel in soils outside the initial excavation (Boring Series 269-01 and 269-02). Soil borings are shown on Figure 3.29 and sampling results are shown in Table 3.20. The investigation proceeded in two phases, as additional excavations were warranted. Based on sampling results, additional soil was excavated from the initial excavation in February 1987 (415 cubic yards) and July 1987 (100 cubic yards) (HLA 1988h). Subsequent to the third phase of excavation, most soil samples

contained less than 10 mg/kg diesel fuel. Diesel fuel concentrations remaining in the soil were below 10 mg/kg, with the exception of: 1) Boring 269-01-0003 at 4.2 feet contained 300 mg/kg diesel fuel; however, the sample collected at 4.5 feet was less than 5 mg/kg; 2) samples collected from Boring 269-01-0020 contained up to 16 mg/kg diesel fuel; and 3) Boring 269-02-0036 at a depth of 23.5 feet contained 24 mg/kg diesel fuel. HLA concluded that no additional excavation was required (HLA 1988h).

- Removal of Rainwater/Spill Collection Vault and Drainline. In 1990, the rainwater/spill collection vault and drainline from the generator were removed and a new rainwater/spill collection vault and drainline were installed inside the fence for the electrical substation (HLA 1991b). At the time of removal, HLA investigated the soils adjacent to and beneath the old rainwater/spill collection vault and drainline (Boring Series 552-01 and 552-03). Soil borings are shown on Figure 3.29. On January 10, 1990, soil samples were collected at the estimated depth of the drainline and analyzed for TPH as diesel. Five of these samples were located on Parcel O-5 (552-01-0013 through 552-01-0017). Sample results are shown on Table 3.20. TPH as diesel was not detected (<10 mg/kg) in any of these samples.

On July 5, 1990, before the drainline was removed, grab soil samples were collected at each pipe connection or approximately every 20 feet along the drainline and analyzed for TPH as diesel and TPH as gasoline. Eight grab samples were collected along the old drainline on Parcel O-5 (552-03-0001 through 552-03-0008). TPH as diesel and TPH as gasoline were not detected (<10 mg/kg) in any of these samples. No staining or odor was observed during removal of the drainline. A City of San Jose Fire Department official was present to witness the soil sampling and drainline removal.

On August 9, 1990, prior to excavation of the 12-foot-deep vault, two samples (552-03-0021 and 552-03-0022) were collected from soils beneath the concrete vault bottom and analyzed for TPH as diesel and TPH as gasoline. One of the samples (552-03-0021) detected TPH as diesel at a concentration of 320 mg/kg. Based on this result, the vault and surrounding area were over excavated to a depth of approximately 20 feet bgs. Confirmatory sampling from the bottom of the excavation (552-03-0023 and 552-03-0024) indicated that TPH as diesel fuel was not detected (<10 mg/kg). In addition, TPH as gasoline and BTEX were not detected in these two samples. Because the fill beneath the collection vault and drainlines were excavated during removal, HLA and IBM concurred that neither further investigation nor further remediation was warranted in this area (HLA 1991b).

Due Diligence Soil Gas Sampling

- Due Diligence Soil Gas Sampling. At the request of the future developer of the Redevelopment Property, ENVIRON conducted a soil gas investigation on Parcels O-1, O-4, and O-5 for due diligence purposes on May 16 and 17, 2006. A total of six soil gas samples at five feet bgs were sampled on Parcel O-5. Two soil gas samples (SG-DD-07 and SG-DD-08) were located south of the PG&E Substation on Parcel O-5. Three soil gas samples (SG-DD-09 through SG-DD-11) were located near the Core Area on Parcel O-5. One soil gas sample (SG-DD-12) was located west of Building 051 on Parcel O-5. These six soil gas sample locations are shown on Figure 3.31. The soil gas samples were analyzed

on-site using a mobile laboratory for VOCs and TVH via USEPA Method 8260B. Ten percent of the samples were collected as duplicate samples in Summa™ canisters and sent to a fixed laboratory for analysis of VOCs using USEPA Method TO-14.

Sample results are summarized in Table 3.21. Compounds detected were BTEX compounds, TVH, 1,2,4-trimethylbenzene, and 1,3,5-trimethylbenzene.

3.2.8 Endicott Boulevard/Tucson Way

Endicott Boulevard/Tucson Way, which is approximately 12 acres, is located at the northern boundary of the Core Area and adjacent to Union Pacific railroad and Monterey Highway, as shown on Figure 3.32. Two soil investigations were conducted in October 2005 on Endicott Boulevard/Tucson Way, as discussed below.

- Shell Sol Area. The Shell Sol 140 release in November 1985, as indicated in Section 3.1.1, occurred in close proximity to Tucson Way, which was called Perimeter Road in the past remediation and soil investigation reports. A small portion of Tucson Way potentially affected by Shell Sol is restricted; and addressed in the soil management plan being prepared by IBM.

In order to minimize the off-site migration of free-phase Shell Sol 140, a subsurface drain system with five sumps was installed near the center of Tucson Way (HLA 1986h). This action had resulted in the movement of free Shell Sol 140 in soils toward the roadway. Subsequently, dissolved Shell Sol 140, benzene, toluene, and xylenes were found in the ground water monitoring wells along Tucson Way (HLA 1986h).

As part of the SI/SP (Attachment VII), soil samples were collected on October 17 and 20, 2005, from the soil beneath Tucson Way in the vicinity of the historical Shell Sol 140 release. Soil samples were collected at six locations (SB1 through SB6) from the native soil beneath the roadway at depths of approximately five, 10, 15, 20, and 25 feet bgs using a macrocore sampler. The sample locations are depicted on Figures 3.32 and 3.33.

The 30 samples were analyzed for TPH as kerosene and diesel using USEPA Method 8015M.¹² The sample results are summarized on Table 3.22. TPH as diesel was detected in 15 of the samples up to 19 mg/kg. TPH as kerosene was detected in one sample (SB6 at five feet bgs) at a concentration of 1.6 mg/kg.

- Former Orchard Areas. As part of the SI/SP (Attachment VI), 80 native soil samples were collected on October 10 through 17, 2005, beneath roads and parking lots throughout the Redevelopment Property to investigate whether residual OCPs and/or arsenic were present in former orchard areas of the Site. Ten of the native soil sample locations (B59 through B67 and B80) were located on Endicott Boulevard/Tucson Way. The sample locations are depicted on Figure 3.32.

¹² Shell Sol 140 is a refined light aliphatic hydrocarbon (predominantly C9-C12) that also contains benzene, toluene, and xylenes.

Samples of the native soil (zero to six inches) were collected by first coring through the asphalt and road base material and then collecting a sample of the native soil located immediately below using a macrocore sampler. The samples were analyzed for OCPs using USEPA Method 8081A and arsenic using USEPA Method 6010.

Sample results are summarized in Table 3.22. DDE was detected in four of the ten samples ranging from 0.005 to 0.023 mg/kg. DDD was detected in one sample at a concentration of 0.0042 mg/kg. Arsenic was detected in nine of the ten samples ranging from 2.3 to 6.9 mg/kg.

3.2.9 Naturally-Occurring Asbestos (NOA) on the Redevelopment Property

During development of the Site, construction-grade fill material, which contained NOA in the form of serpentine rock, from a local quarry was used as fill beneath buildings, parking lots and roadways. The serpentine-rock-containing soil was identified during soil excavation activities related to the Site cleanup in the early 1980s.

As part of the SI/SP (Attachment I), ENVIRON recommended confirmatory soil sampling for NOA in fill beneath roadways, parking lots, and buildings in the Redevelopment Property, assuming these areas were to be disturbed as part of redevelopment activities. As the potential source of any NOA would have been imported fill, only areas beneath parking areas, beneath buildings, and beneath roadways were recommended for sampling for NOA. In addition, limited soil sampling for metals was recommended for any fill materials to be re-used onsite.

The results of implementation of the SI/SP indicated that NOA-containing road base was present on the Redevelopment Property at levels ranging between <0.25% and 15%. Limited sampling for metals in fill beneath roadways and parking lots in the Redevelopment Property indicated that metals were not present in road base above RGs developed in the CMS Report for the Redevelopment Property. NOA-containing road base materials were disposed off-site in accordance with the amendment to the NOA Management Plan, dated January 15, 2007 (ENVIRON 2006c).

Road base materials were handled as follows:

- Road base materials which were non-detect for NOA were reused on-site.
- Road base materials which were less than 0.25 percent (<0.25%) to < 5% NOA, were transported off-site to either Guadalupe Landfill in San Jose, California or Kirby Canyon Landfill in Morgan Hill, California.
- Road base materials which were \geq 5% were transported off-site to the Altamont Landfill in Livermore, California.

A detailed discussion of NOA sampling results and NOA management is provided in the SI/SP Attachment I Completion Report for Roads and Parking Lots dated July 25, 2007 (ENVIRON 2007a).

4.0 DEVELOPMENT OF RISK-BASED TARGET CONCENTRATIONS

Chemical concentrations detected in groundwater, soil gas and soil at the Site were compared to RBTCs in order to identify additional areas within the Redevelopment Property requiring mitigation prior to redevelopment. RBTCs represent concentrations of chemicals that can remain in these media and still be protective of human health for future land uses. The methodology used to develop the RBTCs is consistent with the following CalEPA, RWQCB-SF, and USEPA risk assessment guidance:

- *Supplemental Guidance for Human Health Multimedia Risk Assessments of Hazardous Waste Sites and Permitted Facilities* (CalEPA 1992),
- *Preliminary Endangerment Assessment Guidance Manual* (CalEPA 1994),
- *Guidance for the Evaluation and Mitigation of Subsurface Vapor Intrusion to Indoor Air* (CalEPA 2004; revised 2005),
- *Screening for Environmental Concerns At Sites With Contaminated Soil and Groundwater* (RWQCB-SF 2005),
- *Risk Assessment Guidance for Superfund. Volume I – Human Health Evaluation Manual (Part A)* (USEPA 1989a),
- *Risk Assessment Guidance for Superfund. Volume I – Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals)* (USEPA 1991a),
- *Human Health Evaluation Manual, Supplemental Guidance: “Standard Default Exposure Factors”* (USEPA 1991b),
- *Exposure Factors Handbook* (USEPA 1997a),
- *Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance)* (USEPA 2002), and
- *User’s Guide for Evaluating Subsurface Vapor Intrusion Into Buildings* (USEPA 2003).

The following sections discuss the various components required for developing RBTCs in detail. Section 4.1 identifies the chemicals that have been included in this assessment. Section 4.2 discusses the human populations that may potentially be exposed to chemicals in groundwater, soil gas, or soil at the Redevelopment Property and the pathways through which exposure may occur. Section 4.3 presents the exposure assumptions. Section 4.4 presents the fate and transport modeling used to predict the concentration of volatile chemicals and particulates in air. The toxicity of the chemicals evaluated is discussed in Section 4.5. Section 4.6 explains the methodology for calculation of RBTCs and presents the RBTCs. In Chapter 5.0, measured groundwater, soil gas and soil concentrations are compared to RBTCs and in Chapter 6.0, cancer risks and noncancer hazard indices are estimated. Uncertainties that may result from the various assumptions used in the development of RBTCs and risk estimates are discussed in Chapter 7.0.

As part of this Final Remedy Completion Report, the RBTCs calculated as part of the Screening HHRA/CCR were updated. The RBTCs calculated as part of the Screening HHRA/CCR were based on conservative default assumptions for soil properties at the Site. Since the development of these target concentrations, site-specific data has been collected and the RBTCs have been revised accordingly. This change affects potential exposures related to vapor migration. In addition, a limited number of toxicity values and exposure assumptions (soil ingestion and air exchange rate for the commercial worker scenario) have changed based on CalEPA and USEPA guidance. Data presented in this report have been compared to the updated RBTCs.

4.1 SELECTION OF CHEMICALS TO BE EVALUATED

The purpose of this section is to identify those chemicals that will be quantitatively assessed. This selection of chemicals for which RBTCs were developed is based upon the analytical results from the investigations discussed in Chapter 3.0. The following three subsections discuss those chemicals that were selected for groundwater, soil gas and soil, respectively.

4.1.1 Groundwater

For the purposes of this assessment, RBTCs were developed for all chemicals detected in groundwater within the Redevelopment Property. This includes the last three years of data for the Site-wide groundwater plume and the individual parcel groundwater investigations discussed in Section 3.0. The Site-wide groundwater database (2004 through May 2007) was obtained from IBM. A total of 25 VOCs, TPH, three metals, and two anions were detected in groundwater during these investigations. These chemicals are summarized in Table 4.1.

4.1.2 Soil Gas

As discussed in Section 3.2, several soil gas investigations were conducted on the Redevelopment Property. For the purposes of this assessment, RBTCs were developed for all chemicals detected in soil gas on the Redevelopment Property. Chemicals detected in soil gas include 24 VOCs and TVH. These chemicals are summarized in Table 4.1.

For site characterization, the DTSC encourages both soil gas and soil matrix sampling. According to DTSC, soil gas data are typically more representative of actual site conditions in coarse-grained soil conditions, while soil matrix data are typically more representative of actual site conditions in fine-grained soil formations. For evaluating the risk associated with vapor migration into indoor air, soil gas is the preferred data type, where practicable (CalEPA 2005).

4.1.3 Soil

As discussed in Section 3.2, numerous soil investigations were conducted on the Redevelopment Property. For the purposes of this assessment, RBTCs were developed for all chemicals detected in soil within the Redevelopment Property.

Chemicals detected in soil include seven VOCs, TPH, six semi-volatile organic compounds (SVOCs), 10 pesticides, 16 metals, and three anions. These chemicals are summarized on Table 4.1.

4.2 POTENTIAL POPULATIONS AND EXPOSURE PATHWAYS

In order to develop appropriate RBTCs, the first step is to identify potentially exposed populations. Once they have been identified, the complete exposure pathways by which individuals in each of these potentially exposed populations may contact chemicals present in the groundwater, soil gas, and soil at a site are determined. An exposure pathway is defined as "the course a chemical or pollutant takes from the source to the organism exposed" (USEPA 1988). An exposure route is "the way a chemical or pollutant enters an organism after contact" (USEPA 1988). A complete exposure pathway requires the following four key elements:

- Chemical source,
- Migration route (i.e., environmental transport),
- An exposure point for contact (e.g., soil, air, or water), and
- Human exposure route (e.g., inhalation).

An exposure pathway is not complete unless all four elements are present.

A conceptual site model (CSM) for potential exposure pathways is used to show the relationship between a chemical source, exposure pathway, and potential receptor at a site. The CSM identifies all potential or suspected chemical sources, potentially impacted media, and potential receptors. It also identifies the potential human exposure routes for contacting impacted media. These source-pathway-receptor relationships provide the basis for the quantitative exposure assessment. In fact, only those complete source-pathway-receptor relationships are included in the quantitative risk evaluation. The CSM for the Redevelopment Property is shown on Figure 4.1.

Rationale for the selection of potentially exposed populations is presented in Section 4.2.1 and for the relevant (i.e., complete) exposure pathways in Section 4.2.2.

4.2.1 Potentially Exposed Populations

The proposed land uses for the Redevelopment Property are residential, commercial, and open space (or park) uses. Based on these proposed future land uses, populations that could potentially be exposed to chemicals remaining in groundwater, soil gas, and soil include residents (children and adults), commercial workers, and park visitors (children and adults). Additional populations could include short-term construction/maintenance workers during redevelopment or other short-term maintenance activities.

4.2.2 Relevant Exposure Pathways

Based on the CSM, potential exposure media would include groundwater, soil gas, and soil. Each of these media is discussed separately below.

4.2.2.1 Groundwater

There is a restriction on use of groundwater beneath the Redevelopment Property as a drinking water source. Since groundwater in the Redevelopment Property will not be used

as a source of drinking water or irrigation water, this exposure pathway is not evaluated in this assessment. In addition, as the depth to shallow groundwater across the Redevelopment Property is currently approximately 30 feet bgs, it is assumed that there will be no direct contact with groundwater, including deep excavation activities.

A potentially complete exposure route for groundwater is exposure to VOCs via the inhalation of chemicals that have migrated from groundwater through the soil column into indoor/ambient air. Therefore, potential exposures resulting from the inhalation of groundwater vapors that have migrated through the soil column will be quantified in this assessment. Only inhalation of VOCs in indoor air was modeled for the residential and commercial worker populations, since outdoor concentrations of VOCs will be lower than indoor air concentrations due to higher mixing in the ambient environment. Since park visitors and construction/maintenance workers are assumed to be outdoors, inhalation of VOCs in ambient air was modeled for these populations.

4.2.2.2 Soil Gas

On-site residents and commercial workers could potentially be exposed to compounds migrating from soil gas into indoor air via the inhalation pathway. Similar to groundwater, park visitors and construction/maintenance workers are assumed to be outdoors; therefore, only inhalation of VOCs in ambient air was modeled for these populations.

4.2.2.3 Soil

Future on-site residents, commercial workers, park visitors, and construction/ maintenance workers could be exposed directly to chemicals remaining in surface soils. Potential routes of exposure would include incidental ingestion, dermal contact, and inhalation of volatile chemicals and windblown particulates.

For a residential scenario, CalEPA has typically required that soils down to a depth of approximately 10 feet be remediated (CalEPA 1992). This level of cleanup ensures that residents will be able to perform any activity in their yard, including installing a swimming pool, without resulting in any unacceptable adverse health effects.

Since no direct contact is likely to occur with soils deeper than 10 feet bgs (termed subsurface soils), exposures to chemicals in subsurface soil is limited to the inhalation of VOCs that have migrated through the overlying soil into indoor and ambient air. Therefore, potential exposures resulting from the inhalation of subsurface soil vapors that have migrated through the soil column will be quantified in this assessment for all potentially exposed populations. Only the inhalation of VOCs in indoor air was modeled for residential and commercial worker populations since outdoor concentrations of VOCs will be lower than indoor air concentrations due to higher mixing in the ambient environment. Similar to groundwater, park visitors and construction/maintenance workers are assumed to be outdoors; therefore, only inhalation of VOCs in ambient air was modeled for these populations.

4.3 EXPOSURE ASSESSMENT

The purpose of this section is to develop an upper-bound estimate of the theoretical intake for each of the potentially exposed human populations via each of the exposure routes identified in the CSM. Estimates of human intake are a function of exposure parameters such as duration, frequency, and contact rates. This section provides the equations and assumptions used to develop the intake factors used in the calculation of the RBTCs.

4.3.1 Estimation of Intake

USEPA defines exposure as “the contact with a chemical or physical agent” and defines the magnitude of exposure as “the amount of an agent available at human exchange boundaries (i.e., lungs, gut, skin) during a specified time” (USEPA 1989a). Exposure assessments are designed to determine the degree of contact a person has with a chemical. This section presents the equations used to estimate chemical exposures or intakes. These estimates of intake will be combined with toxicity values (Section 4.5) to estimate RBTCs for each population of concern (Section 4.6).

The chemical intake equation includes variables that characterize the contact rate, exposure time, exposure frequency, exposure duration, body weight, and exposure averaging time. The intake can be calculated using the following generalized equation:

$$IF = \frac{CR \times TF \times ET \times EF \times ED}{BW \times AT}$$

Where:

IF	=	Intake Factor of a environmental medium (liters [L] water, cubic meters [m ³] of air, or kilogram [kg] soil/kg body weight-day),
CR	=	Contact Rate; the amount of medium contacted per unit time (e.g., m ³ air /hour or mg soil/day),
TF	=	Transfer Factor, (mg/m ³)/(milligrams per liter [mg/L]) for groundwater, (mg/m ³)/(mg/m ³) for soil gas, or (mg/m ³)/(mg/kg) for soil,
ET	=	Exposure Time (hours/day),
EF	=	Exposure Frequency (days/year),
ED	=	Exposure Duration (years),
BW	=	Body Weight (kg), and
AT	=	Averaging Time; period over which exposure is averaged (days).

Tables 4.2 through 4.5 present the route-specific equations used in this assessment to derive the RBTCs for groundwater and soil. The equations for exposure via inhalation of groundwater and soil vapors are presented in Table 4.2, inhalation of windblown soil particulates in Table 4.3, incidental ingestion of soil in Table 4.4, and dermal contact with soil in Table 4.5. Exposure assumptions used to estimate intake factors for the potential populations of concern are summarized in Table 4.6 and discussed below.

4.3.2 Exposure Assumptions

Assumptions for route-specific exposure parameters used to estimate intakes could be separated into the following three categories:

- Assumptions regarding human physiology (e.g., body weight and breathing rate),
- Assumptions specific to the potentially exposed population (e.g., years in which an individual resides or works at the same location), and
- Assumptions specific to the given route of exposure (e.g., amount of soil contacted each day).

For this assessment, exposure assumptions corresponding to a reasonable maximum exposure (RME) scenario were developed. Intake assumptions for the RME scenario represent “the highest exposure that is reasonably expected to occur at the site” (USEPA 1989a). According to the USEPA, the intent of the RME scenario is “to estimate a conservative exposure case (i.e., well above the average case) that is still within the range of possible exposures” (USEPA 1989a). The RME is estimated by combining “upper-bound and mid-range exposure factors so that the results represent an exposure scenario that is both protective and reasonable; not the worst possible case” (USEPA 1989a).

Where available and appropriate, exposure parameter values recommended by the CalEPA (CalEPA 1992, 1994, 2005) and USEPA (USEPA 1989a, 1991b, 1997a) were used. For some exposure parameters, the CalEPA and USEPA do not have recommended values or the default recommendations are not appropriate for the populations being evaluated. In such cases, best professional judgment was used by ENVIRON to select parameter values corresponding to the individual pathways and is so noted. The three categories of exposure assumptions are further discussed below.

4.3.2.1 Human Physiological Assumptions

For estimating potential exposures to adult residents, commercial workers and construction/maintenance workers, the physiological assumptions for a male adult have been used as recommended by USEPA (1991b) and CalEPA (1992). The physiological assumptions used in this assessment include an adult body weight of 70 kg. For adult residents, the RME breathing rate is 20 m³/day or 0.83 m³/hour (USEPA 1989a, 1991b; CalEPA 1992). For commercial and construction/maintenance workers, the RME breathing rate is 20 m³/work-day or 2.5 m³/hour (USEPA 1991b, CalEPA 1992). For adult park visitors, the RME breathing rate is assumed to be 3.2 m³/day or 1.6 m³/hour (USEPA 1997a), based on the assumption of a moderate activity level.

For the child resident, physiological assumptions for the average child from infancy to six years (i.e., 0-6 years) have been used. The child is assumed to have a body weight of 15 kg (USEPA 1991b, CalEPA 1992). For the child resident, the RME breathing rate is 10 m³/day or 0.42 m³/hour (USEPA 1991b, CalEPA 1994). For child park visitors, the RME breathing rate is assumed to be 2.4 m³/day or 1.2 m³/hour (USEPA 1997a), based on the assumption of a moderate activity level.

4.3.2.2 Population-Specific Assumptions

Assumptions regarding population-specific exposure frequency, exposure duration, and exposure averaging time are used to determine the pathway-specific chemical intakes for the potentially exposed populations. Exposure frequency and exposure duration determine the total time of exposure for each population. The standard assumptions regarding exposure duration and exposure frequency for residents and commercial workers used in this analysis are those recommended by the USEPA (1989a, 1991b) and CalEPA (1992).

For the residents, it is assumed that exposure occurs for 24 hours/day for all pathways (USEPA 1991b, CalEPA 1992). Consistent with USEPA (1991b) and CalEPA (1992) guidance, an exposure frequency of 350 days per year is assumed for both the adult and child residents. This assumes that residents are present in their home seven days a week for 50 weeks a year (or approximately 96 percent of the time). Approximately two weeks (or 15 days) are spent away from home. The exposure duration for the resident is assumed to be 30 years (USEPA 1991b, 1997a; CalEPA 1992). According to USEPA (1997a), this is the 95th percentile for time spent at one residence.

Workers are assumed to be exposed for eight hours/day for all pathways (USEPA 1991b). For commercial workers, an exposure frequency of 250 days/year is assumed. Consistent with CalEPA (1992), this exposure frequency corresponds to working five days/week for 50 weeks/year. For the construction/maintenance worker, an exposure frequency of 125 days/year is assumed. This corresponds to an exposure of five days/week for 25 weeks/year. An exposure duration of one year is assumed for the construction/maintenance worker involved in short-term work, while 25 years is assumed for the commercial worker (CalEPA 1992).

Park visitors are assumed to spend the same amount of time in a park as is identified in USEPA (1997a) for time spent playing on grass (two hours per event). As with the residential exposure duration, park visitor exposure under a future park use scenario is assumed to occur for an exposure duration of 30 years. However, park visitors are assumed to be exposed for 100 days/year, which is equivalent to two days/week for 50 weeks/year.

For noncarcinogenic effects, it is assumed that the adult and child resident are exposed for 30 years and six years, respectively. For carcinogenic effects, an age-adjusted intake factor was calculated which takes into account the differences in route-specific intake rates, body weights, and exposure duration for children and adults. The 30-year residential exposure duration for carcinogenic effects is a composite of exposure assumptions for six years as a child and 24 years as an adult. These assumptions allow for the possibility that the 30 years an individual is assumed to live in the area may cover from childhood to adulthood. Regulatory guidance recommends this age-adjusted approach (USEPA 1991b, CalEPA 1992, 1994). The age-adjusted approach is also used for the adult and child park visitor.

It should be noted that the averaging time selected for estimating chemical intake for a particular exposed population depends on the type of effect being assessed. In accordance with regulatory guidance, intakes for carcinogens are calculated by averaging the dose received over a lifetime (i.e., 70 years or 25,550 days). As indicated in regulatory guidance

for noncarcinogens, the averaging time used is the period of exposure expressed in days. The basis for the use of different averaging times for carcinogens and noncarcinogens is related to the currently held scientific opinion that the mechanisms of action for the two categories of chemicals are different.

4.3.2.3 Route-Specific Assumptions

Exposures to future populations may potentially occur from inhalation of groundwater and soil vapors, inhalation of airborne soil particulates, incidental ingestion of soil, and dermal contact with soil. The route-specific assumptions used to characterize the intake for each population and exposure pathway are presented below.

It is assumed that residents may be exposed to volatile chemicals remaining in groundwater and soil and windblown particulates via the inhalation route. Breathing rates for this route of exposure were previously discussed in Section 4.3.2.1 above.

Incidental ingestion of soil and dust is highly dependent on the type of work being performed and the age of the receptor. For residents and park visitors, the RME soil ingestion rate is 100 mg/day for adults and 200 mg/day for children (USEPA 1991b, CalEPA 1992). For a commercial worker, the recommended soil ingestion rate is 100 mg/day (CalEPA 2005)¹³. For a construction worker, the recommended incidental soil ingestion rate is 330 mg/day (USEPA 2001a).

Exposure via dermal contact may result from the deposition of soil particles onto skin and the subsequent absorption of chemicals present in the deposited soil through the skin. For residents, park visitors, and construction/maintenance workers, the total exposed surface area assumes exposure to soil via head, hands, forearms, lower legs, and feet (child only) (USEPA 2001b). The total exposed surface area of these body parts is 5,700 square centimeters (cm²) for an adult resident and construction/maintenance worker and 2,800 cm² for a child. For a commercial worker, the recommended exposed surface area of 3,300 cm² assumes exposure via face, forearms, and hands (USEPA 2001b). The risk calculations are based on assumed dermal adherence factors of 0.07 mg/cm² for adult residents and park visitors, while a dermal adherence factor of 0.2 mg/cm² is assumed for child residents, child park visitors, and commercial workers (CalEPA 2000). For construction workers, the assumed dermal adherence factor is 0.8 mg/cm² (CalEPA 2000). Chemical-specific dermal absorption fractions from soil are presented in Table 4.7.

4.3.3 Quantification of Exposure

The intake factors are presented in Table 4.8 for both carcinogenic and noncarcinogenic effects. The intake factors presented in the tables employ the equations given in Tables 4.2 through 4.5, without the chemical specific transfer factors. The chemical-specific transfer factors are discussed in Section 4.4 below.

¹³ In the CCR, an ingestion rate of 50 mg/day was used for the commercial worker. This value has been increased to 100 mg/day based on recent CalEPA risk assessment guidance (CalEPA 2005).

4.4 FATE AND TRANSPORT MODELING

This section describes the approach used to estimate intermedia transfer factors needed to evaluate potential exposure through the inhalation route. Chemicals detected in groundwater and soil can potentially migrate in a vapor phase through the unsaturated zone to indoor or ambient air. This migration will be quantified for the purposes of this assessment through an intermedia transfer factor. This transfer factor is defined so that when it is multiplied by the source concentration of a chemical in groundwater (in $\mu\text{g/L}$) or soil (in $\mu\text{g/kg}$), the product is the resulting steady-state concentration that is predicted in indoor or ambient air (in $\mu\text{g/m}^3$).

For this assessment, the following transfer factors are required:

- Groundwater to residential indoor air,
- Groundwater to commercial indoor air,
- Groundwater to outdoor ambient air (recreational areas),
- Groundwater to construction trench ambient air,
- Soil gas to residential indoor air,
- Soil gas to commercial indoor air,
- Soil gas to outdoor ambient air (recreational areas),
- Soil gas to construction trench ambient air,
- Soil to residential indoor air,
- Soil to commercial indoor air,
- Soil to outdoor ambient air (recreational areas), and
- Soil to construction trench ambient air.

Intermedia transfer factors were estimated using the screening-level model of vapor migration described by Johnson and Ettinger (1991). Specifically, Version 3.1 of the spreadsheet implementation developed by the USEPA was used (USEPA 2004b). The Johnson and Ettinger model was originally developed to predict vapor intrusion into buildings. However, as described below, it is easily adapted to predict vapor intrusion into ambient and trench air.

The Johnson and Ettinger model and its variants couple the following fate and transport processes:

- Source zone partitioning to determine source vapor concentration,
- Transport across the vadose zone by diffusion,
- Transport by diffusion and advection across the soil surface and, if present, a surface barrier such as asphalt or building foundation, and
- Dispersion in indoor or ambient air.

The first process in the above list, source zone partitioning, determines the vapor concentration of the chemical at the source, which may be groundwater or soil. The last three processes, when considered together, describe the attenuation of the source soil vapor concentration as it migrates to indoor or ambient air. In the context of the Johnson and Ettinger model, the combined effect of these three attenuation processes is typically referred to as α , the soil vapor attenuation coefficient. Intermedia transfer factors, as used in this assessment, include the effect of source zone partitioning as well as the three attenuation processes. Therefore, the transfer factor is simply the product of the

appropriate partition coefficient and the vapor attenuation coefficient. No partitioning is required for a soil gas source, so soil gas transfer factors have a partition coefficient of one.

The calculation of transfer factors is based on parameters describing the properties of the chemicals evaluated, the vadose zone, the surface barrier, and the air dispersion zone. The physical-chemical properties are shown in Table 4.9. Based on guidance from USEPA (1991a), only chemicals that easily volatilize are included in the evaluation of indoor and ambient air. These include chemicals with a Henry's Law constant of greater than 1×10^{-5} atmosphere-cubic meter per mole ($\text{atm}\cdot\text{m}^3/\text{mol}$) and a molecular weight of less than 200 grams/mole (g/mol) (USEPA 2003; Yaws and Yang 1992).

Vadose zone soil parameters, which are used to calculate the effective diffusion coefficients, are shown in Table 4.10. These have been updated since the Screening HHRA/CCR based on additional site-specific data collection. These parameter values were estimated based on geologic investigations conducted on the Site, including cone penetrometer testing (CPT), physical testing of soil samples, and soil boring logs. The results of the geologic investigations conducted in the chloroform area by ENVIRON are presented in Appendix B. Figure B-1 in Appendix B shows the CPT and soil boring locations. Physical testing results are shown in Tables B-1, B-2, and B-3 in Appendix B, followed by the CPT results and boring logs. The soil properties in the areas of the Redevelopment Property outside of the chloroform area were estimated by correlating the CPT results in the chloroform area provided in Appendix B with the CPT results outside of the chloroform area presented in Golder Associates (2007).

For the groundwater and soil gas models, silty clay was assumed to be present from the ground surface to a depth of seven feet bgs, with loam (sandy silt) present between seven and 12 feet bgs, and silty clay loam present between 12 and 15 feet bgs. For the soil model, the soil type above the top of the contamination source required for modeling purposes was assumed to be silty clay for all receptors, as this is the soil type present at the ground surface. For the trench worker, the soil type above the top of the contamination zone was assumed to be same as the soil type present at the respective depth of the trench following the three-layer stratigraphy presented above.

Parameters were selected so as to reflect average values obtained from physical testing results, when available. As no physical testing results exist for the top seven feet of soil, representative values were selected based on the identified soil type. Default values given by USEPA (2004) were used for bulk density and porosity. Water-filled porosity was defined as the average of the default values of saturated water content and the residual water content based on the soil type. Soil properties for the 7–12 foot layer used in the modeling were assigned based on the average value obtained from physical testing results for samples EW-1-10-1.5, EW-15-11-11.5, EW-10-8-8.5, and EW-1-6.5-7. For the deepest layer, model soil parameters were set equal to the average values obtained from the physical testing results from EW-6-17-17.5 and EW-10-16-16.5, which are believed to represent the stratigraphy based on boring log and CPT observations. In all layers, the default value was used for the soil organic carbon fraction.

All transfer factors were calculated using the physical-chemical properties and vadose zone parameters given in Tables 4.9 and 4.10. Although the soil parameters remain the same, calculation of transfer factors for each receptor population is based on different assumptions regarding the following:

- Depth to chemical source (soil, groundwater, or soil gas),
- Surface cover (building foundation or no cover), and
- Air dispersion zone dimensions and mixing rates.

The different assumptions for each receptor population are described in the following sections.

4.4.1 Migration from Groundwater to Residential Indoor Air

The receptor population for this scenario is a resident inside a one-story concrete slab-on-grade house. The depth-to-groundwater for this scenario is conservatively estimated to be 15 feet bgs. Although current groundwater measurements on the Redevelopment Property indicate that the shallow groundwater depths are approximately 30 feet or deeper bgs, historically the recorded groundwater at the Site has been as shallow as 17 feet. The groundwater decline is due, in part, to on-site groundwater extraction, which will stop at some point in the future. It is conservatively estimated that a high groundwater depth of 15 feet bgs be used for vapor intrusion modeling. This depth is considered to be the shallowest groundwater level anticipated during the life of new structures after redevelopment (Woodward-Clyde 1993).

In addition to depth-to-groundwater, the parameters needed to estimate migration and mixing of residential indoor air are those describing the foundation and those describing the dimensions of the house. All parameter values for indoor air modeling are shown in Table 4.10. The air exchange rate chosen is the DTSC residential default value of 0.5 air changes per hour (Cal/EPA 2005).

The air transfer factors for groundwater to indoor air for residences are shown in Table 4.11.

4.4.2 Migration from Groundwater to Commercial Indoor Air

The receptor population for this scenario is a commercial worker inside a one-story concrete slab-on-grade store. The parameters used for this scenario are the same as for the residential scenario, except for the following: the air exchange rate chosen is the American Society for Testing and Materials (ASTM) commercial default value of 1.0 air changes per hour (Cal/EPA 2005), and the mixing height was assumed to be 10 feet¹⁴. All parameter values for the commercial indoor air scenario are shown in Table 4.10.

The air transfer factors for groundwater to commercial indoor air are shown in Table 4.11.

4.4.3 Migration from Groundwater to Ambient Air

The receptor population exposed to outdoor ambient air is assumed to be a person in recreational open space. Migration from groundwater to ambient air in a park is estimated using a conceptual model similar to the indoor air model but with two main differences. First, there is assumed to be no barrier to vapor flux at the ground surface (i.e., no building foundation). Second, dilution of vapors migrating

¹⁴ In the CCR, an air exchange rate of 0.83 air changes per hour was used for a commercial building. This value has been increased to 1.0 air changes per hour based on recent CalEPA risk assessment guidance (CalEPA 2005).

into outdoor ambient air is assumed to be mixed over a breathing zone adjacent to the ground surface. All parameter values for ambient air in an outdoor park are shown in Table 4.10.

An outdoor air dispersion factor (Q/C) from USEPA (1996) was used to describe vapor dispersion in outdoor ambient air. The Q/C terms were derived by averaging the results from a more complex dispersion model for a ground-level area source. The model was run for a number of different size area sources, as well as for a number of different U.S. locations. The Q/C term selected ($46.03 \text{ g/m}^2\text{-s}$ [second] per kg/m^3) was from the model run for a 30-acre area source in San Francisco. This size and location were the closest to the Site.

The air transfer factors for groundwater to outdoor ambient air are shown in Table 4.11.

4.4.4 Migration from Groundwater to Construction Trench Ambient Air

The receptor population exposed to trench ambient air is assumed to be a construction/ maintenance worker during redevelopment or other short-term maintenance activities. Information received from Hitachi GST indicated that utilities and buried pipes are present from 3.5 to 14 feet bgs (Duncan 2004). Hitachi GST personnel reported that underground industrial wastewater piping is generally in trenches located 3.5 feet bgs; underground chilled water piping is generally eight to nine feet bgs; and sewer lines can be as deep as 14 feet bgs. A construction/ maintenance worker in a five-foot trench, a nine-foot trench, and a 14-foot trench were modeled. The transfer factors and resulting RBTCs using the five-foot trench model will be used to evaluate construction activities related to the industrial wastewater pipes. The transfer factors and resulting RBTCs for the nine-foot trench model will be used to evaluate construction activities related to the deeper underground chilled water pipes, and the 14-foot trench model will be used to evaluate construction activities related to the sewer pipes.

For a construction/maintenance worker located in the five-foot trench, the receptor would be five feet closer to groundwater. Similarly, a construction/maintenance worker located in a nine-foot or 14-foot trench would be nine or 14 feet closer to groundwater. Migration of chemical vapors from groundwater to the trench ambient air is handled the same as the outdoor ambient air scenario, except that the depth-to-groundwater is assumed to be 10 feet for the five-foot trench model, six feet for the nine-foot trench model, and one foot for the 14-foot trench model. The parameter values used for modeling the trench are shown in Table 4.10.

The air transfer factors for groundwater to outdoor trench ambient air are shown in Table 4.11.

4.4.5 Migration from Soil Gas to Indoor and Ambient Air

For the soil gas scenarios, the depth-to-source was assumed to be at five, 10, and 15 feet bgs representing the depth of soil gas probes used to evaluate residential indoor air, commercial indoor air, and outdoor ambient air. Soil gas transfer factors for a construction/maintenance worker in a five-foot trench were not calculated because the shallow trench is assumed to be five feet deep and the shallow soil gas probes are assumed to be five feet deep. Besides the depth-to-source, all other modeling parameters used were the same as for the groundwater to indoor and ambient air scenarios. See Table 4.10.

The calculated transfer factors for soil gas are shown in Table 4.12.

4.4.6 Migration from Soil to Indoor and Ambient Air

For the soil scenarios, the depth of impacted soil must be estimated. The depth to the top of the impacted soil was estimated to be approximately one foot beneath the building foundation or ambient surface. This assumes that there is approximately one foot of clean fill between the bottom of the building foundation or ground surface and the top of impacted soil. The depth to the bottom of impacted soil was conservatively estimated to be 40 feet bgs. Although current groundwater measurements on the Redevelopment Property indicate that the shallow groundwater depths are approximately 30 feet bgs, the deepest shallow groundwater level recently measured on the Redevelopment Property was approximately 39 feet bgs. This depth represents the deepest depth of shallow unsaturated soils on the Redevelopment Property. These depths of impacted soil were used for the indoor residential, indoor commercial and outdoor park visitor scenarios. The assumed depths of impacted soil used in the soil model scenarios are shown in Table 4.10.

The depth to the impacted soil for the construction/maintenance worker in a trench is different from the other scenarios. First, a construction/maintenance worker located in a five-foot trench would be five feet closer to the bottom of the impacted soil. Similarly, the nine-foot trenches would be nine feet closer to the bottom of the impacted soil. Therefore, the depth to the bottom of the impacted soil is assumed to be 35 feet for the five-foot trench model and 31 feet for the nine-foot trench model. Second, the outdoor trench scenarios assume that the construction/maintenance worker could come into direct contact with chemicals in soil. Besides the depths of impacted soil, other parameters needed for the soil model scenarios (e.g., air exchange rates; vapor flow rates; mixing heights; parameters describing the foundation; dimensions of the house or commercial space; and outdoor air dispersion factor) are the same as those for the groundwater model scenarios. See Table 4.10.

The calculated transfer factors for soil are shown in Table 4.13.

4.4.7 Windblown Dust

It is assumed that residents, park visitors, and commercial workers may be exposed to airborne particulates on a daily basis under regular Site conditions. Based on USEPA screening guidelines (USEPA 2004b), a particulate emission factor (PEF) of $1.316 \times 10^9 \text{ m}^3/\text{kg}$ was used to estimate airborne concentrations of a chemical from corresponding soil concentrations for all chemicals that were not assumed to be volatile. This PEF reflects an airborne concentration of dust of approximately $0.76 \mu\text{g}/\text{m}^3$. For construction/maintenance workers, a PEF of $1.44 \times 10^6 \text{ m}^3/\text{kg}$ is used (RWQCB-SF 2005). This PEF reflects an airborne concentration of dust of approximately $700 \mu\text{g}/\text{m}^3$.

As part of the estimation of the potential exposure via inhalation of windblown dust, it is assumed that the inhaled dust has the same chemical composition as the surface soil in the Redevelopment Property. This is thought to be a conservative assumption because not all of the dust in the air in the area will have originated from the area.

4.5 TOXICITY ASSESSMENT

The purpose of the toxicity assessment is to present the weight-of-evidence regarding the potential for a chemical to cause adverse effects in exposed individuals, and to quantitatively characterize, where possible, the relationship between exposure to a chemical and the increased likelihood and/or severity of adverse effects (i.e., the dose-response assessment). Well conducted epidemiological studies that show a positive association between exposure to a chemical and a specific health effect are the most convincing evidence for predicting potential hazards for humans. However, human data that would be adequate to serve as the basis for the dose-response assessment are available for only a few chemicals. In most cases, toxicity assessment for a chemical has to rely on information derived from experiments conducted on non-human mammals, such as the rat, mouse, rabbit, guinea pig, hamster, dog, or monkey.

When the dose-response assessment is based on animal studies, it usually requires two types of extrapolation: high-to-low dose extrapolation and interspecies extrapolation. High-to-low dose extrapolation involves predicting the incidence rate of an adverse effect at low exposure levels based on the results obtained at high exposure levels. Interspecies extrapolation involves predicting the likelihood of an adverse effect in humans based on results obtained from animal studies. In the absence of evidence to the contrary, it is assumed that adverse effects observed in animals will also occur in humans.

Chemicals are usually evaluated for their potential health effects in two categories, carcinogenic and noncarcinogenic. Different methods are used to estimate the potential for carcinogenic and noncarcinogenic health effects to occur. All chemicals produce noncarcinogenic effects at sufficiently high doses but only some chemicals are associated with carcinogenic effects. Most regulatory agencies consider carcinogens to pose a risk for cancer at all exposure levels (i.e., a "no-threshold" assumption); that is, any increase in dose is associated with an increase in the probability of developing cancer. In contrast, noncarcinogens generally are thought to produce adverse health effects only when some minimum exposure level is reached (i.e., a threshold dose).

Sections 4.5.1 and 4.5.2 describe the methods used for the chronic toxicity assessment of carcinogens and noncarcinogens, respectively. Section 4.5.3 identifies the hierarchy of sources used to select toxicity values for this assessment.

4.5.1 Carcinogenic Effects

Current health risk assessment practice for carcinogens is based on the assumption that there is no threshold dose below which carcinogenic effects do not occur. This current "no-threshold" assumption for carcinogenic effects is based on an assumption that the carcinogenic processes are the same at high and low doses. This approach has generally been adopted by regulatory agencies as a conservative practice to protect public health. The "no-threshold" assumption is used in this assessment for evaluating carcinogenic effects. Although the magnitude of the risk declines with decreasing exposure, the risk is believed to be zero only at zero exposure.

There are two components to the assessment of the carcinogenic effects of a chemical: a qualitative determination of the likelihood of it being a human carcinogen (i.e., weight-of-evidence), and a quantitative assessment of the relationship between exposure dose and response (i.e., cancer slope

factor). Using the weight-of-evidence approach, the USEPA's Carcinogen Assessment Group (CAG) categorizes chemicals into Groups A, B, C, D, and E carcinogens (USEPA 1989a). CAG's classification of carcinogens is briefly described below:

- **Group A – Human Carcinogen**
This category indicates that there is sufficient evidence available from human epidemiological studies to support a causal association between exposure to the chemical and the development of human cancer.
- **Group B – Probable Human Carcinogen**
This category indicates that sufficient evidence exists from animal studies to support a causal relationship between exposure to the chemical and the development of cancer in animals. This category is divided into subgroups B1 and B2. Group B1 chemicals also have limited evidence for carcinogenicity from human epidemiological studies. Group B2 chemicals have inadequate or no evidence from epidemiological studies.
- **Group C – Possible Human Carcinogen**
This category is for chemicals that exhibit limited evidence of carcinogenicity in animals.
- **Group D – Not Classifiable as to Human Carcinogenicity**
This category is used for chemicals with inadequate human and animal evidence of carcinogenicity.
- **Group E – Evidence of Noncarcinogenicity for Humans**
This category is used for chemicals that show no evidence of carcinogenicity in at least two adequate animal tests in different species or in both adequate epidemiological and animal studies.

Cancer slope factors (CSFs) are used to quantify the response potency of a potential carcinogen. CSFs are typically calculated for carcinogens in Group A, B1, and B2. The USEPA decides to derive CSFs for Group C chemicals on a case-by-case basis.

CSFs may be based on either human epidemiological or animal data and are calculated by applying a mathematical model to extrapolate from responses observed at relatively high exposure doses in the studies to responses expected at lower doses of human exposure to chemicals in the environment. A number of mathematical models and procedures have been developed for the extrapolation. In the absence of adequate data to the contrary, the linearized multistage model is employed (USEPA 1989a).

In general, the CSF is a plausible upper-bound estimate of the probability of a response per unit intake of a chemical, e.g., $(\text{mg/kg/day})^{-1}$, over a lifetime. The CSF is used in risk assessments to estimate an upper-bound lifetime probability of an individual developing cancer as a result of exposure to a particular level of a potential carcinogen. The true value of the risk is unknown, and may be as low as zero.

4.5.2 Noncarcinogenic Effects

The dose-response assessment for noncarcinogenic effects requires the derivation of an exposure level below which no adverse health effects in humans are expected to occur. These levels are referred to as reference doses (RfDs) for oral exposure and reference concentrations (RfCs) for inhalation exposure (USEPA 1989a). For the characterization of the potential noncarcinogenic health effects, inhalation RfCs, which are generally reported as concentrations in air, are converted to corresponding inhaled doses (inhalation RfDs) using USEPA-approved interim methodology (USEPA 1989a).

4.5.3 Sources of Toxicity Values

The hierarchy of sources used for the toxicity factors is consistent with those recommended by the CalEPA DTSC for risk assessments. This hierarchy is as follows:

1. CalEPA CSFs, RfDs, and RfCs (CalEPA 2005a, 2005b, 2007),
2. CSFs, RfDs, and RfCs developed by the USEPA and listed in the Integrated Risk Information Service (IRIS) (USEPA 2007a),
3. USEPA CSFs, RfDs, and RfCs listed in the USEPA Health Effects Assessment Summary Tables (HEAST) (USEPA 1997b), and
4. Provisional USEPA RfDs and RfCs recommended by USEPA's National Center for Environmental Assessment (NCEA).

Cancer and noncancer toxicity values used in this assessment are summarized in Table 4.14. Where available, the table also presents the classification of carcinogens according to the weight-of-evidence classifications described in Section 4.5.1.

Specific dermal route CSFs and RfDs have not yet been developed for any chemicals. Consistent with CalEPA and USEPA guidance, potential health effects associated with dermal exposure are calculated using the oral toxicity factors.

Toxicity criteria for TPH mixtures are discussed in further detail below.

4.5.4 Total Petroleum Hydrocarbons

The TPH constituents detected at the Site in soil and groundwater consist of petroleum hydrocarbons in three ranges: TPH-diesel, TPH-motor oil (residual), and TPH-Shell Sol 140 (kerosene). In addition, TVH were detected in soil gas. Petroleum hydrocarbons are chemical mixtures made up of hundreds of individual compounds belonging to two major groups, aliphatic and aromatic. Except for several specifically identified aromatic compounds such as benzene and certain PAHs, the hydrocarbons typically found in petroleum products are considered to be noncarcinogenic. Certain chemicals that may pose a risk to human health and are present in TPH (such as BTEX and PAH) were individually characterized and included in this risk assessment by the development of chemical-specific RBTCs. However, these chemicals represent a very small

fraction of the hundreds of noncarcinogenic hydrocarbon constituents present in TPH-diesel, TPH-motor oil, and TPH-Shell Sol ranges. DTSC (1995b) recommends an approach that examines each TPH mixture as a product of smaller subsets (fractions) of carbon chain ranges, and uses individual surrogate chemicals to derive RfDs for each fraction, similar to that developed by the Total Petroleum Hydrocarbon Criteria Working Group (TPHCWG 1997).

TPH is divided into five fractions based on carbon chain length and chemical class (aromatic or aliphatic). These fractions are C5-C8 aliphatic, C9-C18 aliphatic, C19-C32 aliphatic, C9-C16 aromatic, and C17-C32 aromatic. Based on a review of the TPHCWG and Massachusetts Department of Environmental Protection (MADEP) (2002) methodologies, DTSC proposed toxicity values for each of these fractions (see Table 4.14).

In order to apply this approach to estimate the noncancer risk for each of the TPH ranges, the fractional composition of the TPH analytical range in terms of both carbon range and structural form (i.e., aliphatic or aromatic) must be defined. DTSC (1995b) recommends a TPH-diesel composition based on Park and San Juan (2000) and is presented in TPH RBTC calculation tables, and a TPH-motor oil composition of 100% C17-C32 aromatic. In addition, TPH-Shell Sol was assumed to be 100% C9-C18 aliphatic.

TVH consists of the three volatile fractions, C5-C8 aliphatic, C9-C18 aliphatic, and C9-C16 aromatic in uncertain proportion. As a conservative screen, the RBTC for soil gas was set equal to the lowest RBTC of the three RBTCs calculated for the three fractions.

4.6 CALCULATION OF RISK-BASED TARGET CONCENTRATIONS

The development of RBTCs for the protection of human health requires the same kinds of information and calculations used to develop risk estimates. One can estimate the potential risk associated with a measured concentration of a chemical in a given media (i.e., groundwater or soil) or, alternatively one can calculate the concentration (i.e., RBTC) in that same media which would result in an acceptable cancer risk level or noncancer hazard index (HI). Average concentrations (i.e., 95 percent upper confidence limit on the mean concentration) at or below the RBTCs would support the conclusion that the human health risks within an exposure area (e.g., park or residential lot) are within acceptable limits.

4.6.1 Methodology

For carcinogenic chemicals, the equation used to calculate soil RBTCs due to exposure via the ingestion, dermal contact, and inhalation exposure pathways is as follows:

$$RBTC_{Carcinogen} = \frac{\text{Target Cancer Risk}}{[(CSF_{Inhal} \times IF_{Inhal}) + (CSF_{oral} (IF_{oral} + IF_{dermal}))]}$$

Where:

CSF_{inhal}	=	Inhalation Cancer Slope Factor (mg chemical/kg body weight-day) ⁻¹ ,
IF_{inhal}	=	Intake Factor for inhalation of particulates or vapors (kg soil/kg body weight-day),

CSF_{oral} = Oral Cancer Slope Factor (mg chemical/kg body weight-day)⁻¹,
 IF_{oral} = Intake Factor for soil ingestion, (kg soil/kg body weight-day), and
 IF_{dermal} = Intake Factor for dermal contact, (kg soil/kg body weight-day).

The equation used to calculate human health groundwater and soil gas RBTCs corresponding to potential exposure from the inhalation pathway is as follows:

$$RBTC_{Carcinogen} = \frac{\text{Target Cancer Risk}}{(CSF_{Inhal} \times IF_{Inhal})}$$

Where:

CSF_{inhal} = Inhalation Cancer Slope Factor
 (mg chemical/kg body weight-day)⁻¹, and
 IF_{inhal} = Route-specific intake factor for inhalation of vapors
 (m³ air/kg-body weight-day).

For noncarcinogens, the equation used to calculate soil RBTCs due to exposure via the ingestion, dermal contact, and inhalation exposure pathways is as follows:

$$RBTC_{Noncarcinogen} = \frac{\text{Target Hazard Index}}{\left[\frac{(IF_{Inhal})}{RfD_{Inhal}} + \frac{(IF_{oral} + IF_{dermal})}{RfD_{oral}} \right]}$$

Where:

IF_{Inhal} = Intake Factor for inhalation of particulates or vapors (kg soil/kg
 body weight-day),
 RfD_{Inhal} = Inhalation Reference Dose (mg chemical/kg body weight-day),
 IF_{oral} = Intake Factor for soil ingestion, (kg soil/kg body weight-day),
 RfD_{oral} = Oral Reference Dose (mg chemical/kg body weight-day),
 IF_{dermal} = Intake Factor for dermal contact, (kg soil/kg body weight-day).

The equation used to calculate human health groundwater and soil gas RBTCs due to potential exposure via the inhalation pathway is as follows:

$$RBTC_{Noncarcinogen} = \frac{\text{Target Hazard Index}}{\left[\frac{IF_{Inhal}}{RfD_{Inhal}} \right]}$$

Where:

IF_{Inhal} = Route-specific intake factor for inhalation of vapors
 (m³ air/kg-body weight-day), and

$$\text{RfD}_{\text{Inhal}} = \text{Inhalation Reference Dose} \\ (\text{mg chemical/kg body weight-day}).$$

Route-specific intake factors (i.e., oral, inhalation, or dermal contact) were calculated based on the assumptions and equations presented in Section 4.3. CSFs and RfDs used in the calculations were presented in Section 4.5. The calculated intake factors for carcinogens and noncarcinogens are presented in Table 4.8.

The National Contingency Plan (NCP) (40 Code of Federal Regulations [CFR] §300) is commonly cited as the basis for target risk and hazard levels. According to the NCP, lifetime incremental cancer risks posed by a site should not exceed one in a million (1×10^{-6}) to one hundred in a million (1×10^{-4}), and noncarcinogenic chemicals should not be present at levels expected to cause adverse health effects (i.e., HI greater than one). As a risk management policy, the CalEPA generally considers 1×10^{-6} to be a point of departure for purposes of making risk management decisions, with most approved remediation achieving incremental risk levels of 10 in one million (1×10^{-5}) or lower. The California Safe Drinking Water and Toxic Enforcement Act considers 1×10^{-5} as a no significant risk level.

For this assessment, the calculated RBTCs correspond to a cancer risk of 1×10^{-6} . For noncancer health hazards, a target HI of one is identified. Individual chemical exposures that yield HIs of less than one are not expected to result in adverse, noncancer health effects (USEPA 1989a).

4.6.2 Target Concentrations

In this assessment RBTCs were calculated for all chemicals detected in groundwater, soil gas, and soil for the residential, construction worker, commercial worker, and park visitor scenarios.

The groundwater RBTCs are summarized in Table 4.15. For each TPH fraction shown in Table 4.15, the lowest RBTC is higher than the water solubility limit for that fraction. This means that the RBTCs for TPH-diesel, TPH-motor oil, and TPH-Shell Sol in groundwater are effectively unlimited.

The soil gas RBTCs developed for depths of five, 10, and 15 feet bgs for each of the exposed populations are summarized in Tables 4.16, 4.17, and 4.18, respectively. As a conservative screen, each RBTC for TVH in soil gas was set equal to the lowest RBTC of the three RBTCs calculated for the three fractions. The soil gas TVH RBTCs are very conservative because the actual composition of TVH is likely to include the more volatile and less toxic fractions.

The soil RBTCs for each population are summarized in Table 4.19. The soil RBTCs developed for TPH-diesel, TPH-Shell Sol 140 and TPH-motor oil for each of the exposed populations are summarized in Tables 4.20 through 4.22.

RBTCs for a construction worker have been presented in this section for comparison to the other three scenarios (residential, commercial worker, and park visitor). As shown in Table 4.19, the residential RBTCs for groundwater and soil gas are more conservative than for the other potential populations. For soil, the residential RBTCs are more conservative for most chemicals with the

exception of some metals. For these metals, the lowest (or most conservative) RBTC is for a construction worker. This is due to a very conservative soil ingestion rate (330 mg/day), inhalation rate (20 m³/day) and high dust concentration (700 µg/m³) assumed for the calculation of the construction worker RBTC. The calculation of the RBTC assumes no worker protection (e.g., direct hand to mouth contact, no gloves, no respirator or other protection against dust) and eight hours exposure per day. As this is not representative of typical worker conditions during construction on large redevelopment properties, the residential land use option has been selected as the most conservative land use option for the Site.

5.0 COMPARISON OF RISK-BASED TARGET CONCENTRATIONS TO MEASURED CONCENTRATIONS

In order to assess whether residual chemical concentrations in groundwater, soil gas, and soil in the Redevelopment Property are within acceptable risk ranges based on proposed future land uses, measured concentrations were compared to the RBTCs calculated for the applicable media. As a conservative screen, individual groundwater, soil gas, and soil samples were compared directly to the chemical-specific RBTCs developed for future residential land use. Determination that the Site meets residential standards would eliminate the need for any further Site restrictions (i.e., in addition to the current Site-wide restriction on using shallow groundwater as a drinking water source and the restriction on a small portion of Tucson Way potentially affected by Shell Sol, which is being addressed in the SMP being prepared by IBM).

This section is divided into seven subsections. Section 5.1 presents the comparisons for chemicals detected in Site-wide groundwater. Sections 5.2 through 5.6 presents the comparisons for chemicals detected in all media for Parcels O-1 through O-5, respectively. Section 5.7 presents the comparisons for Endicott Boulevard/Tucson Way.

According to USEPA, the exposure concentration term in the intake equation is the arithmetic average of the concentration that is contacted over the exposure period (USEPA 1989). Although this concentration does not reflect the maximum concentration that could be contacted at any one time, it is regarded as a reasonable estimate of the concentration likely to be contacted over time, since assuming long-term contact with the maximum concentration is not reasonable. Because of the uncertainty associated with any estimate of exposure concentration, USEPA recommends that the 95 percent upper confidence limit (UCL) on the arithmetic average be used for this variable (USEPA 1989). The 95 percent UCL provides reasonable confidence that the true site average will not be underestimated (USEPA 1992). Therefore, even if any one sample concentration exceeds the RBTC, the average may not.

Chapter 6.0 presents the estimated cancer risks and noncancer hazard indices for Site-wide groundwater, Parcels O-1 through O-5, and Endicott Boulevard/Tucson Way. In Chapter 6.0, exposure point concentrations (EPCs) are calculated for each chemical of concern in each applicable exposure area. In addition, cumulative risks (added over chemicals and pathways) are presented.

5.1 SITE-WIDE GROUNDWATER

For this evaluation, ENVIRON obtained the last three years of data (2004-2006) for the Site-wide groundwater plume on the Redevelopment Property. Chemicals detected on the Redevelopment Property in groundwater during this time period include the following:

- VOCs: acetone, benzene, 2-butanone, carbon tetrachloride, chloroethane, Chloroform, dibromofluoromethane, 1,1-DCA, 1,2-DCA, 1,1-DCE, cis-1,2-DCE, trans-1,2-DCE, ethylbenzene, Freon 12, Freon 113, isopropanol, methyl chloride, methylene chloride, PCE, toluene, 1,1,1-TCA, 1,1,2-TCA, TCE, vinyl chloride, and xylenes.

- Metals: chromium (total), hexavalent chromium, and iron.
- TPH

Tables 5.1 and 5.2 compare the maximum chemical concentrations detected on the Redevelopment Property in Site-wide groundwater to the lowest residential groundwater RBTC. None of the chemicals detected in Site-wide groundwater were above their respective minimum residential RBTCs.

5.2 PARCEL O-1

Investigations conducted on Parcel O-1 included soil and soil gas. Soil and soil gas results are discussed separately below in Sections 5.2.1 and 5.2.2, respectively.

5.2.1 Soil

As discussed in Section 3.2.3, five soil investigations were conducted on Parcel O-1 that are representative of current Redevelopment Property conditions. One of these investigations was historical (prior to 2004). The data for this historical investigation is summarized in Table 3.7 and the sample locations are shown on Figure 3.8. Four soil investigations were conducted under the SI/SP and CMS for the Redevelopment Property. The data for these investigations are summarized in Table 3.6 and the sample locations are shown on Figure 3.10. The soil investigations are as follows:

- Old Septic Tank in Vicinity of Building 010 – During this investigation, which was conducted in July 1990, two borings were advanced to a maximum of 37.5 feet bgs, and soil samples were collected one-foot bgs and approximately every six feet to the total depth of each boring (for a total of 13 soil samples). The soil samples were analyzed for VOCs and BTEX. The only chemical detected was 1,1,1-TCA. 1,1,1-TCA was detected in two locations, at depths of seven and 13 feet.
- Former UST at Building 011 – During this investigation, which was conducted in November 2006, soil samples were collected from two locations at depths of 10 and 15 feet bgs (for a total of four soil samples). These samples were analyzed for TPH as diesel and motor oil, and BTEX. No chemicals were detected above laboratory detection limits.
- Previously Unknown Well Beneath Boulder Boulevard – During this investigation, which was conducted in January 2007, one soil sample was collected from the top six inches of soil present in the well (approximately 15 feet bgs) and analyzed for VOCs, TPH as diesel and motor oil, and metals. Chemicals detected included arsenic, barium, chromium (total), cobalt, copper, lead, mercury, nickel, vanadium, and zinc.
- Current Orchard Areas – During this investigation, which was conducted in October 2004, shallow soil samples (zero to six inches; and a limited subset at two to three feet bgs) were collected from 20 locations and analyzed for OCPs and metals. Chemicals detected included nine OCPs (DDD, DDE, DDT, dieldrin, endrin, chlordane [technical], alpha-chlordane, gamma-

chlordane, toxaphene), arsenic, barium, chromium (total), cobalt, copper, lead, mercury, nickel, vanadium, and zinc.

- Former Orchard Areas – During this investigation, which was conducted in October 2005, ten soil samples were collected (from native soil immediately beneath the asphalt and road base material) and analyzed for OCPs and arsenic. Chemicals detected included DDE, DDT and arsenic.

Based on these investigations, a total of 20 chemicals were detected in soil on Parcel O-1:

- VOCs: 1,1,1-TCA.
- OCPs: DDD, DDE, DDT, dieldrin, endrin, chlordane (technical), alpha-chlordane, gamma-chlordane, toxaphene.
- Metals: arsenic, barium, chromium, cobalt, copper, lead, mercury, nickel, vanadium, and zinc.

Tables 5.3 and 5.4 compare the maximum chemical concentrations detected in soil (at all depths) at Parcel O-1 to the lowest residential soil RBTCs. Any historical soil data that was not superseded by new data collected as part of the CCR has been included in this evaluation. Only two chemicals exceeded their minimum residential soil RBTC, toxaphene and arsenic.

Toxaphene was detected in one out of 36 samples collected to evaluate the current and former orchard areas. Toxaphene was detected in this sample (1-14) at a concentration of 0.43 mg/kg, slightly above its minimum residential RBTC of 0.41 mg/kg. As presented in Section 6.4.1, the exposure point concentration (EPC) for toxaphene in the orchard areas is 0.053 mg/kg.

Arsenic was detected at concentrations greater than the minimum residential RBTC in all samples. The maximum arsenic concentration detected for this parcel was 11 mg/kg, which is above the average background concentration for the Site (8 mg/kg), but below the maximum of 12 mg/kg. The average concentration of arsenic in orchard areas on Parcel O-1 is 7.4 mg/kg.

5.2.2 Soil Gas

As discussed in Section 3.2.3, two soil gas investigations were conducted on Parcel O-1 as follows:

- Soil Gas Sampling Near Monitoring Well RA-24 – During this investigation, which was conducted in October 2004, 28 locations were sampled at depths of approximately five and 15 feet bgs. All soil gas samples were analyzed for VOCs and TVH. Low concentrations of VOCs were detected in all samples. TVH was also detected.
- Due Diligence Soil Gas Sampling – During this investigation, which was conducted in May 2006, five locations at two depths (five and 10 feet bgs) were sampled and analyzed for VOCs and TVH. Both VOCs and TVH were detected.

The data for the soil gas investigations is summarized in Tables 3.4 and 3.5, and the sample locations are shown on Figure 3.9. Based on these investigations, a total of 16 chemicals were detected in soil gas on Parcel O-1:

- VOCs: benzene, 1,1-DCA, 1,1-DCE, cis-1,2-DCE, ethylbenzene, Freon 12, Freon 113, PCE, toluene, 1,1,1-TCA, TCE, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, m,p-xylene, and o-xylene.
- TVH

Tables 5.5 through 5.8 compare the maximum chemical concentrations detected in soil gas at Parcel O-1 to the lowest residential soil gas RBTC at five, 10, and 15 feet bgs, respectively. Two chemicals slightly exceeded their minimum residential RBTC at five feet bgs, benzene (in samples SJ-SG-17 and SJ-SG-5) and TCE (in samples SG-DD-02 and SJ-SG-3). All exceedences were near monitoring well RA-24. Benzene was detected at a maximum concentration of 0.31 mg/m³ compared to its minimum residential RBTC of 0.24 mg/m³. TCE was detected at a maximum of 5.1 mg/m³ compared to its minimum residential RBTC of 3.8 mg/m³.

5.3 PARCEL O-2

Investigations conducted on Parcel O-2 included soil, soil gas, and groundwater. The results for these media are discussed below in Sections 5.3.1 through 5.3.3.

5.3.1 Soil

As discussed in Section 3.2.4, 23 soil investigations were conducted on Parcel O-2 that are representative of current Redevelopment Property conditions. Twelve of these investigations were historical (prior to 2004). The data for these historical investigations are summarized in Table 3.10 and the sample locations are shown on Figure 3.11. Eleven soil investigations were conducted under the SI/SP and CMS for the Redevelopment Property. The data for these investigations are summarized in Table 3.11 and the sample locations are shown on Figure 3.13. The soil investigations are as follows:

- Hydrofluoric Release (Building 026) – During this investigation, which was conducted in February 1984, samples were collected beneath Building 026 to determine if an above grade release of HF had affected soil. Only fluoride and nitrate were detected.
- Chemicals Penetrating Floor in Laboratory (Building 026) – During this investigation, which was conducted in September 1984, seven soil samples (up to a depth of 1.5 feet bgs) were collected and analyzed for Freon 113, TCA, methylene chloride, total chromium, hexavalent chromium, copper, and fluoride. Total chromium, copper and fluoride were detected.
- Soil Investigation Prior to Constructing Addition to Building 012 – During this investigation, which was conducted in 1985, soil samples were collected from six locations (18 samples ranging in depth from 1.5 to 21 feet bgs) and analyzed for Freon 113, TCA, and TCE. None of these chemicals was detected above the laboratory detection limit (<0.001 mg/kg).

- Former Diesel Fuel UST (Building 010) – During this investigation, which was conducted in April 1986, soil samples were collected from two locations (9.5 feet bgs on either side of the excavation pit) and analyzed for TPH as diesel fuel. TPH as diesel fuel was not detected above the laboratory detection limit (<10 mg/kg).
- Former Diesel Fuel UST (west of Building 026) – During this investigation, which was conducted in April 1986, two soil samples were collected from the bottom of the excavation at a depth of 10.5 feet bgs and analyzed for TPH. TPH was not detected (<10 mg/kg) in either sample.
- Liquid Seepage in Room 400 (Building 026) – During this investigation, which was conducted in February 1987, three samples each from eight boring were collected and analyzed for TCE, Freon 113, TCA, PCE, total chromium, hexavalent chromium, copper, nickel, fluoride, and nitrate. Chemicals detected included TCE, chromium (total), copper, nickel, and nitrate.
- Room 400 Investigation (Building 026) – In October 2006, ENVIRON collected an additional sample of soil beneath the Room 400 concrete slab. The sample was analyzed for VOCs, TPH as diesel and motor oil, and metals. Chemicals detected included TPH as diesel, arsenic, barium, chromium (total), cobalt, copper, lead, nickel, vanadium, and zinc.
- Sumps in Rooms 113C and 114A (Building 026) – During this investigation, which was conducted in March and April 1987, seven locations were sampled (19 samples from a depth of 1.0 foot bgs to 6.9 feet bgs) and analyzed for chromium, nickel, lead, iron, fluoride, nitrate, sulfate and chloride. In addition a GC scan for organics was conducted. Chemicals detected included chromium, nickel, lead, iron, and chloride.
- Soil Beneath Building 026, Including Chemical Storage Room – During these investigations, which were conducted in July, September, and October 1987, 26 soil samples were collected beneath several rooms within Building 026 and analyzed for VOCs. The samples collected in July 1987 were also analyzed for metals, hexavalent chromium, fluoride, chloride, and nitrate. Chemicals detected included TCE, arsenic, chromium (total), copper, nickel, lead, and nitrate. As part of the SI/SP, the area in the vicinity of the cast iron pipe beneath the Chemical Storage Room (where TCE was detected during the 1987 investigations) was re-sampled for VOCs. Therefore, the 1987 VOC data has not been included in this evaluation.
- Former Cast Iron Pipe Beneath Chemical Storage Room (Building 026) – In October 2006, three soil borings (15 samples from a depth of 0 to 20 feet bgs) were advanced in the area of the former cast iron pipe below the former Chemical Storage Room. Samples were analyzed for VOCs, metals, and hexavalent chromium. Detected chemicals included TCE, arsenic, barium, beryllium, chromium (total), cobalt, copper, lead, mercury, molybdenum, nickel, vanadium, and zinc.
- Sump in Photographic Laboratory – Room 808u (Building 026) – During this investigation, which was conducted in April 1988, three soil samples were collected from one location at depths of 1.5, 3.0 and 4.5 feet bgs. The samples were analyzed for hydroquinone. In addition, a

GC scan was conducted for VOCs. No chemicals were detected above the laboratory detection limits.

- Staining near Drains in Kodak Processing Room 149 (Building 026) – During this investigation, which was conducted in December 1988, three soil samples were collected (each at 1.1 feet below the floor) and analyzed for hydroquinone. Hydroquinone was not detected at a detection limit of 5 mg/kg.
- Sump in Photographic Laboratory – Room 305u (Building 026) – During this investigation, which was conducted in March 1989, five samples (from 1.0 to 5.0 feet below the concrete floor) were collected and analyzed for hydroquinone. In addition, a GC scan was conducted for VOCs. No chemicals were detected above the laboratory detection limits.
- Cut Hydraulic Fluid Pipeline at Loading Dock (Building 026) – During this investigation, which was conducted in November 1990, four confirmation samples were collected and analyzed for TPH as diesel and TOG. TPH as diesel and TOG were not detected in any of the samples (<10 mg/kg).
- Buried Concrete Trench Soil Sampling (west of Building 026) – During this investigation, which was conducted October 2006 through March 2007, soil samples were collected from five locations along the trench line and analyzed for VOCs and metals. No VOCs were detected above the laboratory detection limits. Detected chemicals include arsenic, barium, beryllium, cadmium, chromium (total), cobalt, copper, lead, mercury, molybdenum, nickel, silver, vanadium, and zinc.
- Former WV-02 (Original) (Building 026) – During this investigation, which was conducted in October 2006, two soil borings (10 soil samples from a depth of 0 to 20 feet bgs) were advanced in the area of WV-02 (Original). These samples were analyzed for VOCs and metals. Detected chemicals included TCE, arsenic, barium, beryllium, chromium (total), cobalt, copper, lead, mercury, nickel, vanadium, and zinc.
- Former Buried Clay Pipeline Associated with WV-02 (Original) – During this investigation, which was conducted in October 2006, two soil borings (10 soil samples from a depth of 0 to 20 feet bgs) were advanced every 100 feet along the former buried clay pipeline associated with WV-02 (Original). These samples were analyzed for VOCs and metals. Detected chemicals included arsenic, barium, beryllium, chromium (total), cobalt, copper, lead, mercury, nickel, vanadium, and zinc.
- Former WV-02 (Second) (Building 026) – During this investigation, which was conducted in October 2006, two soil borings (10 soil samples from a depth of 0 to 20 feet bgs) were advanced in the area of WV-02 (second) and analyzed for VOCs and metals. Detected chemicals include arsenic, barium, beryllium, chromium (total), cobalt, copper, lead, mercury, nickel, vanadium, and zinc.
- Former WV-15 (Building 026) – During this investigation, which was conducted in October 2006, one grab soil sample was collected beneath the former slab and analyzed for VOCs, TPH

as diesel and motor oil, and metals. Chemicals detected included acetone, TPH as diesel, arsenic, barium, beryllium, chromium (total), cobalt, copper, lead, mercury, nickel, vanadium, and zinc.

- Emergency Diesel Generators (Building 010) – During this investigation, which was conducted in November 2006, soil samples were collected from four locations (16 samples ranging in depth from five feet bgs to 20 feet bgs) and analyzed for TPH as diesel and motor oil. TPH diesel was detected in one location at 4.4 mg/kg.
- Clarifier (Building 026) – During this investigation, which was conducted in January 2007, eight confirmation soil samples were collected and analyzed for VOCs, TPH as diesel and motor oil and metals. Chemicals detected included TCE, TPH as diesel, TPH as motor oil, arsenic, barium, beryllium, chromium (total), copper, lead, mercury, nickel, silver, vanadium, and zinc.
- Current Orchard Areas – During this investigation, which was conducted in October 2004, shallow soil samples (zero to six inches) were collected from four locations and analyzed for OCPs and metals. Chemicals detected included three OCPs (DDE, DDT, dieldrin), arsenic, barium, chromium (total), copper, lead, mercury, nickel, vanadium, and zinc.
- Former Orchard Areas – During this investigation, which was conducted in October 2005, 23 shallow soil samples were collected (from native soil immediately beneath asphalt and road base material) and analyzed for OCPs and arsenic. Chemicals detected included DDD, DDE, DDT, dieldrin, gamma-chlordane and arsenic. Due to elevated concentrations of OCPs in one sample (B44), additional step out sampling and investigation was conducted. This investigation, conducted from December 2005 through November 2006, included soil sampling and excavation. After excavation, remaining samples included 45 samples collected from depths of zero to 4.5 feet bgs that were analyzed for OCPs. Chemicals detected included DDD, DDE, DDT, dieldrin, and endrin.

Based on these investigations, a total of 29 chemicals were detected in soil on Parcel O-2:

- VOCs: acetone and TCE.
- OCPs: DDD, DDE, DDT, dieldrin, gamma-chlordane, and endrin.
- TPH: TPH as diesel and motor oil.
- Metals: antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, iron, lead, mercury, molybdenum, nickel, silver, vanadium, and zinc.
- Anions: chloride, fluoride and nitrate.

Tables 5.3 and 5.4 compares the maximum chemical concentrations detected in soil (at all depths) at Parcel O-2 to the lowest residential soil RBTCs. Any historical soil data that was not superseded by new data collected as part of the CCR has been included in this evaluation. Three chemicals exceeded their minimum residential soil RBTC: dieldrin, arsenic, and iron.

Dieldrin was analyzed for as part of the investigation of current and former orchard areas. Dieldrin was detected in nine out of 72 samples remaining after excavation with detected concentrations ranging from 0.0069 mg/kg to 0.062 mg/kg. Three samples were above the minimum residential

soil RBTC at concentrations of 0.032 mg/kg (D6), 0.038 mg/kg (EXC-B4), and 0.062 mg/kg (EXC-C6-SWSouth) compared to the minimum residential RBTC of 0.03 mg/kg. As discussed in Section 6.5.1, the EPC for dieldrin in orchard areas is 0.0078 mg/kg.

Arsenic was detected at concentrations greater than the minimum residential RBTC in most soil samples. The maximum arsenic concentration detected for this parcel was 11 mg/kg, which is above the average background concentration for the Site (8 mg/kg), but below the maximum of 12 mg/kg. The average concentration of arsenic in orchard areas on Parcel O-2 is 6.7 mg/kg.

Iron was analyzed and detected in the historical soil investigation that evaluated trenches and sumps in Rooms 113C and 114A. During this soil investigation, iron was detected at concentrations ranging from 7,100 mg/kg to 110,000 mg/kg, compared to the minimum residential RBTC of 23,000 mg/kg. Two locations (four soil samples) exceeded the minimum residential RBTC. In addition, the one background sample collected during the investigation (Sample 406-02-0015 at a concentration of 28,000 mg/kg) also exceeded the RBTC. As discussed in the CCR (ENVIRON 2005a), iron results were compared to typical iron background results from literature sources. Background concentrations of iron in California soils range from 10,000 to 87,000 mg/kg, with a mean of 37,000 mg/kg (Bradford 1996). Only one of the soil samples analyzed for iron exceeded 87,000 mg/kg at a depth of 3.5 feet bgs. As presented in Section 6.5.1, the mean concentration of iron in this area is 29,000 mg/kg and the EPC is 50,000 mg/kg.

5.3.2 Soil Gas

As discussed in Section 3.2.4, five soil gas investigations were conducted on Parcel O-2 as follows:

- Soil Gas Sampling Near Monitoring Well A-30 – During this investigation, which was conducted in October 2004, 11 locations were sampled at depths of approximately five and 15 feet bgs. All soil gas samples were analyzed for VOCs and TVH. Low concentrations of VOCs and TVH were detected. The VOCs most frequently detected were benzene, 1,1,1-TCA, TCE, toluene and xylene.

A step out investigation was conducted in this area in May 2006. Soil gas samples were collected from eight locations at depths of five feet bgs and deeper (nine to 15 feet bgs depending on soil conditions). All soil gas samples were analyzed for VOCs and TVH. Low concentrations of VOCs and TVH were detected.

- Buried Concrete Trench Soil Gas Sampling – During this investigation, which was conducted in November 2005, soil gas samples were collected from eight locations (from depths of five and 10 feet bgs) and analyzed for VOCs. Chemicals detected included BTEX, 1,1-DCA, 1,1-DCE, cis-1,2-DCE, trans-1,2-DCE, chloroform, Freon 12, Freon 113, methylene chloride, 1,1,1-TCA, PCE, TCE, and TVH.
- Former WV-02 (Original) Soil Gas Sampling – During this investigation, which was conducted in November 2006, soil gas samples were collected from four locations (at a depth of five feet bgs) and analyzed for VOCs. Chemicals detected included BTEX, chloroform, 1,1-DCA, Freon 11, Freon 113, PCE, 1,1,1-TCA, TCE, 1,2,4-trimethylbenzene, and 1,3,5-trimethylbenzene.

- Building 026 Clarifier Soil Gas Sampling – During this investigation, which was conducted in November 2006, two soil gas samples were collected at five and 10 feet bgs and analyzed for VOCs. Chemicals detected included BTEX, Freon 11, Freon 113, PCE, 1,1,1-TCA, TCE, 1,2,4-trimethylbenzene, and 1,3,5-trimethylbenzene.
- Building 026 Footprint Soil Gas Sampling – During this investigation, which was conducted in November 2006, soil gas samples were collected from 28 locations at a depth of five feet bgs and analyzed for VOCs. Chemicals detected included BTEX, bromomethane, carbon tetrachloride, chloroethane, chloroform, 1,1-DCA, 1,1-DCE, cis-1,2-DCE, Freon 11, Freon 12, Freon 113, methyl chloride, methylene chloride, PCE, 1,1,1-TCA, TCE, 1,2,4-trimethylbenzene, and 1,3,5-trimethylbenzene.

These data are summarized in Tables 3.8 and 3.9, and the sample locations are shown on Figure 3.12. Based on these investigations, a total of 24 chemicals were detected in soil gas on Parcel O-2:

- VOCs: benzene, bromomethane, carbon tetrachloride, chloroethane, chloroform, 1,1-DCA, 1,1-DCE, cis-1,2-DCE, trans-1,2-DCE, ethylbenzene, Freon 11, Freon 12, Freon 113, methyl chloride, methylene chloride, PCE, 1,1,1-TCA, TCE, toluene, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, m,p-xylene and o-xylene.
- TVH

Tables 5.5 through 5.8 compare the maximum chemical concentrations detected in soil gas at Parcel O-2 to the lowest residential soil gas RBTC. Any historical soil data that was not superseded by new data collected as part of the CCR has been included in this evaluation. Two chemicals exceeded their minimum residential RBTC, benzene (beneath Building 026) and TCE (near monitoring well A-30).

Of the 28 soil gas samples collected beneath the former Building 026 footprint, benzene was detected in all 28 samples at concentrations ranging from 0.0061 mg/m³ to 0.94 mg/m³. Only one sample (B026-C3) exceeded the minimum residential RBTC of 0.24 mg/m³.

Of the 21 soil gas samples collected at five feet bgs near monitoring well A-30, TCE was detected in eight samples. Five samples (SG-26-3, SG-26-5, SG-26-6, SG-26-8 and SJ-SG-26) exceeded the minimum residential RBTC. TCE was detected at a maximum of 21 mg/m³ compared to its minimum residential soil RBTC of 3.8 mg/m³.

5.3.3 Groundwater

As discussed in Section 3.2.4, one groundwater investigation was conducted on Parcel O-2 as follows:

- Building 026 Grab Groundwater Sampling – In January 2007, two grab groundwater samples were collected from Building 026 (one near former WV-02 [original] and one near former WV-02 [second]) and analyzed for VOCs and hexavalent chromium. VOCs detected included Freon 113, TCE, and 1,1,1-TCA. Hexavalent chromium was detected near former WV-02 (second).

This data is summarized in Table 3.12, and the sample locations are shown on Figure 3.15. Based on this investigation, a total of four chemicals were detected in groundwater on Parcel O-2:

- VOCs: Freon 113, TCE, and 1,1,1-TCA.
- Metals: hexavalent chromium.

Tables 5.1 and 5.2 compare the maximum chemical concentrations detected in groundwater at Parcel O-2 to the lowest residential groundwater RBTC. None of the chemicals detected in groundwater at Parcel O-2 were above their respective minimum residential RBTCs.

5.4 PARCEL O-3

The only media investigated on Parcel O-3 was soil. As discussed in Section 3.2.5, four soil investigations were conducted on Parcel O-3 that are representative of current Redevelopment Property conditions. The data for these investigations are summarized in Table 3.13 and the sample locations are shown on Figure 3.18. The four investigations are as follows:

- Buried Concrete Trench – During this investigation, which was conducted in October 2006, one soil sample was collected from four feet bgs and analyzed for VOCs and metals. The only chemicals detected were arsenic, barium, beryllium, chromium (total), cobalt, copper, lead, nickel, and vanadium.
- Black Soil in Parking Lot South of Building 026 – During this investigation, which was conducted in October 2006, one soil sample was collected (from native soil beneath the asphalt and road base material) and analyzed for VOCs, SVOCs, TPH as diesel and motor oil, and metals. Chemicals detected included acetone, diethyl phthalate, TPH as diesel and motor oil, arsenic, barium, chromium (total), cobalt, copper, lead, nickel, vanadium, and zinc.
- Current Orchard Areas – During this investigation, which was conducted in October 2004, shallow soil samples (zero to six inches) were collected from five locations and analyzed for OCPs and metals. An excavation unrelated to this investigation was performed in the area of two of these sample locations. After excavation, chemicals detected included two OCPs (DDE and DDT) and arsenic, barium, beryllium, chromium (total), cobalt, copper, lead, mercury, nickel, vanadium, and zinc.
- Former Orchard Areas Beneath Roads and Parking Lots – During this investigation, which was conducted in October 2005, six soil samples were collected (from native soil immediately beneath the asphalt and road base material) and analyzed for OCPs and arsenic. Chemicals detected included DDE and arsenic.

Based on these investigations, a total of 17 chemicals were detected in soil on Parcel O-3:

- VOCs: acetone.
- SVOCs: diethyl phthalate.
- OCPs: DDE and DDT.

- TPH: TPH as diesel and motor oil.
- Metals: arsenic, barium, beryllium, chromium, cobalt, copper, lead, mercury, nickel, vanadium, and zinc.

Table 5.3 compares the maximum chemical concentrations detected in soil (at all depths) at Parcel O-3 to the lowest residential soil RBTCs. The only chemical that exceeded the minimum residential RBTC was arsenic, which was detected at concentrations greater than the minimum residential RBTC in 12 out of 13 samples. The maximum arsenic concentration detected for this parcel was 8.3 mg/kg, which is slightly above the average background concentration for the Site (8 mg/kg), but below the maximum of 12 mg/kg. The average concentration of arsenic in orchard areas on Parcel O-3 is 7.3 mg/kg.

5.5 PARCEL O-4

Investigations conducted on Parcel O-4 included soil, soil gas, and groundwater. The results for these media are discussed below in Sections 5.5.1 through 5.5.3.

5.5.1 Soil

As discussed in Section 3.2.6, 15 soil investigations were conducted on Parcel O-4 that are representative of current Redevelopment Property conditions. Four of these investigations were historical (prior to 2004). The data for these historical investigations are summarized in Table 3.16 and the sample locations are shown on Figure 3.19. Eleven soil investigations were conducted under the current SI/SP, the CMS Report for the Redevelopment Property, or as part of a due diligence investigation. The data for these investigations are summarized in Table 3.14 and the sample locations are shown on Figures 3.20, 3.24, and 3.25. The soil investigations are as follows:

- Soil Beneath Building 028 – During this investigation, which was conducted in February 1984, three soil samples were collected from one boring (at depths of 0.0, 1.0 and 2.0 feet bgs) and analyzed for Freon 113, TCA, PCE, methylene chloride, acetone, IPA, xylenes and NMP. Chemicals detected included Freon 113, methylene chloride and acetone.
- Industrial Wastewater Leak from Pipe – During these investigations, which were conducted in January and July 1988, five soil borings (with samples collected from 2.0 to 9.0 feet bgs) were advanced and samples were analyzed for a subset of metals. Three samples were collected for the purpose of obtaining background concentrations. Chemicals detected included chromium (total), copper, iron, nickel and zinc.
- Removal of Industrial Wastewater Pipeline – During this investigation, which was conducted in 1989, 25 soil borings were collected (from depths ranging from 1 to 5.5 feet bgs) and analyzed for a subset of metals. After excavation, chemicals detected included chromium (total), copper, iron, nickel, and zinc.
- WV-04 Buried Concrete Trench – During this investigation, which was conducted in 1994, one soil sample was collected from below WV-04 and four soil samples were collected from 1.5 feet below the trench. The results from the soil sample taken below WV-04 are not included in this

risk assessment, as this area was re-sampled in 2006 (see WV-04 Soil Sampling below). The samples below the trench were analyzed for metals. Chemicals detected included antimony, barium, beryllium, chromium (total), cobalt, copper, lead, nickel, vanadium, and zinc.

- Due Diligence Sampling Near Homestead Lake – During this investigation, which was conducted in August 2006, shallow soil samples (zero to six inches) were collected from eight locations and analyzed for OCPs and metals. Chemicals detected included DDE and arsenic.
- Building 028J and Surrounding Area – Soil investigations were conducted in this area in September 2006, December 2006, and January 2007. All samples were analyzed for VOCs; a subset was analyzed for metals. Chemicals detected included VOCs (mainly chloroform), arsenic, barium, beryllium, chromium (total), cobalt, copper, lead, nickel, vanadium, and zinc.
- Buried Concrete Trench – During this investigation, which was conducted in November 2006 through April 2007, soil samples were collected from five locations (at depths between approximately three and six feet bgs) and analyzed for VOCs and metals. Chemicals detected included arsenic, barium, chromium (total), cobalt, copper, lead, mercury, nickel, silver, vanadium, and zinc.
- Former WV-04 Soil Sampling – During this investigation, which was conducted in November 2006, one soil sample was collected from native soil beneath the bottom of the former WV-04. The sample was analyzed for hexavalent chromium, metals and VOCs. Chemicals detected included arsenic, barium, chromium (total), cobalt, copper, lead, mercury, nickel, and vanadium.
- Former WV-03 Soil Sampling – During this investigation, which was conducted in December 2006, two soil borings (at approximately five feet bgs) were collected and analyzed for VOCs and metals. Chemicals detected included arsenic, barium, chromium (total), cobalt, copper, lead, mercury, nickel, vanadium, and zinc.
- Former Diesel UST at Building 028 – During this investigation, which was conducted in January 2007, 10 confirmation soil samples were collected from depths of approximately surface to three feet bgs and analyzed for TPH as diesel and motor oil, VOCs, SVOCs, and metals. Chemicals detected included TPH as diesel and motor oil and arsenic, barium, chromium (total), cobalt, copper, lead, mercury, nickel, vanadium, and zinc.
- Building 018 Pipe Backfill – This investigation, which was conducted from January through April 2007, included soil sampling and excavation. After excavation, 19 soil confirmation samples were collected (from approximately 1.5 to 5 feet bgs) and analyzed for TPH as diesel and motor oil. Low levels of TPH as diesel and motor oil were detected.
- Passenger Elevator in Lobby of Building 028 (Elevator No. 1) – During this investigation, which was conducted in January 2007, one soil sample was collected beneath the elevator pit (approximately 26 feet bgs) and analyzed for TPH. TPH was not detected.
- Freight Elevator at Building 028 – This investigation, which was conducted January through February 2007, included soil sampling and excavation. After excavation, remaining soil

samples include nine samples collected from depths ranging from 24 to 30 feet bgs and analyzed for TPH as diesel and motor oil and PAHs. Chemicals detected in these samples included TPH as diesel and motor oil and some low level PAHs.

- Current Orchard Areas – During this investigation, which was conducted in October 2004, shallow soil samples (zero to six inches; and a limited subset at two to three feet bgs) were collected from five locations and analyzed for OCPs and metals. Samples from four additional step-out locations were analyzed for arsenic. Chemicals detected included two OCPs (DDE and DDT) and arsenic, barium, cadmium, chromium (total), cobalt, copper, lead, mercury, nickel, vanadium, and zinc.
- Former Orchard Areas Beneath Roads and Parking Lots – During this investigation, which was conducted in October 2005, 17 soil samples were collected (from native soil immediately beneath the asphalt and road base material) and analyzed for OCPs and arsenic. Chemicals detected included three OCPs (DDD, DDE, and DDT), and arsenic.

Based on these investigations, a total of 30 chemicals were detected in soil on Parcel O-4:

- VOCs: acetone, chloroform, Freon 113, methylene chloride and 1,1,2-TCA.
- SVOCs: benzo(a)anthracene, benzo(a)pyrene, benzo(g,h,i)perylene, chrysene, and pyrene.
- OCPs: DDD, DDE and DDT.
- TPH: TPH as diesel and motor oil.
- Metals: antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, iron, lead, mercury, nickel, silver, vanadium, and zinc.

Tables 5.3 and 5.4 compare the maximum chemical concentrations detected in soil (at all depths) at Parcel O-4 to the lowest residential soil RBTCs. Any historical soil data that was not superseded by new data collected as part of the CCR has been included in this evaluation. Five chemicals exceed their minimum residential RBTC: arsenic, chloroform, iron, methylene chloride and nickel.

As shown in Table 5.4, chloroform exceeded the minimum residential soil RBTC of 0.00874 mg/kg at 15 soil sample locations near Building 028J. The range of detected concentrations was between 0.0050 mg/kg and 0.022 mg/kg. Remediation of chloroform in soil, soil gas, and groundwater is currently on-going in this area.

Arsenic was also detected in Parcel O-4 soil at levels above the minimum residential RBTC. Seventy-two out of 73 samples had arsenic at concentrations greater than the minimum residential RBTC of 0.061 mg/kg. Detections for arsenic ranged from 1.9 to 16 mg/kg. Of the detections, eight were equal to or greater than the average background concentration for arsenic (8 mg/kg) and one sample was 16 mg/kg (Sample 5-33 located in the current orchard area), was greater than the maximum background concentration (12 mg/kg). The average background concentration of arsenic in orchards areas on Parcel O-4 is 8.0 mg/kg. As discussed in the CCR (ENVIRON 2005a), in the initial current orchard investigation, arsenic was detected at a concentration of 16 mg/kg (Sample 5-33) which was potentially above typical background concentrations. As a result, the deeper sample at location 5-33 was analyzed for arsenic. In addition, four more samples 25 feet away from

location 5-33 were analyzed for arsenic at both shallow and deeper depths. Results for these samples showed arsenic concentrations ranging from 5.5 to 7.1 mg/kg. Given the limited extent of the elevated arsenic, no additional investigation or remediation appears to be warranted in the current orchard area within Parcel O-4.

Methylene chloride was analyzed for in one historical soil sample at depths of 0, 1, and 2 feet bgs collected beneath Building 028. Methylene chloride was detected in the shallowest soil sample at a concentration of 0.58 mg/kg as compared to the minimum residential RBTC of 0.05 mg/kg.

Iron was analyzed and detected in the historical soil investigations that evaluated the industrial wastewater pipe leaks and removal. During these soil investigations, iron was detected at concentrations ranging from 2,200 mg/kg to 50,000 mg/kg, compared to the minimum residential RBTC of 23,000 mg/kg. Eight locations (11 soil samples) exceeded the minimum residential RBTC. In addition, the one background sample collected during the investigation and analyzed for iron (Sample 459-01-002 at a concentration of 37,000 mg/kg) also exceeded the RBTC. As discussed in the CCR (ENVIRON 2005a), iron results were compared to typical iron background results from literature sources. Background concentrations of iron in California soils range from 10,000 to 87,000 mg/kg, with a mean of 37,000 mg/kg (Bradford 1996). As discussed in Section 6.7.1, the mean concentration for iron in this area is 23,000 mg/kg and the EPC is 27,000 mg/kg. Therefore, the concentrations detected are well within the range of naturally occurring background concentrations.

Nickel was also analyzed and detected in the historical soil investigations that evaluated the industrial wastewater pipe leaks and removal. During these soil investigations, nickel was detected at concentrations ranging from 9 mg/kg to 1,800 mg/kg, compared to the minimum residential RBTC of 1,500 mg/kg. Only one sample exceeded the minimum residential RBTC. As presented in Section 6.7.1, the EPC for nickel on Parcel O-4 is 470 mg/kg.

5.5.2 Soil Gas

As discussed in Section 3.2.6, three soil gas investigations were conducted on Parcel O-4 as follows:

- Due Diligence Soil Gas Sampling – During this investigation, which was conducted in May 2006, one soil gas sample was collected from a depth of five feet bgs and analyzed for VOCs and TVH. A duplicate sample was also collected. Chemicals detected included BTEX, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene and TVH.
- Buried Concrete Trench and Building 028J – During this investigation, which was conducted in November 2005, soil gas samples were collected from 10 locations along the buried concrete trench and two locations around Building 028J and analyzed for VOCs and TVH. Chemicals detected included VOCs (mainly chloroform) and TVH.
- Building 028J Step Out – During this investigation, which was conducted in March 2007, soil gas samples were collected from 23 locations at a depth of five and 10 feet bgs. Samples were analyzed for VOCs. Chemicals detected included VOCs (mainly chloroform).

These data are summarized in Tables 3.17 and 3.18, and the sample locations are shown on Figures 3.26 and 3.27. Based on these investigations, a total of 19 chemicals were detected in soil gas on Parcel O-4:

- VOCs: benzene, carbon tetrachloride, chloroform, 1,1-DCA, 1,1-DCE, ethylbenzene, Freon 11, Freon 12, Freon 113, methyl chloride, methylene chloride, toluene, 1,1,1-TCA, TCE, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, m,p-xylene, and o-xylene.
- TVH

Tables 5.5, 5.6, and 5.8 compare the maximum chemical concentrations detected in soil gas at Parcel O-4 to the lowest residential soil gas RBTC at five, 10, and 15 feet bgs, respectively. Only chloroform in the Building 028J Area exceeds its soil gas RBTC at depths of five and 10 feet bgs. Chloroform was detected in 11 out of 36 samples taken at a depth of five feet bgs on Parcel O-4. The range of detected concentrations was between 0.16 and 24 mg/m³. Seven of these samples exceeded the minimum residential RBTC of 1.1 mg/m³. Remediation of chloroform in soil, soil gas, and groundwater is currently on-going in this area.

5.5.3 Groundwater

As discussed in Section 3.2.6, two groundwater investigations were conducted on Parcel O-4 as follows:

- Building 028J and Surrounding Area – From January through March 2007, 28 grab groundwater samples were collected at and near the former Building 028J and analyzed for VOCs and water quality parameters. Chemicals detected included chloroform, 1,1-DCA, 1,1-DCE, toluene, 1,1,1-TCA, TCE, xylenes, chloride, and nitrate. (This data is summarized in Table 3.15, and the sample locations are shown on Figures 3.23 and 3.25.)
- Freight Elevator in Building 028 (Elevator No. 3) – In January 2007, two grab groundwater samples were collected from beneath the Freight Elevator pit and analyzed for VOCs, TPH, and PAHs. The only chemicals detected were TPH as diesel and motor oil. In March 2007, grab groundwater samples were collected from six additional locations in this area and analyzed for TPH as diesel and motor oil. Only TPH as diesel was detected. (This data is summarized in Table 3.15, and the sample locations are shown on Figures 3.22 and 3.23.)

Based on this investigation, a total of 11 chemicals were detected in groundwater on Parcel O-4:

- VOCs: chloroform, 1,1-DCA, 1,1-DCE, toluene, 1,1,1-TCA, TCE and xylenes (total).
- TPH: TPH as diesel and motor oil.
- Anions: chloride and nitrate.

Tables 5.1 and 5.2 compare the maximum chemical concentrations detected in groundwater at Parcel O-4 to the lowest residential groundwater RBTC. Only chloroform in the Building 028J Area exceeded its minimum residential groundwater RBTC. Chloroform was detected in 17 out of

30 samples taken at Parcel O-4. The range of detected concentrations was between 0.0018 mg/L and 0.89 mg/L. Two samples exceeded the minimum residential RBTC of 0.38 mg/L. Remediation of chloroform in soil, soil gas, and groundwater is currently on-going in this area.

5.6 PARCEL O-5

Investigations conducted on Parcel O-5 included soil and soil gas. Soil and soil gas results are discussed separately below in Sections 5.6.1 and 5.6.2, respectively.

5.6.1 Soil

As discussed in Section 3.2.7, ten soil investigations were conducted on Parcel O-5 that are representative of current Redevelopment Property conditions. Four of the investigations were historical (prior to 2004). The data for these historical investigations are summarized in Table 3.20 and the sample locations are shown on Figure 3.29. Six soil investigations were conducted under the SI/SP and CMS Report for the Redevelopment Property. These data are summarized in Table 3.19 and the sample locations are shown on Figure 3.30. The soil investigations are as follows:

- Electrical Substation - 1984 Diesel Fuel Spill – This investigation, which was conducted in October 1984, included both soil sampling and excavation. After excavation, remaining soil samples include 24 samples (from depths ranging from surface to 12.5 feet bgs). All samples were analyzed for TPH as diesel. Residual diesel fuel was left up to 14 mg/kg.
- Electrical Substation - 1985 Diesel Fuel Spill – This investigation, which was conducted in 1985 and 1987, included both soil sampling and excavation. After excavation, remaining soil samples include 45 samples (from depths ranging from surface to 34 feet bgs). All samples were analyzed for TPH as diesel. Residual diesel fuel was left up to 300 mg/kg.
- Electrical Substation - Removal of Rainwater/Spill Collection Vault and Drainline – This investigation, which was conducted in 1990, included both soil sampling and excavation. After excavation, remaining soil samples include 13 soil samples (from depths ranging from 5.5 to 20 feet bgs). All samples were analyzed for TPH as diesel and gasoline. All remaining soils were nondetect for TPH as diesel and gasoline (<10 mg/kg).
- Former Gasoline UST at Building 018 – During this investigation, which was conducted in 1985, two confirmation soil samples (8.0 to 8.5 feet bgs) were collected beneath the former UST and analyzed for benzene, toluene, xylene and TPH. No chemicals were detected above their detection limits.
- Black Soil in Raleigh Road - During this investigation, which was conducted in March 2007, one surface soil sample was collected and analyzed for VOCs, TPH, and metals. Chemicals detected included TPH as diesel and motor oil, arsenic, barium, beryllium, chromium (total), cobalt, copper, lead, mercury, nickel, vanadium, and zinc.
- Passenger Elevator Pit in Building 051 – During this investigation, which was conducted in April 2007, one soil sample was collected (at a depth of five feet bgs) and analyzed for TPH as

diesel and motor oil, PAHs, and metals. Chemicals detected included TPH as diesel and motor oil, arsenic, barium, beryllium, chromium (total), cobalt, copper, lead, mercury, nickel, vanadium, and zinc.

- Loading Dock Elevator in Building 051 – During this investigation, which was conducted in April 2007, one soil sample was collected (at a depth of five feet bgs) and analyzed for TPH, PAHs, PCBs and metals. Chemicals detected included TPH as diesel and motor oil, arsenic, barium, beryllium, chromium (total), cobalt, copper, lead, mercury, nickel, vanadium, and zinc.
- Building 051 Parking Lot - During this investigation, which was conducted in April 2007, one soil sample was collected (from beneath the asphalt and road base material) and analyzed for VOCs, TPH as diesel and motor oil, and metals. Chemicals detected included acetone, TPH as diesel and motor oil, arsenic, barium, beryllium, chromium (total), cobalt, copper, lead, mercury, nickel, vanadium, and zinc.
- Current Orchard Areas – During this investigation, which was conducted in October 2004, shallow soil samples (zero to six inches; and a limited subset at two to three feet bgs) were collected from 34 locations and analyzed for OCPs and metals. Samples from eight step-out locations were analyzed for OCPs. Chemicals detected included five OCPs (DDE, dieldrin, endosulfan I, and endrin), arsenic, barium, beryllium, cadmium, chromium (total), cobalt, copper, lead, mercury, nickel, vanadium, and zinc.
- Former Orchard Areas Beneath Roads and Parking Lots – During this investigation, which was conducted in October 2005, 14 soil samples were collected (from native soil immediately beneath the asphalt and road base material) and analyzed for OCPs and arsenic. Chemicals detected included three OCPs (DDE, DDT, and gamma-chlordane) and arsenic.

Based on these investigations, a total of 21 chemicals were detected in soil on Parcel O-5:

- VOCs: acetone.
- OCPs: DDE, DDT, dieldrin, gamma-chlordane, endosulfan I, and endrin.
- TPH: TPH as diesel and motor oil.
- Metals: arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, nickel, vanadium, and zinc.

Tables 5.3 and 5.4 compare the maximum chemical concentrations detected in soil (at all depths) at Parcel O-5 to the lowest residential soil RBTCs. Any historical soil data that was not superseded by new data collected as part of the CCR has been included in this evaluation. Two chemicals exceeded the minimum residential RBTC, dieldrin and arsenic.

Dieldrin exceeded the minimum residential RBTC (0.03 mg/kg) in two out of 53 samples collected to evaluate the current and former orchard areas; the shallow (0 to 0.5 feet bgs) sample collected at 5-24 (original) at a concentration of 0.046 mg/kg and the shallow (0 to 0.5 feet bgs) sample at 5-24B (step out) at a concentration of 0.21 mg/kg. As discussed in Section 6.8.1, the EPC for dieldrin on Parcel O-5 is 0.021 mg/kg.

Arsenic exceeded the minimum residential RBTC in all samples and exceeded 12 mg/kg in two samples; the shallow (0 to 0.5 feet bgs) sample at 5-28 (original) at a concentration 22 mg/kg and the shallow (0 to 0.5 feet bgs) sample at 5-28D (step out) at a concentration of 17 mg/kg. The average concentration for arsenic in orchard areas on Parcel O-5 is 8.5 mg/kg. As discussed in the CCR (ENVIRON 2005), in the initial current orchard investigation, arsenic was detected at a concentration of 22 mg/kg (Sample 5-28) which was potentially above typical background concentrations. As a result, the deeper sample at location 5-28 was analyzed for arsenic. In addition, four more samples 25 feet away from location 5-28 were analyzed for arsenic at both shallow and deeper depths. Results for these samples showed arsenic concentrations ranging from 6.5 to 17 mg/kg. Given the limited extent of the elevated arsenic, no additional investigation or remediation appears to be warranted in the current orchard area within Parcel O-5.

5.6.2 Soil Gas

As discussed in Section 3.2.7, one soil gas investigation was conducted on Parcel O-5 as follows:

- Due Diligence Soil Gas Sampling – During this investigation, which was conducted in May 2006, six soil gas samples were collected at five feet bgs and analyzed for VOCs and TVH. Chemicals detected included toluene, ethylbenzene, and xylenes, Freon 114, trimethylbenzenes, and TVH.

This data is summarized in Table 3.21 and the sample locations are shown on Figure 3.31. Based on this investigation, a total of eight chemicals were detected in soil gas on Parcel O-5:

- VOCs: ethylbenzene, Freon 114, toluene, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, m,p-xylene, and o-xylene
- TVH

Table 5.5 compares the maximum chemical concentrations detected in soil gas at Parcel O-5 to the lowest residential soil gas RBTC. No chemicals exceeded the minimum residential soil gas RBTCs.

5.7 ENDICOTT BOULEVARD/TUCSON WAY

The only media investigated on Endicott Boulevard/Tucson Way was soil. As discussed in Section 3.2.8, two soil investigations on Endicott Boulevard/Tucson Way are as follows:

- Historical Shell Sol 140 Release near Building 110C – During this investigation, which was conducted in October 2005, six soil samples were collected (from native soil immediately beneath the asphalt and road base material) and analyzed for TPH as diesel and kerosene. Both TPH as diesel and kerosene were detected. (This data is summarized in Table 3.22, and the sample locations are shown on Figures 3.32 and 3.33.)
- Former Orchard Areas – During this investigation, which was conducted in October 2005, ten soil samples were collected (from native soil immediately beneath the asphalt and road base material) and analyzed for OCPs and arsenic. Chemicals detected included two OCPs (DDD

and DDE) and arsenic. (This data is summarized in Table 3.22, and the sample locations are shown on Figure 3.32.)

Based on these investigations, a total of five chemicals were detected on Endicott Boulevard/Tucson Way:

- OCPs: DDD and DDE.
- TPH: diesel and kerosene.
- Metals: arsenic.

Table 5.3 compares the maximum chemical concentrations detected in soil (at all depths) at Endicott Boulevard/Tucson Way to the lowest residential soil RBTCs. This is a very conservative comparison, as the future use of Endicott Boulevard/Tucson Way will be a public roadway which will be capped with asphalt.

The only chemical that exceeded the minimum residential RBTC was arsenic, which was detected at concentrations greater than the minimum residential RBTC in nine out of 10 samples. The maximum arsenic concentration detected for this parcel was 6.9 mg/kg, which is lower than the average background concentration for the Site (8 mg/kg). The average concentration for arsenic in former orchard areas beneath Endicott Boulevard/Tucson Way is 6.0 mg/kg.

6.0 RISK CHARACTERIZATION

Section 6.1 describes the methodology used to estimate cancer risks and noncancer HIs for each of the potential populations of concern. The calculation of EPCs used in the risk estimates is discussed in Section 6.2. Section 6.3 presents the estimated cancer risks and noncancer HI for Site-wide groundwater. Sections 6.4 through 6.8 present the estimated cancer risks and noncancer HIs for Parcels O-1 through O-5, respectively. The estimated cancer risks and noncancer HI for Endicott Boulevard/Tucson Way is presented in Section 6.9.

6.1 METHOD FOR ESTIMATING RISK

The methodology used to derive the cancer risks and noncancer HIs is based on guidance provided by CalEPA and USEPA. For carcinogenic effects, the relationship is given by the following equation (USEPA 1989a):

$$\text{Risk} = I \times \text{CSF}$$

Where:

Risk	=	Cancer Risk; the incremental probability of an individual developing cancer as a result of exposure to a particular cumulative dose of a potential carcinogen (unitless)
I	=	Intake of a chemical (mg chemical/kg body weight-day)
CSF	=	Cancer Slope Factor (mg chemical/kg body weight-day) ⁻¹

A separate estimated cancer risk for each potential exposure pathway is calculated by summing the chemical-specific risks for the multiple chemical associated with that exposure pathway. The estimated risks for the exposure pathways relevant to the potentially exposed population are summed to estimate the overall multi-chemical, multi-pathway risks for each potentially exposed population.

The relationship for noncarcinogenic effects is given by the following equation (USEPA 1989a):

$$\text{HQ} = \frac{I}{\text{RfD}}$$

Where:

HQ	=	Hazard Quotient; an expression of the potential for noncarcinogenic effects, which relates the allowable amount of a chemical (RfD) to the estimated site-specific intake (unitless)
I	=	Intake of chemical (mg chemical/kg body weight-day)
RfD	=	Reference Dose; the toxicity value indicating the threshold amount of chemical contacted below which no adverse health effects are expected (mg chemical/kg body weight-day).

The HI is the sum of more than one hazard quotient for multiple substances and/or multiple exposure pathways.

The intake equations used to calculate forward risk, are the same as those used in the calculation of the RBTCs presented in Section 5.0. For soil, potential exposure pathways include soil ingestion, dermal contact and inhalation (of either vapors or windblown particulates). For soil gas and groundwater, potential pathways include inhalation of vapors.

For the forward risk calculations, surface soil concentrations were calculated for all soils collected at a depth of less than or equal to 10 feet bgs. Risk estimates for soil gas are based on concentrations detected at five feet bgs.

Both CalEPA (2005a) and USEPA (2004a) guidance notes that background concentrations of arsenic are often well above the OEHHA screening levels and USEPA PRGs; contributing to an estimated cancer risk estimate of greater than 1×10^{-6} . Both guidance documents recommend the use of site-specific background concentrations as screening levels. In Section 5.0 of this report, detected concentrations of arsenic were compared to site background concentrations. As noted in Section 5.0, arsenic is present across the Redevelopment Property at background concentrations. Therefore, arsenic has not been included in the site-specific estimated cancer risks and noncancer HIs presented in this section.

6.2 CALCULATION OF EXPOSURE POINT CONCENTRATIONS

The quantification of exposure was based on EPCs that were calculated using Matlab (Version 2007b, The Mathworks) to estimate the 95 percent upper confidence limit (95UCL) of the population mean. Matlab was used to calculate EPCs in order to implement statistical methods that rigorously account for non-detected sample results and to efficiently automate the EPC calculation process. The statistical methods used in the calculation of EPCs are the same as those implemented in the recently released Version 4.0 of ProUCL (USEPA 2007c). However, ProUCL 4.0 was not available at the time the EPCs were calculated.

The previous ProUCL Version 3.0 typically replaced non-detects with one-half the detection limit (USEPA 2004c). In Monte Carlo experiments, this approach has been shown to give very poor estimates of the true 95UCLs (USEPA 2006). Since the Site data contains large numbers of non-detected concentrations (particularly in regards to the orchard investigations), more appropriate methods of handling non-detects were evaluated. In a comprehensive review on EPC calculation methods, USEPA (2006) identified only two classes of methods that can be used on datasets with multiple detection limits: methods based on the Kaplan-Meier (KM) estimator and methods based on a regression on order statistics (ROS). The ROS methods do not perform as well as the KM estimator methods on datasets with skewed distributions and are not recommended in ProUCL Version 4.0 (USEPA 2007c). Therefore, only KM estimator methods were considered for use in this risk assessment. The use of the KM estimator for censored datasets is well-established in the statistical field of survival analysis and commonly used in medical research and engineering reliability analysis.

The KM estimator can be used in many different 95UCL calculation methods, all of which are non-parametric methods that do not assume that the data follow a particular statistical distribution. Since in practice it is not easy to test the distribution of datasets containing non-detects, non-parametric methods are preferred (USEPA 2007c, p. 203). To determine the most appropriate

method to use for the Site data, each of the following KM estimator methods were considered based on the Monte Carlo test results and recommendations given in USEPA (2006) and USEPA (2007b):

Bootstrap methods

- Standard bootstrap method
- Bootstrap t method
- Percentile bootstrap method
- Bias-corrected accelerated (BCA) method

Other Non-Parametric Methods

- Normal approximation based on standard normal critical values
- Normal approximation based on Student t critical values
- Chebyshev inequality

Initial statistical analysis showed that many of the Site chemical datasets are heavily skewed. Because the normal approximation approaches do not perform well for skewed datasets (USEPA 2007c, p. 102), they were removed from further consideration. The Chebyshev inequality can yield overly conservative UCL95s when compared to the other methods (USEPA 2007b, p. 5). Since the Site concentration data are already likely biased high due to the preferential sampling of contaminated areas, introducing further bias in the selection of an EPC method is undesirable. The remaining candidate methods are the four bootstrap methods. In practice, these methods tend to give similar results. However, the bootstrap t method can give unreliable results in some circumstances (USEPA 2007b), and the BCA method has been shown to perform slightly better than the standard bootstrap and percentile bootstrap for skewed datasets (USEPA 2007b, p. 105).

Thus, the BCA bootstrap method using the KM estimator was selected as the most appropriate method to use for the Site risk calculations. This method was used to calculate all of the EPCs for the risk assessment. In cases in which there are fewer than three concentrations, the highest detected concentration was used as the EPC. The highest detected concentration was also used as the EPC if the calculated 95UCL was greater than the maximum detected concentration.

It should be noted that an average lot size in California is approximately 5,000 ft² (CalEPA 1994); with a typical backyard approximately 1,000 ft² (CalEPA 1992). This is the appropriate averaging area for a future residential land use scenario. Due to the large size of the Redevelopment Property and the distance between investigations, it may not be appropriate to calculate EPCs across investigations in all cases. It would be appropriate to average over current/former orchard areas as the underlying assumptions for sampling of these areas is homogeneous applications of agriculturally related chemicals.

6.3 SITE-WIDE GROUNDWATER

As discussed in Section 3.0, and shown in Figures 3.4 through 3.7, the Site-wide groundwater plume encompasses more than one parcel. For this assessment, the estimated excess lifetime cancer risks and noncancer HIs have been conservatively calculated using the maximum concentrations detected. As shown in Table 6.1, even using this conservative approach, the estimated excess lifetime cancer risk and noncancer HI based on potential future residential land use (vapor intrusion

into a building) are below target levels. The estimated excess lifetime cancer risk under a residential land use scenario at the maximum detected concentrations is 4.4×10^{-7} and the noncancer HI for a child under a residential land use scenario is 0.007.

6.4 PARCEL O-1

Media investigated on Parcel O-1 included soil and soil gas. Estimated cancer risks and noncancer HIs for soil and soil gas are discussed separately below in Sections 6.4.1 and 6.4.2, respectively. Section 6.4.3 discussed cumulative risks for Parcel O-1. The discussion in the text focuses on a future residential land use scenario.

6.4.1 Soils

Five soil investigations were conducted on Parcel O-1. In one investigation (Former UST at Building 011), no chemicals were detected. In a second investigation (Previously Unknown Well Beneath Boulder Boulevard), metals were detected at a depth of greater than 15 feet. The remaining three investigations (Old Septic Tank in Vicinity of Building 010, Current Orchard Areas and Former Orchard Areas) are evaluated in this section. The data from the current and former orchard area investigations have been combined into an evaluation of total orchard areas.

Table 6.2 presents the estimated excess lifetime cancer risk and noncancer HIs based on exposure to Parcel O-1 soil in the area of the old septic tank. No carcinogenic chemicals were detected during this investigation. The estimated noncancer HI for a child under a residential land use scenario is 0.0014, below the target HI of 1.0.

As shown on Table 6.3, the estimated excess lifetime cancer risk under a residential land use scenario based on exposure to Parcel O-1 soil related to orchard areas is 8.8×10^{-7} . The estimated noncancer HI for a child under a residential land use scenario is 0.55. The cancer risk estimate is below the target risk range (1×10^{-4} to 1×10^{-6}) and the noncancer HI is below the target HI of 1.0.

6.4.2 Soil Gas

Two soil gas investigations were conducted on Parcel O-1. Cancer risk and noncancer HIs were calculated for both investigations; soil gas near monitoring well RA-24 and due diligence soil gas sampling (soil gas near the storm drain)(see Tables 6.4 and 6.5, respectively).

As shown on Table 6.4, the estimated excess lifetime cancer risk under a residential land use scenario based on exposure to Parcel O-1 soil gas near monitoring well RA-24 is 1.2×10^{-6} . The major chemical contributors to this risk estimate are benzene (5.4×10^{-7}) and TCE (3.4×10^{-7}). The noncancer HI for a child under a residential land use scenario is 0.14. The cancer risk estimate is within the target risk range (1×10^{-4} to 1×10^{-6}) and the noncancer HI is below the target HI of 1.0.

As shown in Table 6.5, the estimated excess lifetime cancer risk under a residential land use scenario based on exposure to soil gas near the storm drain on Parcel O-1 is 4.6×10^{-7} and the noncancer HI for a child is 0.07. The cancer risk estimate is within the target risk range (1×10^{-4} to 1×10^{-6}) and the noncancer HI is below the target HI of 1.0.

6.4.3 Cumulative Risks

Table 6.6 summarizes the estimated cancer risks and noncancer hazard indices for all soil and soil gas investigations conducted on Parcel O-1. With the exception of the orchard areas, none of the investigations evaluated for Parcel O-1 are co-located. This means that due to the distance between investigations, no one resident located on any one residential property would be exposed to all areas at one time. Therefore, it would not be appropriate to add risks over all areas. However, regardless of the location within Parcel O-1, all populations could be potentially exposed to residual pesticides in soil. Without arsenic, which is present in concentrations consistent with background, the cancer risk estimate for orchard areas is less than 1×10^{-6} and the noncancer HI is below the target HI of 1.0.

The highest estimated risk for Parcel O-1 is based on soil gas samples collected near monitoring well RA-24. The estimated excess lifetime cancer risk for this area is 1.2×10^{-6} , at the very low end of the target cancer risk range (1×10^{-4} to 1×10^{-6}).

6.5 PARCEL O-2

Media investigated on Parcel O-2 included soil, soil gas and groundwater. Estimated cancer risks and noncancer HIs for soil, soil gas and groundwater are discussed separately below in Sections 6.5.1 through 6.5.3, respectively. Section 6.5.4 discussed cumulative risks for Parcel O-2. The discussion in the text focuses on a future residential land use scenario.

6.5.1 Soil

Twenty-three soil investigations were conducted on Parcel O-2. No chemicals were detected in seven of the investigations (Soil Investigation Prior to Constructing Addition to Building 012, Former Diesel Fuel UST – Building 010, Former Diesel Fuel UST – west of Building 026, Sump in Photographic Laboratory – Room 808u, Staining near Drains in Kodak Processing Room 149, Sump in Photographic Laboratory – Room 305u, and Cut Hydraulic Fluid Pipeline at Loading Dock).

The remaining 16 investigations were combined into the following 13 areas for purposes of this evaluation:

- Hydrofluoric Release – Building 026 (Table 6.7)
- Chemicals Penetrating Floor in Laboratory – Building 026 (Table 6.8)
- Room 400 – Building 026 (includes Liquid Seepage in Room 400 and Room 400 Investigation)(Table 6.9)
- Sumps in Rooms 113C and 114A – Building 026 (Table 6.10)
- Soil Beneath Building 026 (including the Chemical Storage Room and Former Cast Iron Pipe Beneath Chemical Storage Room) (Table 6.11)
- Buried Concrete Trench Soil Sampling – west of Building 026 (Table 6.12)
- Former WV-02 (Original) – Building 026 (Table 6.13)
- Former Buried Clay Pipeline Associated with WV-02 (Original)(Table 6.14)
- Former WV-02 (Second) – Building 026 (Table 6.15)

- Former WV-15 – Building 026 (Table 6.16)
- Emergency Diesel Generators - Building 010 (Table 6.17)
- Building 026 Clarifier (Table 6.18)
- Current/Former Orchard Areas (Table 6.19)

Table 6.7 presents the estimated excess lifetime cancer risk and noncancer HI based on exposure to Parcel O-2 soil in the area of the hydrofluoric release in Building 026. No carcinogenic chemicals were detected during this investigation. The estimated noncancer HI for a child under a residential land use scenario is 0.05, below the target HI of 1.0.

Table 6.8 presents the estimated excess lifetime cancer risk and noncancer HI based on exposure to Parcel O-2 soil in the area of the laboratory floor in Building 026. No carcinogenic chemicals were detected during this investigation. The estimated noncancer HI for a child under a residential land use scenario is 0.019, below the target HI of 1.0.

As shown on Table 6.9, the estimated excess lifetime cancer risk under a residential land use scenario based on exposure to Parcel O-2 soil in the area of Room 400 in Building 026 is 1.7×10^{-8} . The estimated noncancer HI for a child under a residential land use scenario is 0.49. The cancer risk estimate is below the target risk range (1×10^{-4} to 1×10^{-6}) and the noncancer HI is below the target HI of 1.0.

As shown on Table 6.10, the estimated excess lifetime cancer risk under a residential scenario land use scenario based on exposure to Parcel O-2 soil in the area of Rooms 113C and 114A in Building 026 is 1.0×10^{-8} . The cancer risk estimate is below the target risk range (1×10^{-4} to 1×10^{-6}). The estimated noncancer HI for a child under a residential land use scenario is 2.2. The major chemical contributor to the HI is iron (2.1). As discussed in Section 5.3.1, background concentrations of iron in California soils range from 10,000 to 87,000 mg/kg, with a mean of 37,000 mg/kg (Bradford 1996). Only one of the soil samples analyzed for iron exceeded 87,000 mg/kg; Sample 406-02-0010 at a concentration of 110,000 mg/kg located at a depth of 3.5 feet bgs. This sample is representative of only a very small area as the concentration of iron at a depth of 2.0 feet bgs at this same location decreases to 55,000 mg/kg. For this area, the mean concentration of iron is 29,000 mg/kg; the EPC is 50,000 mg/kg. The estimated noncancer HI for a child under a residential land use scenario excluding iron is 0.068, below the target HI of 1.0.

As shown on Table 6.11, the estimated excess lifetime cancer risk under a residential land use scenario based on exposure to Parcel O-2 soil beneath Building 026 (including the chemical storage room) is 2.4×10^{-7} . The estimated noncancer HI for a child under a residential land use scenario is 0.55. The cancer risk estimate is below the target risk range (1×10^{-4} to 1×10^{-6}) and the noncancer HI is below the target HI of 1.0.

As shown on Table 6.12, the estimated excess lifetime cancer risk under a residential land use scenario based on exposure to Parcel O-2 soil near the buried concrete trenches is 2.8×10^{-8} . The estimated noncancer HI for a child under a residential land use scenario is 0.61. The cancer risk estimate is below the target risk range (1×10^{-4} to 1×10^{-6}) and the noncancer HI is below the target HI of 1.0.

As shown on Table 6.13, the estimated excess lifetime cancer risk under a residential land use scenario based on exposure to Parcel O-2 soil near WV-02 (original) is 2.2×10^{-7} . The estimated noncancer HI for a child under a residential land use scenario is 0.53. The cancer risk estimate is below the target risk range (1×10^{-4} to 1×10^{-6}) and the noncancer HI is below the target HI of 1.0.

As shown on Table 6.14, the estimated excess lifetime cancer risk under a residential land use scenario based on exposure to Parcel O-2 soil near the former buried clay pipeline associated with WV-02 (original) is 2.4×10^{-8} . The estimated noncancer HI for a child under a residential land use scenario is 0.55. The cancer risk estimate is below the target risk range (1×10^{-4} to 1×10^{-6}) and the noncancer HI is below the target HI of 1.0.

As shown on Table 6.15, the estimated excess lifetime cancer risk under a residential land use scenario based on exposure to Parcel O-2 soil near WV-02 (second) is 2.2×10^{-8} . The estimated noncancer HI for a child under a residential land use scenario is 0.60. The cancer risk estimate is below the target risk range (1×10^{-4} to 1×10^{-6}) and the noncancer HI is below the target HI of 1.0.

As shown on Table 6.16, the estimated excess lifetime cancer risk under a residential land use scenario based on exposure to Parcel O-2 soil near WV-15 is 2.2×10^{-8} . The estimated noncancer HI for a child under a residential land use scenario is 0.48. The cancer risk estimate is below the target risk range (1×10^{-4} to 1×10^{-6}) and the noncancer HI is below the target HI of 1.0.

Table 6.17 presents the estimated excess lifetime cancer risk based on exposure to Parcel O-2 soil in the area of the emergency diesel generators at Building 010. No carcinogenic chemicals were detected during this investigation. The estimated noncancer HI for a child under a residential land use scenario is 0.00033, well below the target HI of 1.0.

As shown on Table 6.18, the estimated excess lifetime cancer risk under a residential land use scenario based on exposure to Parcel O-2 soil near the Building 026 clarifier is 2.5×10^{-7} . The estimated noncancer HI for a child under a residential land use scenario is 0.91. The cancer risk estimate is below the target risk range (1×10^{-4} to 1×10^{-6}) and the noncancer HI is below the target HI of 1.0.

As shown on Table 6.19, the estimated excess lifetime cancer risk under a residential land use scenario based on exposure to Parcel O-2 soil related to orchard areas is 3.7×10^{-7} . The estimated noncancer HI for a child under a residential land use scenario is 0.61. The cancer risk estimate is below the target risk range (1×10^{-4} to 1×10^{-6}) and the noncancer HI is below the target HI of 1.0.

6.5.2 Soil Gas

Five soil gas investigations were conducted on Parcel O-2. For Parcel O-2 soil gas, cancer risk and noncancer HIs were calculated for four investigations:

- Near Monitoring Well A-30 (Table 6.20)
- Buried Concrete Trench (Table 6.21)
- WV-02 (Original) (Table 2.22)
- Building 026 Footprint (Table 2.23)

Data from the shallow soil gas sample collected during the fifth investigation, Building 026 Clarifier Soil Gas Sampling, was considered invalid due to high detection of the leak compound. In addition, the data was collected prior to removal of the clarifier.

Table 6.20 presents the estimated excess lifetime cancer risk based on exposure to Parcel O-2 soil gas near monitoring well A-30. As shown in Table 6.20, the estimated excess lifetime cancer risk for a residential land use scenario is 1.9×10^{-6} . The cancer risk estimated is within the target risk range (1×10^{-4} to 1×10^{-6}). The major chemical contributor to the estimate cancer risk is TCE (1.4×10^{-6}). The noncancer HI for a child under a residential land use scenario is 0.25, below the target HI of 1.0. The TCE results at this location are further discussed below:

As discussed in the Completion Report, Soil Inspection/Sampling Plan, Attachment IX – Soil Gas Evaluation for Parcels O-1 and O-2 (ENVIRON 2005b), soil gas near monitoring well A-30 was first investigated by ENVIRON in October 2004. Results of that investigation showed that TCE slightly exceeded its minimum residential RBTC of 3.8 mg/m^3 in one location (SJ-SG-26 at a concentration of 5.1 mg/m^3). None of the deeper soil gas samples were above residential RBTCs.

The purpose of the step out sampling around location SJ-SG-026 in May 2006 was to determine if a soil source area existed at this location. During this investigation, concentrations of TCE above the minimum residential RBTC (3.8 mg/m^3) were detected in four shallow soil gas samples (ranging from 7.1 to 21 mg/m^3).

Based on this additional investigation, no evidence of a VOC soil source area was found. This area of soil gas sampling overlays the TCE plume currently being remediated by IBM. It is most likely that the source of the elevated VOCs in soil gas in the area is the groundwater. Further investigation and subsequent remediation of the groundwater contamination will be conducted by Golder Associates, Inc. on behalf of IBM.

This area is designated for open space/park, not residential use. As shown in Table 6.20, the estimated excess lifetime cancer risk for a park user scenario is 8.0×10^{-10} and the noncancer HI for a child park user is 0.00013, well below target risk levels.

As shown in Table 6.21, the estimated excess lifetime cancer risk for a residential land use scenario based on exposure to Parcel O-2 soil gas near the buried concrete trenches is 3.8×10^{-7} and the noncancer HI for a child is 0.28. The cancer risk estimate is below the target risk range (1×10^{-4} to 1×10^{-6}) and the noncancer HI is below the target HI of 1.0.

As shown in Table 6.22, the estimated excess lifetime cancer risk for a residential land use scenario based on exposure to Parcel O-2 near WV-02 (original) is 2.2×10^{-7} and the noncancer HI for a child is 0.0088. The cancer risk estimate is below the target risk range (1×10^{-4} to 1×10^{-6}) and the noncancer HI is below the target HI of 1.0.

As shown in Table 6.23, the estimated excess lifetime cancer risk for a residential land use scenario based on exposure to Parcel O-2 soil gas beneath Building 026 is 8.7×10^{-7} and the noncancer HI for a child is 0.015. The cancer risk estimate is below the target risk range (1×10^{-4} to 1×10^{-6}) and the noncancer HI is below the target HI of 1.0.

6.5.3 Groundwater

Only one groundwater investigation was conducted on Parcel O-2. For groundwater, the estimated excess lifetime cancer risks and noncancer HI for Parcel O-2 (investigation near Building 026) are summarized in Table 6.24. As shown in this table, the estimated excess lifetime cancer risk under a residential land use scenario is 3.0×10^{-8} . The estimated noncancer HI for a child under a residential land use scenario is 0.00011. The cancer risk estimate is below the target risk range (1×10^{-4} to 1×10^{-6}) and the noncancer HI is below the target HI of 1.0.

6.5.4 Cumulative Risks

Table 6.25 summarizes the estimated cancer risks and noncancer hazard indices for all soil and soil gas investigations conducted on Parcel O-2. With the exception of WV-O2 (original), the footprint of Building 026 and the orchard areas, none of the other investigations evaluated for Parcel O-2 are co-located. This means that due to the distance between investigations, no one resident located on any one residential property would be exposed to all areas at one time. Therefore, it would not be appropriate to add risks over all areas.

In the area of WV-O2 original, both soil and soil gas were investigated. Assuming the risks from these two media are additive, the estimated cancer risk for a residential land use scenario in this area is 4.4×10^{-7} and the noncancer HI is 0.54; below target risk levels.

Many investigations were conducted in and around the Building 026 footprint and adjacent areas. Due to the large size of Building 026, these areas were not combined in this assessment. A number of the historical soil investigations may overlap with the recent soil gas investigation in Building 026, however, even if the risks were additive they would be at or within the target risk range. (The highest risk estimates for a residential land use scenario would be 2.4×10^{-7} for soils beneath Building 026 and 8.7×10^{-7} for the soil gas investigation. The total estimated risk would be 1.1×10^{-6}).

Regardless of the location within Parcel O-2, all populations could be potentially exposed to residual pesticides in soil. Without arsenic, which is present in concentrations consistent with background, the cancer risk estimate for orchard areas under a residential land use scenario is less than 1×10^{-6} and the noncancer HI is below the target HI of 1.0. [Note that adding these risk estimates directly to risk estimates from other areas would be an overestimate, as the metals detected as part of both studies are likely representative of background.]

The highest estimated risk for Parcel O-2 is based on soil gas samples collected near monitoring well A-30. The estimated excess lifetime cancer risk for this area under a residential land use scenario is 1.9×10^{-6} , at the very low end of the target cancer risk range (1×10^{-4} to 1×10^{-6}). However, this area is designated for open space/park, not residential use. The estimated excess lifetime cancer risk for a park user scenario is 8.0×10^{-10} and the noncancer HI for a child park user is 0.00013; well below target risk levels.

6.6 PARCEL O-3

The only media of concern for Parcel O-3 is soil. The discussion in the text focuses on a future residential land use scenario.

Four soil investigations were conducted on Parcel O-3 (Buried Concrete Trench, Black Soil in Parking Lot South of Building 026, Current Orchard Areas, and Former Orchard Areas). For soil, the estimated excess lifetime cancer risks and noncancer HIs for Parcel O-3 are summarized in Table 6.26. Due to the small parcel size, the four soil investigations have been combined. As shown in the Table 6.26, the estimated excess lifetime cancer risk under a residential land use scenario is 1.1×10^{-7} . The estimated noncancer HI for a child under a residential land use scenario is 0.77. The cancer risk estimate is below the target risk range (1×10^{-4} to 1×10^{-6}) and the noncancer HI is below the target HI of 1.0.

6.7 PARCEL O-4

Media investigated on Parcel O-4 included soil, soil gas and groundwater. Estimated cancer risks and noncancer HIs for soil, soil gas and groundwater are discussed separately below in Sections 6.7.1 through 6.7.3, respectively. Section 6.7.4 discussed cumulative risks for Parcel O-4. The discussion in the text focuses on a future residential land use scenario.

6.7.1 Soil

Fifteen soil investigations were conducted on Parcel O-4. Note that no chemicals were detected near the passenger elevator in the lobby of Building 028, and chemicals (TPH and low level PAHs) detected during the freight elevator investigation at Building 028 were collected at a depth of greater than 20 feet bgs. The remaining 13 investigations were combined into the following eight areas for purposes of this evaluation:

- Soil Beneath Building 028 (Table 6.27)
- Industrial Wastewater Leak from Pipe and Removal of Industrial Wastewater Pipeline (combines investigations covering both the leak and removal of the pipeline) (Table 6.28)
- Building 028J Area (includes Building 028J and Surrounding Area and Former WV-03 Soil Sampling) (Table 6.29)
- Buried Concrete Trenches (Table 6.30)
- WV-04 (includes the 1994 – WV-04 Buried Concrete Trench - and 2006 – Former WV-04 Soil Sampling - investigations) (Table 6.31)
- Former Diesel UST at Building 028 (Table 6.32)
- Building 018 Pipe Backfill (Table 6.33)
- Current/Former Orchards (includes Current Orchard Areas, Former Orchard Areas and Due Diligence Sampling Near Homestead Lake) (Table 6.34)

As shown on Table 6.27, the estimated excess lifetime cancer risk under a residential land use scenario based on exposure to Parcel O-4 soil beneath Building 028 is 1.2×10^{-6} . The major chemical contributor to the estimated cancer risk is methylene chloride. The estimated noncancer HI for a child under a residential land use scenario is 0.021. The cancer risk estimate is within the

target risk range (1×10^{-4} to 1×10^{-6}) and the noncancer HI is below the target HI of 1.0. During this investigation, which was conducted in 1984, three soil samples from one boring were collected at a depth of 0.0, 1.0, and 2.0 feet bgs and analyzed for select VOCs. Methylene chloride was only detected in the shallowest sample. Due to the small sample size, the maximum concentration was used in the risk estimates. However, methylene chloride has likely naturally attenuated over the last 25 years and would be well below the target risk range.

As shown on Table 6.28, the estimated excess lifetime cancer risk under a residential land use scenario based on exposure to Parcel O-4 soil in the area of the industrial wastewater lines is 4.7×10^{-8} . The cancer risk estimate is below the target risk range (1×10^{-4} to 1×10^{-6}). The estimated noncancer HI for a child under a residential land use scenario is 1.5. The major chemical contributor to the HI is iron (1.2). As discussed in Section 5.5.1, background concentrations of iron in California soil range from 10,000 to 87,000 mg/kg, with a mean of 37,000 mg/kg (Bradford 1996). For this area, the mean concentration of iron is 23,000 mg/kg; the EPC is 27,000 mg/kg. The estimated noncancer HI for a child under a residential land use scenario excluding iron is 0.34, below the target HI of 1.0.

As shown on Table 6.29, the estimated excess lifetime cancer risk under a residential land use scenario based on exposure to Parcel O-4 soil in the area Building 028J is 1.1×10^{-6} . The estimated noncancer HI for a child under a residential land use scenario is 0.58. The cancer risk estimate is within the target risk range (1×10^{-4} to 1×10^{-6}) and the noncancer HI is below the target HI of 1.0.

As shown on Table 6.30, the estimated excess lifetime cancer risk under a residential land use scenario based on exposure to Parcel O-4 soil in the area of the concrete trenches is 1.0×10^{-7} . The estimated noncancer HI for a child under a residential land use scenario is 0.88. The cancer risk estimate is below the target risk range (1×10^{-4} to 1×10^{-6}) and the noncancer HI is below the target HI of 1.0.

As shown on Table 6.31, the estimated excess lifetime cancer risk under a residential land use scenario based on exposure to Parcel O-4 soil in the area WV-04 is 2.7×10^{-8} . The estimated noncancer HI for a child under a residential land use scenario is 0.59. The cancer risk estimate is below the target risk range (1×10^{-4} to 1×10^{-6}) and the noncancer HI is below the target HI of 1.0.

As shown on Table 6.32, the estimated excess lifetime cancer risk under a residential land use scenario based on exposure to Parcel O-4 soil in the area of the former diesel UST at Building 028 is 4.4×10^{-8} . The estimated noncancer HI for a child under a residential land use scenario is 0.57. The cancer risk estimate is below the target risk range (1×10^{-4} to 1×10^{-6}) and the noncancer HI is below the target HI of 1.0.

Table 6.33 presents the estimated excess lifetime cancer risk and noncancer HI based on exposure to Parcel O-4 soil in the area of the Building 018 pipe backfill. TPH diesel and motor oil were the only chemical of concern for this investigation. The estimated noncancer HI for a child under a residential land use scenario is 0.041, well below the target level of 1.0.

As shown on Table 6.34, the estimated excess lifetime cancer risk under a residential land use scenario based on exposure to Parcel O-4 soil related to orchard areas is 8.1×10^{-8} . The estimated

noncancer HI for a child under a residential land use scenario is 0.61. The cancer risk estimate is below the target risk range (1×10^{-4} to 1×10^{-6}) and the noncancer HI is below the target HI of 1.0.

6.7.2 Soil Gas

Three soil gas investigations were conducted on Parcel O-4. For Parcel O-4 soil gas, cancer risk and noncancer HIs were calculated for all three investigations:

- Near the Core Area (collected as part of a due diligence investigation) (Table 6.35)
- Former Building 028J (including the area surrounding the building) (Table 6.36)
- Buried Concrete Trench (trench sample TR-9 was included in the Building 028J tables as it is located adjacent to this building) (Table 6.37)

Table 6.35 presents the estimated excess lifetime cancer risk and noncancer HIs based on exposure to Parcel O-4 soil gas near the Core Area. No carcinogenic chemicals were detected during this investigation. The estimated noncancer HI for a child under a residential land use scenario is 0.35, below the target level of one.

As shown in Table 6.36, the estimated excess lifetime cancer risk under a residential land use scenario based on exposure to soil gas near former Building 028J is 4.8×10^{-6} . The cancer risk estimate is within the target risk range (1×10^{-4} to 1×10^{-6}). The major chemical contributor to the cancer risk estimate is chloroform (4.4×10^{-6}). The noncancer HI for a child under a residential land use scenario is 0.20, below the target HI of 1.0. The remediation of chloroform in soil, soil gas, and groundwater is currently on-going in this area.

Table 6.37 presents the estimated excess lifetime cancer risk and noncancer HIs based on exposure to soil gas near buried concrete trenches on Parcel O-4. No carcinogenic chemicals were detected during this investigation. The estimated noncancer HI for a child under a residential land use scenario is 0.0015, well below the target HI of 1.0.

6.7.3 Groundwater

Cancer risk and noncancer HIs were calculated for the two investigations conducted on Parcel O-4; the former Building 028J Area and the Freight Elevator at Former Building 028 (Tables 6.39 and 6.40, respectively).

As shown in Table 6.38, the estimated excess lifetime cancer risk under a residential land use scenario based on exposure to groundwater near Building 028J is 5.2×10^{-7} and the noncancer HI for a child is 0.0014.

As shown on Table 6.39, no carcinogenic chemicals were detected in Parcel O-4 groundwater at the freight elevator at former Building 028. For groundwater, the estimated noncancer HI for a child under a residential land use scenario is 0.048, below the target HI of 1.

6.7.4 Cumulative Risk

Table 6.40 summarizes the estimated cancer risks and noncancer hazard indices for all soil and soil gas investigations conducted on Parcel O-4. With the exception of the Building 028J area and the orchard areas, none of the investigations evaluated for Parcel O-4 are co-located. This means that due to the distance between investigations, no one resident located on any one residential property would be exposed to all areas at one time. Therefore, it would not be appropriate to add risks over all areas.

Sampling within the Building 028J area included soil, soil gas, and groundwater. For determining the cumulative risk for this area, it is appropriate to add the estimated cancer risks and noncancer HIs for soil and soil gas. This is because the soil gas concentrations are predicted to be due to the groundwater concentrations. The estimated excess cancer risk due to exposure to both soil and soil gas under a residential land use scenario is 5.8×10^{-6} and the noncancer HI for a child is 0.78. The major chemical contributor to the estimated cancer risk is chloroform. Chloroform in groundwater is present at concentration up to 0.89 mg/L, above the groundwater cleanup standard for chloroform (0.080 mg/L) required by the current IBM RWQCB-SF Order No. R2-2002-0082 for the Site. Remediation of chloroform in soil, soil gas, and groundwater is currently on-going in this area.

Regardless of the location within Parcel O-4, all populations could be potentially exposed to residual pesticides in soil. The cancer risk estimate for orchard areas is less than 1×10^{-6} and the noncancer HI is below the target HI of 1.0.

6.8 PARCEL O-5

Media investigated on Parcel O-5 included soil and soil gas. Estimated cancer risks and noncancer HIs for soil and soil gas are discussed separately below in Sections 6.8.1 and 6.8.2, respectively. Section 6.8.3 discussed cumulative risks for Parcel O-5. The discussion in the text focuses on a future residential land use scenario.

6.8.1 Soil

Ten soil investigations were conducted on Parcel O-5. Note that no chemicals were detected in the former gasoline UST investigation at Building 018. The remaining 9 investigations were combined into the following six areas for purposes of this evaluation:

- Electrical Substation (including sample results from the 1984 Diesel Fuel Spill, the 1985 Diesel Fuel Spill, and the Removal of Rainwater/Spill Collection Vault and Drainline) (Table 6.41)
- Black Soil in Raleigh Road (Table 6.42)
- Passenger Elevator Pit – Building 051 (Table 6.43)
- Loading Dock Elevator Pit – Building 051 (Table 6.44)
- Parking Lot – Building 051 (Table 6.45)
- Current/Former Orchards (Table 6.46)

Table 6.41 presents the estimated excess lifetime cancer risk based on exposure to Parcel O-5 soil in the area of the electrical substation. No carcinogenic chemicals were detected during this investigation. The estimated noncancer HI for a child is 0.0064, well below the target HI of 1.0.

As shown on Table 6.42, the estimated excess lifetime cancer risk under a residential land use scenario based on exposure to soil in Raleigh Road is 2.1×10^{-8} . The estimated noncancer HI for a child under a residential land use scenario is 0.54. The cancer risk estimate is below the target risk range (1×10^{-4} to 1×10^{-6}) and the noncancer HI is below the target HI of 1.0.

As shown on Table 6.43, the estimated excess lifetime cancer risk under a residential land use scenario based on exposure to Parcel O-5 soil in the area of the passenger elevator pit at former Building 051 is 1.9×10^{-8} . The estimated noncancer HI for a child under a residential land use scenario is 0.51. The cancer risk estimate is below the target risk range (1×10^{-4} to 1×10^{-6}) and the noncancer HI is below the target HI of 1.0.

As shown on Table 6.44, the estimated excess lifetime cancer risk under a residential land use scenario based on exposure to Parcel O-5 soil in the area of the loading dock elevator pit at former Building 051 is 2.2×10^{-8} . The estimated noncancer HI for a child under a residential land use scenario is 0.51. The cancer risk estimate is below the target risk range (1×10^{-4} to 1×10^{-6}) and the noncancer HI is below the target HI of 1.0.

As shown on Table 6.45, the estimated excess lifetime cancer risk under a residential land use scenario based on exposure to Parcel O-5 soil in the area of the parking lot near former Building 051 is 3.4×10^{-8} . The estimated noncancer HI for a child under a residential land use scenario is 0.54. The cancer risk estimate is below the target risk range (1×10^{-4} to 1×10^{-6}) and the noncancer HI is below the target HI of 1.0.

As shown on Table 6.46, the estimated excess lifetime cancer risk under a residential land use scenario based on exposure to Parcel O-5 soil related to orchard areas is 8.1×10^{-7} . The estimated noncancer HI for a child under a residential land use scenario is 0.62. The cancer risk estimate is below the target risk range (1×10^{-4} to 1×10^{-6}) and the noncancer HI is below the target HI of 1.0.

6.8.2 Soil Gas

Only one soil gas investigation was conducted on Parcel O-5. As shown in Figure 3.31, the due diligence soil gas samples are scattered throughout Parcel O-5. For this assessment, the estimated excess lifetime cancer risks and noncancer HIs have been conservatively calculated using the maximum concentrations detected. As shown on Table 6.47, no carcinogenic chemicals were detected in Parcel O-5 soil gas. For soil gas, the estimated noncancer HI for a child under a residential land use scenario at the maximum detected concentrations is 0.25, below the target HI of 1.

6.8.3 Cumulative Risk

Table 6.48 summarizes the estimated cancer risks and noncancer hazard indices for all soil and soil gas investigations conducted on Parcel O-5. With the exception of electrical substation area and the orchard areas, none of the investigations evaluated for Parcel O-5 are co-located. This means that

due to the distance between investigations, no one resident located on any one residential property would be exposed to all areas at one time. Therefore, it would not be appropriate to add risks over all areas.

There were two soil investigations conducted near the electrical substation, a historical soil investigation and two soil gas samples collected as part of a due diligence study. No carcinogenic chemicals were detected in either study. Due to the low estimated HIs (0.0064 for the soil investigation and 0.25 for the soil gas investigation), the total estimated HI for this area would be below the target HI of 1.0.

All populations could be potentially exposed to residual pesticides in soil. The cancer risk estimate for orchard areas is less than 1×10^{-6} and the noncancer HI is below the target HI of 1.0.

6.9 ENDICOTT BOULEVARD/TUCSON WAY

The only media of concern for Endicott Boulevard/Tucson Way is soil. The discussion in the text focuses on a future residential land use scenario.¹⁵

For soil, the estimated excess lifetime cancer risks and noncancer HIs for Endicott Boulevard/Tucson Way are summarized in Table 6.49. Due to the small parcel size, the two soil investigations (Historical Shell Sol 140 Release near Building 110C and Former Orchard Areas) have been combined. As shown in the Table 6.49, the estimated excess lifetime cancer risk under a residential land use scenario is 8.7×10^{-9} . The estimated noncancer HI for a child under a residential land use scenario is 0.0017. The cancer risk estimate is below the target risk range (1×10^{-4} to 1×10^{-6}) and the noncancer HI is below the target HI of 1.0.

A small portion of Tucson Way potentially affected by Shell Sol is restricted; and addressed in the soil management plan being prepared by IBM.

¹⁵ It should be noted that a small portion of Tucson Way that was potentially affected by Shell Sol is restricted. The restriction, which is addressed in the SMP being prepared by IBM, includes no land use other than industrial, commercial or office space and no excavation below 15 feet bgs unless approved by the RWQCB-SF.

7.0 UNCERTAINTIES

The process of developing RBTCs or estimating risk has inherent uncertainties associated with the calculations and assumptions used. The approach used in this assessment has been health protective whenever possible and tends to overestimate exposures, resulting in RBTCs that are likely to be lower (or risk estimates that are likely to be higher) than what may be required to be protective of human health. A discussion of the key uncertainties used in the development of RBTCs and estimation of risk for this assessment is presented below.

7.1 EXPOSURE ASSESSMENT

Numerous assumptions must be made in order to estimate human exposure to chemicals. These assumptions include parameters such as daily breathing rates, soil ingestion rates, skin surface area exposed to soil, human activity patterns, and many others. Most of the exposure assumptions used in this assessment are recommended by CalEPA and USEPA, and are often the upper 90th or 95th percentile values. The use of 90th or 95th percentile values, when available, is recommended by the USEPA in order to estimate the “Reasonable Maximum Exposure” that may occur at a site. However, the combination of several upper-bound estimates used as exposure parameters may substantially overestimate chemical intake. The RBTCs calculated in this assessment are, therefore, likely to be lower (and the risk estimates higher) than what may be required to be protective of human health.

It should also be noted that the data used in this assessment are representative of current conditions at the Redevelopment Property. As time progresses, the chemicals in groundwater, soil gas and soil are likely to biodegrade and decrease in concentration. In addition, concentrations in groundwater and soil gas are expected to decrease with continued remediation. Such natural attenuation and continued groundwater remediation was not accounted for in the modeling for this assessment. Therefore, the risks estimated from current concentrations may overestimate the long-term risks to future populations.

7.2 FATE AND TRANSPORT MODELING

The uncertainties in the calculated emission flux of chemicals are associated with the limitations of the fate and transport models used in this assessment and a number of assumptions made during these calculations. First, there are inherent limitations in the models, which introduce uncertainties in the calculated flux. In particular, the modeling used in this assessment assumes vertical homogeneity in soil characteristics within each horizon in the vadose zone. In reality, there is variation in soil characteristics within each horizon in the vadose zone. Due to the nature of vertical variation in soil along the vadose zone, this constraint may result in either an overestimate or underestimate of the calculated flux. Further, the models also do not account for horizontal transport of chemicals within the vadose zone. If presence of chemicals is highly localized (i.e., impacted area is surrounded by a clean area), horizontal transport tends to dilute the localized source of chemicals and decrease the flux of chemicals to the atmosphere. For this case, the true flux could be lower than presented in this assessment and therefore, the calculated RBTCs would be lower (and risk estimates higher) than may be required to be protective of human health.

Other conservative assumptions used in the modeling include assuming a constant groundwater and soil gas source concentration through time. Relaxing this assumption would result in a lower flux and higher RBTCs (or lower risk estimates).

In addition, the shallowest expected future depth-to-groundwater was used for calculating flux from groundwater. This is especially conservative given that the current measured depth to groundwater in the Redevelopment Property is approximately twice the depth used in the model. Further, the depth-to-impacted soil was estimated based on the deepest shallow groundwater has recently been across the Redevelopment Property. This is also especially conservative given that the chemicals in soil are not spread uniformly down to 40 feet bgs across the Redevelopment Property. For the time period in which the models were run, the depth-to-impacted soil chosen essentially invokes an infinite source model for soils. As mentioned above, these conservative assumptions result in protective cleanup targets for each of the possible land uses. In fact, more representative assumptions would likely result in higher RBTCs and lower risk estimates than those presented in this report.

The uncertainties in the calculated indoor air concentrations are mostly associated with the assumed parameters and structure of a residential home or commercial building. First and most importantly, the attenuation through the slab of a house or commercial structure is difficult to characterize since actual attenuation through a building slab is difficult to measure. Factors that influence it include the degree of cracking of the slab, the permeability of the soil underlying the slab, the degree of building underpressurization, and building construction. Buildings that are constructed with air space between the soil and the living space (such as those with open basements or crawl spaces) would have greater attenuation of chemical migration into the building because the air space serves to passively vent vapors from the soil. The model used in this assessment did not assume open basements or crawl spaces.

Uncertainty associated with mixing height can occur if ventilation within the indoor space is good. For this model, a residential mixing height of eight feet was chosen, which is appropriate for a one-story home and conservative for a two-story home or a home with good ventilation between the first floor and an attic. A commercial mixing height of 10 feet was chosen. The effect of a change in mixing height is a simple linear extrapolation on the corresponding transfer factor. If the mixing height were doubled, the transfer factors would be reduced by a factor of two and increase the RBTCs by a factor of two.

Sensitivity in air exchange rate is also easily calculated, in that a doubled exchange rate reduces the transfer factors by two resulting in increased RBTCs by a factor of two. The air exchange rate can be different depending on whether ventilation in the building is aided by windows or doors being open or closed; the range of residential air exchange rates was estimated to be between 0.21/hour and 1.48/hour (USEPA 2003). The values used in this assessment are within that range at 0.5/hour for residential and 1.0/hour for commercial. However, if the air exchange rates in future homes or commercial buildings are greater, the RBTCs would be higher and the risk estimates lower than presented here. Similarly, if future homes or retail stores have lower air exchange rates, the RBTCs would be lower and the risk estimates higher than those presented in this assessment.

There is also uncertainty in the outdoor air dispersion factor (Q/C) used to describe vapor dispersion in outdoor ambient air. Doubling the Q/C term would halve the transfer factors and increase the RBTCs by a factor of two. The Q/C term used was for a 30-acre source area (the largest area source run in the model) and for a site located in San Francisco (the closest location to the Site). In addition to uncertainties in the model used to develop the Q/C factors, there are uncertainties with the Q/C term chosen. In reality, the size of the area source may be larger than 30 acres; however, based on the results of the model, the Q/C terms exponentially decrease as the source area increases. Therefore, running the model using a source area greater than 30 acres would only slightly decrease the Q/C term (and therefore, only slightly decrease the RBTCs). In addition, the average wind speeds input into the model for the San Francisco location is likely different than average wind speeds for San Jose. The difference in average wind speeds between San Francisco and San Jose would only slightly change the Q/C term (and therefore, only slightly change the RBTCs).

7.3 TOXICITY ASSESSMENT

Available scientific information is insufficient to provide a thorough understanding of all the toxic properties of each of the chemicals to which humans may be exposed. Therefore, it is often necessary to infer these properties by extrapolating them from data obtained from animal testing and other, alternative exposure conditions. Although reliance on experimental animal data has been widely used in general risk assessment practices, chemical absorption, metabolism, excretion, and toxic responses may differ between humans and the species for which experimental toxicity data are available. Uncertainties in using animal data to predict potential effects in humans are introduced when routes of exposure in animal studies differ from human exposure routes, when the exposures in animal studies are short-term or subchronic, and when effects seen at relatively high exposure levels in animal studies are used to predict effects at the much lower exposure levels found in the environment. Uncertainties in the toxicological assessments for carcinogens and noncarcinogens are discussed below.

7.3.1 Carcinogens

The use of animal data presents an uncertainty in predicting carcinogenicity in humans. While many substances are carcinogenic in one or more animal species, only a small number of substances are known to be human carcinogens, raising the possibility that not all animal carcinogens are human carcinogens and that not all human carcinogens are animal carcinogens. To prevent the underestimation of carcinogenic risk, regulatory agencies generally assume that humans are at least as sensitive to carcinogens as the most sensitive animal species.

The development of CSFs for carcinogens is predicated on the assumption generally made by regulatory agencies that no threshold exists for carcinogens (i.e., that there is some risk of cancer at all exposure levels above zero). The no-threshold hypothesis for carcinogens, however, may not be valid for all substances.

7.3.2 Noncarcinogens

In order to adjust for uncertainties that arise from the use of animal data, regulatory agencies often base the RfD and RfC for noncarcinogenic effects on the most sensitive animal species (i.e., the species that experiences adverse effects at the lowest dose). These doses are then adjusted via the use of safety or uncertainty factors. The adjustment compensates for the lack of knowledge regarding interspecies extrapolation, and guards against the possibility of humans being more sensitive than the most sensitive experimental animal species tested. The use of uncertainty factors is considered to be protective of health. In addition, when route-specific toxicity data were lacking, RfDs were extrapolated from one route to another (i.e., oral to inhalation and inhalation to oral). Due to the absence of contrary data, equal absorption rates were assumed for both routes.

7.4 UNCERTAINTIES IN RISK

The USEPA (1989b) notes that the conservative assumptions used in risk assessments are intended to assure that the estimated risks do not underestimate the actual risks posed by a site and that the estimated risks do not necessarily represent actual risks experienced by population at or near a site. By using standardized conservative assumptions in a risk assessment, USEPA further states that:

“These values are upperbound estimates of excess cancer risk potentially arising from lifetime exposure to the chemical in question. A number of assumptions have been made in the derivation of these values, many of which are likely to over-estimate exposure and toxicity. The actual incidence of cancer is likely to be lower than these estimates and may be zero.”

The RBTCs developed in this assessment are based primarily on a series of conservative assumptions. The use of conservative assumptions tends to produce upper-bound estimates of risk. Although it is difficult to quantify the uncertainties associated with all the assumptions used in this assessment, the use of conservative assumptions is likely to result in a substantial overestimate of exposure, and hence, risk.

8.0 SUMMARY/CONCLUSIONS

The purpose of this Final Remedy Completion Report is to characterize the current condition of the Redevelopment Property in order to ensure that these areas are appropriately characterized and remediated prior to removal from the RCRA Permit.

The data collected as part of the SI/SP, along with applicable historical investigation data, provide the basis for this Final Remedy Completion Report. As part of the Final Remedy Completion Report, the RBTCs were updated. The RBTCs calculated as part of the Screening HHRA/CCR, were based on conservative default assumptions for soil properties at the Site. Since the development of these target concentrations, site-specific data have been collected and the RBTCs have been revised accordingly. In addition, a limited number of toxicity values and exposure assumptions have changed based on CalEPA and USEPA guidance. Data presented in this report have been compared to the updated RBTCs.

Numerous investigations have been conducted at the Site to characterize the nature and extent of chemicals in groundwater, soil gas and soil. In order to assess whether residual chemical concentrations in groundwater, soil gas and soil in the Redevelopment Property are within acceptable risk ranges based on proposed future land uses, measured concentrations were compared to the RBTCs calculated for the applicable media. As a conservative screen, individual groundwater, soil gas and soil samples were compared directly to the chemical-specific RBTCs developed for a residential land use scenario. Chemicals with concentrations exceeding the minimum residential RBTC in at least one sample included arsenic, chloroform, dieldrin, iron, methylene chloride, nickel and toxaphene in soil; benzene, chloroform, and TCE in soil gas; and chloroform in groundwater.

Cancer risks and noncancer HIs were calculated for all investigation areas evaluated within each parcel using calculated EPCs for each chemical of concern in each applicable exposure area. Not including arsenic or iron, both of which were determined to be consistent with background concentrations in Site soils, cancer risk estimates for all areas were within the target risk range (1×10^{-4} to 1×10^{-6}) and the noncancer HIs were below the target HI of 1.0.

In all but four areas, the estimated cancer risks were below 1×10^{-6} . These four areas include soil gas near monitoring well RA-24 on Parcel O-1 (1.2×10^{-6}), soil gas near monitoring well A-30 on Parcel O-2 (1.9×10^{-6}), soil beneath Building 028 on Parcel O-4 (1.2×10^{-6}), and soil and soil gas in the Building 028J Area on Parcel O-4 (combined 5.8×10^{-6}).

The major chemical contributor to the estimated cancer risk for soil gas near monitoring well A-30 on Parcel O-2 is TCE. TCE exceeded the minimum residential RBTC (3.8 mg/m^3) in five shallow soil gas samples located just north of Building 010 (ranging from 5.1 to 21 mg/m^3). Soil gas results near monitoring well A-30 on Parcel O-2 are thought to be related to the Site-wide groundwater plume. Groundwater remediation is being conducted by IBM in this area. According to the *In Situ* Remedial Technologies Feasibility Study for Source Area Remediation prepared by Golder in June 2007 (Golder 2007) on behalf of IBM, groundwater remediation in the area of monitoring well A-30 will involve a modified pump and treat system (or extraction/injection system) with accelerated bioremediation, and a targeted *in situ* source zone treatment. In preparation of groundwater

remediation, Golder will also conduct a supplemental Site characterization to assess biogeochemical conditions, source zone delineation, residual source zone characteristics, and a detailed characterization of the contaminant flow paths.

In the Building 028J area, chloroform is the major chemical contributor to the cancer risk estimate. The maximum detected concentrations of chloroform exceeded the lowest residential RBTCs in at least two samples for all media (thirteen locations for soil, seven locations for soil gas, and two locations for groundwater). In addition, chloroform was detected above the groundwater cleanup standard for chloroform (0.080 mg/L) required by the current IBM RWQCB-SF Order No. R2-2002-0082 for the Site in 10 locations. Soil, soil gas and groundwater in the Building 028J Area on Parcel O-4 are currently undergoing remediation. A CMS for the Chloroform Release Area at Former Building 028J has been prepared (ENVIRON 2007j) recommending 2-PHASE™ Extraction as the preferred remedial alternative.

As documented in this Final Remedy Completion Report, extensive soil, soil gas and groundwater investigations have been conducted on the Redevelopment Property. In regards to Site-wide groundwater on the Redevelopment Property, IBM will continue remediation under the oversight of the RWQCB-SF. Remediation of chloroform in the Building 028J Area on Parcel O-4 is currently ongoing under the oversight of DTSC. All remaining areas on the Redevelopment Property have been determined to meet residential standards and are ready for removal from the RCRA Permit.

9.0 REFERENCES

- American Society for Testing and Materials (ASTM). 1995. Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites. E 1739-95. Philadelphia, PA.
- Antrim Engineering & Construction, Inc. (Antrim). 1995. *Post Closure Report, Decontamination and Closure of Waste Vault 04 – Tank T-1 And Associated Trench, San Jose, California*. February.
- Bradford, G.R., A.C. Chang, A.L. Page, D. Bakhtar, J.A. Frampton, and H. Wright. 1996. *Background Concentrations of Trace and Major Elements in California Soils*. Kearney Foundation of Soil Science, University of California. March.
- California Environmental Protection Agency (CalEPA). 2006. *Letter to Hitachi GST, Re: Conditional Approval of Redevelopment Area Corrective Action Investigation Documents, Hitachi Global Storage Technologies, Incorporated, EPA ID. NO. CAR0001288793*. Department of Toxic Substances Control. January.
- CalEPA. 2005a. Use of California Human Health Screening Levels (CHHSLs) in Evaluation of Contaminated Properties. January.
- CalEPA. 2005b. *All Chronic Reference Exposure Levels Adopted by Office of Environmental Health Assessment*. February.
- CalEPA. 2004. *Guidance for the Evaluation and Mitigation of Subsurface Vapor Intrusion to Indoor Air* (CalEPA 2004a; revised 2005).
- CalEPA. 2000. *Guidance for the Dermal Exposure Pathway*. Department of Toxic Substances Control. January.
- CalEPA. 1994. *Preliminary Endangerment Assessment Guidance Manual (PEA)*. Department of Toxic Substances Control. January.
- CalEPA. 1992. *Supplemental Guidance for Human Health Multimedia Risk Assessments of Hazardous Waste Sites and Permitted Facilities*. Department of Toxic Substances Control. Sacramento, California. July.
- City of San Jose, California. 2005a. Draft Environmental Impact Report. Hitachi Campus and Mixed-Use Transit Village Project. General Plan Amendment (GP04-02-01) and Planned Development Rezoning (PDC04-031). SCH#2004072110. Volume I through V. Approved as Final: June 6.
- City of San Jose, California. 2005b. First Amendment to the Draft Environmental Impact Report. Hitachi Campus and Mixed-Use Transit Village Project. General Plan Amendment (GP04-02-01) and Planned Development Rezoning (PDC04-031). SCH#2004072110. Volume I through V. Approved as Final: June 6.

- Dragun, J. and A. Chiasson. 1991. *Elements in North American Soils*. Hazardous Materials Control Resources Institute.
- Duncan, M. 2004. E-mail communication. Advisory Engineer, Environmental Programs. Hitachi Global Storage Technologies, Inc. August 10.
- ENVIRON International Corporation (ENVIRON). 2007a. *Completion Report, Soil Inspection/Sampling Plan, Attachment I – Roads/Parking Lots, Hitachi Global Storage Technologies, Inc., Redevelopment Property, 5600 Cottle Road, San Jose, California*. July 25.
- ENVIRON. 2007b. *Completion Report, Soil Inspection/Sampling Plan, Attachment II – Aboveground Storage Tanks Associated with Emergency Generators, Hitachi Global Storage Technologies, Inc., Redevelopment Property, 5600 Cottle Road, San Jose, California*. July 13.
- ENVIRON. 2007c. *Completion Report, Soil Inspection/Sampling Plan, Attachment III – Buried Concrete Trenches, Building 028J and Former Waste Vaults 02-04, Hitachi Global Storage Technologies, Inc., Redevelopment Property, 5600 Cottle Road, San Jose, California*. July 13.
- ENVIRON. 2007d. *Completion Report, Soil Inspection/Sampling Plan, Attachment IV – Hydraulic Elevators, Hitachi Global Storage Technologies, Inc., Redevelopment Property, 5600 Cottle Road, San Jose, California*. July 13.
- ENVIRON. 2007e. *Completion Report, Soil Inspection/Sampling Plan, Attachment V – Former Petroleum Underground Storage Tanks, Hitachi Global Storage Technologies, Inc., Redevelopment Property, 5600 Cottle Road, San Jose, California*. July 13.
- ENVIRON. 2007f. *Completion Report, Soil Inspection/Sampling Plan, Attachment VI – Former Orchard Areas, Hitachi Global Storage Technologies, Inc., Redevelopment Property, 5600 Cottle Road, San Jose, California*. July 13.
- ENVIRON. 2007g. *Completion Report, Soil Inspection/Sampling Plan, Attachment VII – Endicott Boulevard/Tucson Way, Hitachi Global Storage Technologies, Inc., Redevelopment Property, 5600 Cottle Road, San Jose, California*. July 23.
- ENVIRON. 2007h. *DRAFT Completion Report, Soil Inspection/Sampling Plan, Attachment VIII – Other Remaining Areas, Hitachi Global Storage Technologies, Inc., Redevelopment Property, 5600 Cottle Road, San Jose, California*. July 11.
- ENVIRON. 2007i. *Completion Report, Soil Inspection/Sampling Plan, Attachment IX – Soil Gas Evaluation for Parcels O-1 and O-2, Hitachi Global Storage Technologies, Inc., Redevelopment Property, 5600 Cottle Road, San Jose, California*. July 23.

- ENVIRON. 2007i. Corrective Measures Study, Chloroform Release Area at Former Building 028J, Hitachi Global Storage Technologies, Inc., Redevelopment Property, 5600 Cottle Road, San Jose, California. August 29.
- ENVIRON. 2006a. *Corrective Measures Study (CMS) Report, Redevelopment Property, Hitachi Global Storage Technologies, Inc., 5600 Cottle Road, San Jose, California.* June 28, 2006: revised August 31, 2006.
- ENVIRON. 2006b. *Pesticide Investigation Results and Soil Removal Plan – Former Orchard Areas Beneath Roads/Parking Lots. Hitachi Global Technologies, Inc., Redevelopment Property, 5600 Cottle Road, San Jose, California.* June 27: revised August 28, 2006.
- ENVIRON. 2006c. *Naturally-Occurring Asbestos (NOA) Management Plan, Redevelopment Property, Hitachi Global Storage Technologies, Inc., 5600 Cottle Road, San Jose, California.* June 27.
- ENVIRON. 2005a. *Draft Current Conditions Report (CCR), Hitachi Global Technologies, Inc., Redevelopment Area and Endicott Boulevard/Tucson Way, 5600 Cottle Road, San Jose, California.* July.
- ENVIRON. 2005b. *Soil Inspection/Sampling Plan (SI/SP). Hitachi Global Technologies, Inc., Redevelopment Area and Endicott Boulevard/Tucson Way, 5600 Cottle Road, San Jose, California.* August 22: revised January 31, 2006.
- ENVIRON. 2005c. “Additional Sampling on Parcels O-1 through O-3.” Letter to Hitachi Global Storage Technologies, Inc. December 2.
- Golder Associates Inc. (Golder). 2007. *In Situ Remedial Technologies Feasibility Study for Source Area Remediation, IBM Facility, 5600 Cottle Road, San Jose, California.* June.
- HLA. 1996. *Letter to IBM, Re: Status of Remediation Plans, Building 006/Tank Farm 067 Area and Southeast Corner of Building 001 Unsaturated Zone, San Jose, California.* November 15, 1996.
- HLA. 1991a. *Soil Investigation, Building 026 Loading Dock, Hydraulic Fluid Investigation, IBM, San Jose, California.* March 11.
- HLA. 1991b. *Soil Investigation, Electrical Substation Trench, IBM, San Jose, California.* February 28.
- HLA. 1990a. *Soil Investigation, Septic Tank, Building 010, IBM, San Jose, California.* September 18.
- HLA. 1990b. *Soil Investigation, Room 808u, Building 026 Sump Investigation, IBM, San Jose, California.* January.

- HLA. 1989a. *DRAFT Report, Soil Investigation, Emergency Diesel Generators, IBM, San Jose, California.* February 10.
- HLA. 1989b. *Soil Investigation, Building 026, Kodak Processing Room 149, IBM, San Jose, California.* March 17.
- HLA. 1989c. *Report, Soil Investigation, Building 026, Room 305u Sump, IBM, San Jose, California.* June 2.
- HLA. 1989d. *Soil Investigation, Building 028 Passenger Elevator, IBM, San Jose, California.* September 19.
- HLA. 1989e. *Soil Investigation, Building 028 Southeast Elevator, IBM, San Jose, California.* October 19.
- HLA. 1989f. *Soils Investigation, Chemical Waste Pipeline and W-3 Strip Out, Building 028, IBM, San Jose, California.* November 16.
- HLA. 1989g. *Report, Building 028 Industrial Waste Investigation, IBM, San Jose, California.* March 16.
- HLA. 1989h. *Soil Investigation, Lobby Elevator No. 1, Building 051, IBM, San Jose, California.* December 13.
- HLA. 1989i. *Soil Investigation, Lobby Elevator No. 2, Building 051, IBM, San Jose, California.* December 14.
- HLA. 1989j. *Soil Investigation, Loading Dock Elevator, Building 051, IBM, San Jose, California.* December 8.
- HLA. 1988a. *Investigation of a Possible Dense Nonaqueous Phase Liquid, Building 006 and Tank Farm 067 Area, San Jose, California, prepared for IBM.* April 20, 1988.
- HLA. 1988b. *Draft Chemical Data, Soil and Groundwater Samples from Borings, September 1, 1980 to June 30, 1988, Prepared for IBM, San Jose, California.* August.
- HLA. 1988c. *Soil Investigation, Building 026, Product Development Laboratories, IBM, San Jose, California.* April 27.
- HLA. 1988d. *Soil Investigation, Building 026, Product Development Laboratories, IBM, San Jose, California.* April 27.
- HLA. 1988e. *DRAFT Soil Investigation, Building 026 Sump, IBM, San Jose, California.* June 28.
- HLA. 1988f. *Soil Investigation, Building 028 Elevator Shaft, IBM General Products Division, San Jose, California.* August 19.

- HLA. 1988g. *Soil Investigation, Building 028 Industrial Waste, IBM General Products Division, San Jose, California.* April 28.
- HLA. 1988h. *Subsurface Investigation of Diesel Fuel Release Near the Electrical Substation, IBM General Products Division, San Jose, California.* March 3.
- HLA. 1987a. *Report, Soil Investigation, Building 026, Room 400, IBM, San Jose, California.* April 21.
- HLA. 1987b. *Report, Soil Investigation, Building 026, Rooms 113C and 114A, IBM, San Jose, California.* July 23.
- HLA. 1987c. *Letter Report, Recommendations for Additional Soil Excavation, Diesel Fuel Investigation Near the PG&E Substation, San Jose, California.* March 24.
- HLA. 1986a. *Services during Removal of Diesel Tank 011-N, IBM General Products Division, San Jose, California.* August 15.
- HLA. 1986b. *Services during Removal of Diesel Tank 010-N, IBM General Products Division, San Jose, California.* August 15.
- HLA. 1986c. *Services during Removal of Diesel Tank 026-W, IBM General Products Division, San Jose, California.* August 15.
- HLA. 1986d. *Report, Soil Investigation, Building 026, Industrial Waste Vault W-2, IBM, San Jose, California.* June 6.
- HLA. 1986e. *Soil Investigation, Building 028 Elevator Shaft, IBM General Products Division, San Jose, California.* September 5.
- HLA. 1986f. *Services During Removal of Solvent Tank at Building J, IBM General Products Division, San Jose, California.* September 9.
- HLA. 1986g. *Report, Soil Investigation, Chemical Storage Room, Building J, IBM, San Jose, California.* December 19.
- HLA. 1986h. *Shell Sol 140 Investigation, IBM, San Jose, California.* December 8.
- HLA. 1985a. *Final Report. Supplemental Soil Investigation, IBM Building 012, San Jose, California.* September 24.
- HLA. 1985b. *Letter Report: Gasoline Tank Removal, Building 018, IBM, San Jose, California.* August 23.
- HLA. 1982. *Subsurface Investigation, Spill Containment Tank at Building 028J, IBM General Products Division, San Jose, California.* December 13.

- International Technology Corporation (IT). 1990. *Waste Hydrofluoric Acid Storage Tank Closure Report, Waste Vault 15, IBM Corporation, San Jose, California*. March 5.
- IT. 1987. *Building 28 – Soil Characterization, Project No. 480040.01*. November 2.
- Johnson, P.C. and R.A. Ettinger. 1991. Heuristic Model for Predicting the Intrusion Rate of Contaminant Vapors Into Buildings. *Environ. Sci. Technol.* 25:1445-1452.
- Kennedy/Jenks/Chilton (K/J/C). 1987. *Draft, Comprehensive Plan – IBM Groundwater Restoration Program, Appendix A, Summary of Remedial Investigations*. June.
- Lawrence Berkeley National Laboratory (LBNL). 2002. *Analysis of Background Distributions of Metals in the Soil at Lawrence Berkeley National Laboratory*. June.
- MACTEC Engineering and Consulting, Inc. (MACTEC). 2007. *Annual Report to the RWQCB, Second Semi-Annual – July 1, 2006 through December 31, 2006, Groundwater Self-Monitoring Program*. Prepared for IBM. February 13.
- Massachusetts Department of Environmental Protection (MADEP). 2002. *Characterizing Risks Posed by Petroleum Contaminated Sites: Implementation of the MADEP VPH/EPH Approach*. Policy # WSC-02-411. October 31.
- Regional Water Quality Control Board – San Francisco Bay Region (RWQCB-SF). 2007. *Order No. R2-2007-0004, Amendment of Site Cleanup Requirements Order No. R2-2002-0082, for International Business Machines, 5600 Cottle Road, San Jose, Santa Clara County, California*. January 30.
- RWQCB-SF. 2005. *Screening for Environmental Concerns at Sites with Contaminated Soil and Groundwater*. Interim Final. February.
- RWQCB-SF. 2002. *Order No. R2-2002-0082, Final Site Cleanup Requirements and Rescission of Order No. 88-157 For: International Business Machines, San Jose, Santa Clara County, California*. August 20.
- RWQCB-SF. 1998. *Letter to IBM, Re: Closure of Shell-Sol Hydraulic Control System, IBM Site at 5600 Cottle Road, San Jose, Santa Clara County*. June 16, 1998.
- RWQCB-SF. 1988. *Order No. 88-157, Site Cleanup Requirements For: International Business Machines, San Jose, Santa Clara County, California*. October 21.
- Total Petroleum Hydrocarbon Criteria Working Group (TPHCWG). 1997. *Development of Fraction Specific Reference Doses (RfDs) and Reference Concentrations (RfCs) for Total Petroleum Hydrocarbons (TPH)*. Volume 4. Amherst, Massachusetts.
- United States Environmental Protection Agency (USEPA). 2007a. *Integrated Risk Information System (IRIS)*. Online database maintained by USEPA. Cincinnati, OH.

- USEPA. 2007b. *ProUCL Version 4.0, Technical Guide*. EPA/600/R-07/041. April.
<http://www.epa.gov/nerlesd1/tsc/software.htm>
- USEPA. 2007c. *ProUCL Version 4.0, Users Guide*. EPA/600/R-07/041. April.
<http://www.epa.gov/nerlesd1/tsc/software.htm>
- USEPA. 2006. *On the Computation of a 95% Upper Confidence Limit of the Unknown Population Mean Based Upon Data Sets with Below Detection Limit Observations*. National Exposure Research Laboratory. EPA/600/R-06/022. March.
- USEPA. 2004a. Region 9 Preliminary Remediation Goals (PRGs). San Francisco, California. October.
- USEPA. 2004b. *User's Guide for Evaluating Subsurface Vapor Intrusion Into Buildings*. Office of Emergency and Remedial Response. June 19.
- USEPA. 2004c. *ProUCL Version 3.0, User Guide*. EPA/600/R04/079. April.
<http://www.epa.gov/nerlesd1/tsc/images/proucl3apr04.pdf>
- USEPA. 2002. *Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance)* Office of Solid Waste and Emergency Response. November.
- USEPA. 2001a. *Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites*. Peer Review Draft. Office of Solid Waste and Emergency Response. Washington, D.C. March.
- USEPA. 2001b. *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)*. Interim. EPA/540/R/99/005. Office of Emergency and Remedial Response. Washington, D.C. September.
- USEPA. 1997a. *Exposure Factors Handbook*. EPA/600/P-95/002Fa. August.
- USEPA. 1997b. *Health Effects Assessment Summary Tables (HEAST). FY 1997 Update*. Office of Research and Development. EPA 540-R-97-36. July.
- USEPA. 1996. *Soil Screening Guidance: Technical Background Document*. Office of Solid Waste and Emergency Response. EPA/540/R95/128. May.
- USEPA. 1991a. *Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual (Part B: Development of Risk-Based Preliminary Remediation Goals)*. Office of Emergency and Remedial Response. Publication 9285.7-01B. December.

- USEPA. 1991b. *Risk Assessment Guidance for Superfund. Volume 1: Human Health Evaluation Manual. Supplemental Guidance. Standard Default Exposure Factors*. Office of Emergency and Remedial Response. March 25.
- USEPA. 1989a. *Risk Assessment Guidance for Superfund. Volume 1: Human Health Evaluation Manual (Part A). Interim Final*. Office of Emergency and Remedial Response. EPA-540/1-89/002. Washington, D.C. December.
- USEPA. 1989b. *Risk Assessment Guidance for Superfund Human Health Risk Assessment: U.S. EPA Region IX Recommendations (Interim Final)*. San Francisco, CA. December 15.
- USEPA. 1988. *Superfund Exposure Assessment Manual*. EPA/540/1-88/001. Office of Remedial Response. Washington, D.C.
- Woodward-Clyde. 1993. *Geotechnical Investigation, Chemical and Industrial Waste Piping Through IBM Cottle Road Plant, San Jose, California*. January.
- Yaws, C.L.; Yang, H.-C., *Henry's law constant for compound in water* in *Thermodynamic and Physical Property Data*, C. L. Yaws, ed(s)., Gulf Publishing Company, Houston, TX, 1992, 181-206.