

**REPORT ON  
ANNUAL GROUNDWATER MONITORING, 2008  
SANTA SUSANA FIELD LABORATORY  
VENTURA COUNTY, CALIFORNIA**

for

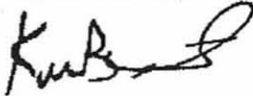
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**File No. 32600/05/10/M497  
27 February 2009**

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## LIST OF ACRONYMS AND ABBREVIATIONS

ASU	air stripping unit
CCR	California Code of Regulations
CFOU	Chatsworth Formation Operable Unit
1,1-DCA	1,1-dichloroethane
1,1-DCE	1,1-dichloroethene
cis-1,2-DCE	cis-1,2-dichloroethene
COC	constituent of concern
DMR	Discharge Monitoring Reports
DPH	(California) Department of Public Health
DTSC	(California) Department of Toxic Substances Control
EFH	extractable fuel hydrocarbons
EPA	(United States) Environmental Protection Agency
FLUTe	Flexible Liner Underground Technologies, LLC
FSDF	Former Sodium Disposal Facility
GWRC	Groundwater Resources Consultants, Inc.
K-40	potassium-40
LC	liquid chromatography
LCS/LCSD	laboratory control sample/laboratory control sample duplicate
LUFT	leaking underground fuel tank
MCL	maximum contaminant level
MDA	minimum detectable activity
MDL	method detection limit
mg/L	milligrams per liter
MS	mass spectrometry
MS/MSD	matrix spike/matrix spike duplicate
MSL	mean sea level
NDMA	n-nitrosodimethylamine
NL	notification level
NPDES	National Pollutant Discharge Elimination System
PCB	polychlorinated biphenyl
PCE	tetrachloroethene
pCi/L	picoCuries per liter
per mil	parts per thousand
pg/L	picograms per liter
QAPP	Quality Assurance Project Plan
QA/QC	quality assurance and quality control
Ra-226	radium-226
Ra-228	radium-228
RAL	regulatory action level
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
RPD	replicate percent difference
SAP	Sampling and Analysis Plan
SDG	sample delivery group
SDWA	Safe Drinking Water Act
SSFL	Santa Susana Field Laboratory
SMCL	secondary maximum contaminant level
SMOU	Surficial Media Operable Unit
Sr-90	strontium-90

## LIST OF ACRONYMS AND ABBREVIATIONS

(continued)

SVOC	semi-volatile organic compound
2,3,7,8-TCDD	2,3,7,8-tetrachlorodibenzo-p-dioxin
2,3,7,8-TCDD TEQ	2,3,7,8-TCDD toxic equivalency
TCE	trichloroethene
trans-1,2-DCE	trans-1,2-dichloroethene
TEQ	toxic equivalency
$\mu\text{g/L}$	micrograms per liter
U-233/234	uranium-233/234
U-235	uranium-235
U-238	uranium-238
UV	ultra-violet
VOC	volatile organic compound
V-SMOW	Vienna Standard Mean Ocean Water

## 1. INTRODUCTION

This report summarizes the groundwater monitoring and groundwater extraction and treatment system activities conducted during 2008 at the Santa Susana Field Laboratory (SSFL) located in Ventura County, California (Figure 1). This report is intended to fulfill the requirements of multiple regulatory programs being implemented at SSFL. These include requirements addressed in the Post-Closure Permit monitoring program approved by the California Environmental Protection Agency Department of Toxic Substances Control (DTSC), and the Leaking Underground Fuel Tank (LUFT) monitoring program overseen by DTSC. Specific requirements include performance of detection monitoring, evaluation monitoring, and interim corrective action monitoring as described in the SSFL (Facility) Post-Closure Permits and per the requirements of Title 22, California Code of Regulations (22 CCR), sections 66264.97 through 66264.99. The monitoring also complies with the Consent Order for Corrective Action issued on 16 August 2007 by DTSC (2007b).

Monitoring activities conducted during the year included:

- measurement of water levels
- collection and laboratory analysis of groundwater samples
- measurement of groundwater extraction and treatment system water levels, pumping rates, and volumes

Historical data were summarized in previous reports by Groundwater Resources Consultants (GWRC, 2000) and Haley & Aldrich (2001 through 2008a, 2008c, 2008e, 2008f).

The scope of this annual report includes the following as required per the Post-Closure Permits and 22 CCR, sections 66264.97 through 66264.99:

- summary of water level measurements
- discussion of the rates and direction of groundwater movement
- summary of results of laboratory analyses of water samples
- summary of groundwater extraction volumes and extraction well water levels and flow rates
- summary of results of laboratory analyses of permitted treatment system influent and effluent water samples
- water level hydrographs
- groundwater elevation contour map of the Chatsworth Formation water table surface for October 2008
- contaminant concentration posting maps for the year 2008
- contaminant concentration versus time plots for 1999 through 2008

Haley & Aldrich collected additional groundwater data in 2008 as part of the Surficial Media Operable Unit Resource Conservation and Recovery Act (RCRA) Facility Investigation (SMOU RFI), the Chatsworth Formation Operable Unit (CFOU) RFI (Montgomery Watson, 2000b), and the Perchlorate Characterization Work Plan (MWH, 2003e). Groundwater samples were also collected for the analysis of radionuclide activities in select Area IV wells for the United States Department of Energy (DOE) and the Energy Technology Engineering Center (ETEC).

One Chatsworth Formation well, RD-98, was constructed during June 2008 at the former Radioactive Materials Handling Facility (RMHF) Leach Field. Three shallow wells, SRE-



NS-E, SRE-NS-N, and SRE-NS-W, were constructed during June 2008 (Haley & Aldrich, 2008d). Twenty piezometers were constructed during April through July 2008 (CH2M Hill, 2008).

## **1.1 Report Organization**

Groundwater monitoring results, including analytical results and water levels, are presented in Section 2. Section 3 discusses remedial systems at SSFL, and Section 4 discusses surface water discharge monitoring at National Pollutant Discharge Elimination System (NPDES) Outfalls 001 and 002.

## 2. GROUNDWATER MONITORING

This section presents a discussion of groundwater levels and analytical results from 2008 groundwater sampling events conducted at SSFL. Monitoring wells are scheduled to be sampled quarterly, semiannually, or annually in accordance with the current Sampling and Analysis Plan (SAP) for the Facility (GWRC, 1995a, 1995b). The exceptions include former SSFL water supply wells, wells where Westbay or FLUTE systems are installed, and piezometers. Figure 2 shows the locations of the wells. Figure 3 shows the locations of piezometers. Groundwater elevation contours for the first-encountered water in the Chatsworth Formation, as determined from groundwater levels measured during the fourth quarter 2008 monitoring event, are shown in Figure 4.

Additional subsurface investigations are being conducted at SSFL as part of ongoing programs. As a result of these ongoing investigations, additional information on site geology and groundwater conditions becomes available. To the extent possible, this new information is incorporated into quarterly and annual groundwater monitoring reports.

Site geology is summarized and illustrated on Figure 5. Data collected in the eastern and central portions of SSFL indicate the presence of several geologic features that may impact groundwater flow (MWH, 2002, 2007b). The geologic features depicted on Figure 5 reflect the understanding and interpretation of both the stratigraphy and structure at SSFL and are based on over five years of field and office evaluations.

The following subsections provide a review of groundwater levels, and groundwater quality results and trends. Annual precipitation, year 2008 water level measurements, and historical water level hydrographs for select wells are presented in Tables I and II, and Appendix A, respectively. Hydrographs representing vertical profiles of 2008 water levels in wells installed with FLUTE and Westbay systems were prepared by MWH and are presented in Appendix A. Well construction details are summarized in Appendix C. FLUTE system, Westbay system, and piezometers construction details also are presented in Appendix C.

Groundwater quality results and trends (as presented in Tables III through XIV, Appendices E and F, and Figures 6 through 39) are discussed in Section 2.2.

### 2.1 Groundwater Elevations and Flow Conditions

Groundwater occurs at SSFL in the alluvium, weathered bedrock, and unweathered bedrock (Montgomery Watson, 2000a). First-encountered groundwater may be observed in any of these media under water table conditions. For the purposes of this report, “near-surface groundwater” is defined as groundwater that is present in the alluvium and weathered bedrock, and groundwater that occurs in the unweathered bedrock is referred to as “Chatsworth Formation groundwater”.

Near-surface groundwater is indicated to have a limited areal extent at SSFL, typically occurring in alluvial drainages (topographic lows) and valleys (e.g., Burro Flats in Area IV, Figure 40). At some locations within SSFL, where near-surface groundwater exists, the near-surface and Chatsworth Formation groundwater appear to be vertically continuous and not separated by a vadose zone (MWH, 2003d).

Based on data collected to date, perched groundwater is also indicated to exist at locations within SSFL (MWH, 2003d). At these locations, a vadose zone within the Chatsworth

Formation apparently separates near-surface and Chatsworth Formation groundwater. Groundwater data collection and analysis is ongoing and interpretations of existing hydrogeologic conditions will be modified appropriately.

### **2.1.1 Near-Surface Groundwater**

Near-surface water level measurements were conducted at each of the 95 shallow wells, and at the ECL French Drain and ECL Sump during 2008 (Table II and Appendix A). During 2008, water levels were also measured at 51 of the piezometers installed at the Facility (Table II). Near-surface groundwater elevations followed the general historical trend, highest during the late winter and spring rainy season, and lowest during the summer and early fall dry months.

Near-surface groundwater is indicated to occur in Quaternary alluvium distributed primarily in the Burro Flats area (Figures 5 and 40) and along ephemeral drainages, and in the upper weathered portion of the Chatsworth Formation. The alluvium is indicated to generally consist of unconsolidated sand, silt, and clay. This occurrence of near-surface groundwater is discontinuous at the Facility. Some portions of the alluvium and upper weathered Chatsworth Formation are saturated only during and immediately following a wet season.

Discharge of water to Facility storage reservoirs and channels as part of site operations can also affect groundwater levels in shallow wells. Most of these types of discharges have ceased.

For the 2008 water year, a total of 15.91 inches of precipitation was measured, approximately 14% below average since 1960 (Table I). A water year begins on October 1 and concludes on September 30 of the following calendar year.

Water level data from shallow wells continue to indicate that near-surface groundwater movement is generally a reflection of surface topography. Groundwater movement within the canyon areas is generally indicated in the same direction as surface flow in the canyons. Downward vertical movement of near-surface groundwater into the Chatsworth Formation bedrock is also indicated to occur (MWH, 2003d).

### **2.1.2 Chatsworth Formation**

The principal water bearing system at the Facility is the fractured Chatsworth Formation, predominantly composed of weak- to well-cemented sandstone with interbeds of siltstone and claystone. Several hydraulically significant features such as fault zones and shale beds are present at SSFL and may act as aquitards or otherwise influence the groundwater flow system (Montgomery Watson, 2000a; MWH, 2002, 2007b).

#### **2.1.2.1 Groundwater Elevations and Flow Conditions**

Water level elevations were measured during 2008 at 161 Chatsworth Formation wells (Table II and Appendix A).

Static depths to water in Chatsworth Formation wells measured during 2008 ranged from above land surface at artesian wells RD-59B, RD-59C, RD-68A,

and RD-68B to about 468 feet below land surface at OS-25. Water level elevations measured in Chatsworth Formation monitor wells during 2008 ranged from approximately 1,224 feet above mean sea level (MSL) at well RD-75 to about 1,896 feet above MSL at well RD-12 (Table II, Figure 4).

Discrete depth-interval water level data from Westbay- and FLUTE-equipped wells were collected by dataloggers and are presented in Table II and Appendix A. Access to manually measure water levels was not available at these wells.

The water level contour map, presented as Figure 4, was prepared using October 2008 water level elevations from the shallowest well in each Chatsworth Formation cluster, and from individual Chatsworth Formation wells at non-cluster locations.

Chatsworth Formation water levels during the fourth quarter 2008 were generally higher than fourth quarter 2007 water levels (Haley & Aldrich, 2008a; Appendix A).

As noted above, ongoing field investigations have resulted in the installation of several multi-port sampling devices (FLUTE and Westbay systems) in wells in the Former Sodium Disposal Facility (FSDF) area, and the northwest and northeast portions of SSFL (Figure 40). The elevation of first water in the multi-port devices in some wells appears to vary from that previously observed in the open well boreholes.

The groundwater elevation contour map, Figure 4, is provided to satisfy in part the requirements of 22 CCR, section 66264.97 for determining groundwater flow rates and directions. A groundwater elevation contour map can be used in simple hydrogeologic settings to depict variations in the elevation of the water table surface, which can in turn be used to interpret apparent relative directions of groundwater flow. However, the groundwater elevation contours depicted in Figure 4 are not used to infer groundwater flow directions or rates of groundwater movement for the following reasons, among others:

- Several hydraulically significant features such as fault zones and shale beds are present at SSFL and may act as impediments to groundwater flow across them. Accordingly, while significant variations in the elevation of groundwater are present at SSFL, these differences may not necessarily indicate preferred directions of groundwater flow.
- Some water level elevations depicted may not represent the elevation of the first occurrence of groundwater due to the relatively long, open intervals of some of the monitoring wells. The water levels shown represent average heads over the screened or open interval.
- Groundwater flow directions and rates in fractured rock are likely influenced by the bedrock fracture network and characteristics of the bedrock matrix and possibly the orientation of structural features and stratigraphy.

## 2.2 Groundwater Quality Results

This section summarizes the results of quarterly groundwater sampling and analysis for 2008. The groundwater monitoring program at SSFL fulfills the requirements of multiple regulatory programs prescribed by:

- the Post-Closure Permits (DTSC, 1995);
- Class 1 and Class 2 Permit Modifications of the Post-Closure Permits (DTSC, 2001);
- the LUFT program overseen by DTSC;
- various characterization efforts conducted at SSFL including the CFOU RFI groundwater investigation (Montgomery Watson, 2000b), the Happy Valley Interim Measures project (MWH, 2003f), the Perchlorate Characterization program (MWH, 2003e), the SMOU RFI program (Ogden, 2000), and the Area IV tritium investigation;
- the DTSC requirement to “collect both filtered/unfiltered samples on a quarterly basis for five quarters in groundwater monitoring wells in which metals are a contaminant of potential concern” (DTSC, 2007a); and
- the Consent Order for Corrective Action issued on 16 August 2007 by DTSC (2007b).

The Post-Closure Permit monitoring programs include the Evaluation Monitoring Program and the Detection Monitoring Program. The Evaluation Monitoring Program requires semiannual sampling of point of compliance wells, evaluation monitoring wells, and interim corrective action wells for the analysis of volatile organic compounds (VOCs; Tables III and IV) (DTSC, 2001). Detection monitoring wells, including background wells, are scheduled for quarterly sampling for the analysis of VOCs (DTSC, 2001). At five-year intervals, the Post-Closure Permit requires constituent of concern (COC) monitoring at wells in the Evaluation Monitoring and Detection Monitoring Programs. The next five-year COC monitoring required by the 1995 Post-Closure Permits is scheduled for 2010.

In this report, groundwater sampling results from Facility wells are compared to regulatory limits for discussion purposes. For those compounds or water quality constituents that have drinking water Maximum Contaminant Levels (promulgated by the Safe Drinking Water Act [SDWA] and 22 CCR, sections 64431 through 64449 and 64672), the primary Maximum Contaminant Levels (MCLs) are used for comparison (California Department of Public Health [DPH], 2008). Some COCs do not have associated MCLs but have notification levels (NLs) that are used for comparison and discussion. NLs are health-based advisory levels established for chemicals in drinking water for which there are no formal MCLs. California water purveyors are required to advise their customers of the presence of these chemicals in drinking water when concentrations are at or above NLs. If concentrations of these chemicals exceed 10 or 100 times the NLs, water purveyors are required to remove the water source from their distribution system (DPH, 2007b). Some chemicals have archived advisory levels (AALs) which have the same requirements and recommendations as for notification levels (DPH, 2007a). It is important to note that groundwater at SSFL is not used as a drinking water supply. References to AALs, MCLs, and NLs are for purposes of discussion only.

Reporting requirements in the Post-Closure Permits call for posting of water quality results above method detection limits (MDLs). Analytical results with concentrations greater than the MDL but less than the reporting limit are qualified (flagged as estimated with a "J") to indicate the uncertainty associated with the quantification of these data. The currently approved Sampling and Analysis Plan (SAP) calls for analytical methods which are not sufficiently sensitive to detect constituents of concern 1,4-dioxane (EPA Method 8260) and

n-nitrosodimethylamine (NDMA; EPA Method 8270C) at the California Department of Public Health (DPH) notification levels for these compounds. Therefore, Boeing has added the use of more sensitive DPH-approved analytical methods, including EPA Method 8260-SIM for 1,4-dioxane and EPA Method 1625M for NDMA.

During the first and second quarter 2008 monitoring events, EPA Method 521 was used to analyze for NDMA. During the second quarter, additional nitrosamines including n-nitrosodiethylamine (NDEA) and n-nitrosodi-n-propylamine (NDPA) for which NLs have also been promulgated were also analyzed by EPA method 521.

Boeing has performed quality assurance and quality control (QA/QC) analyses to assess the presence of NDMA in water samples, laboratory-supplied trip blanks, field blanks, locally-supplied municipal drinking water, and method blanks. The analytical results produced from this additional QA/QC sampling have indicated that NDMA is detected in QC samples at concentrations below the NL of 0.010 micrograms per liter ( $\mu\text{g/L}$ ), but above the MDL, indicative of the introduction of the compound from field sampling procedures or analytical laboratory processes, thus leading to false positive readings. To minimize the reporting of false positive readings, NDMA analytical results from EPA Method 1625M were previously presented at the reporting limit of 0.010  $\mu\text{g/L}$ . Continuous process improvements in the field and laboratory procedures have reduced the magnitude and frequency of detects in QC samples. As a result, NDMA results from EPA Method 1625M are now presented at the reporting limit of 0.005  $\mu\text{g/L}$ . During the second quarter, analytical results from EPA Method 521 are presented at the reporting limits of 0.002  $\mu\text{g/L}$  for NDMA, NDEA, and NDPA analyzed by Weck Laboratories and at 0.002  $\mu\text{g/L}$ , 0.005  $\mu\text{g/L}$ , and 0.007  $\mu\text{g/L}$  for NDMA, NDEA, and NDPA analyzed by E.S. Babcock & Sons.

Pursuant to the groundwater monitoring program, groundwater samples were collected during 2008 from shallow and Chatsworth Formation wells, and off-site wells. A summary of the analyses conducted at individual wells during 2008 is presented in Table B-I of Appendix B.

Pursuant to the monitoring program for 2008, laboratory analyses were performed to determine the concentration of:

- volatile organic compounds (VOCs)
- fuel hydrocarbons
- radionuclides (gross alpha, gross beta, plutonium, radium, strontium, thorium, tritium, uranium, and gamma-emitting radionuclides)
- metals
- cyanide
- semi-volatile organic compounds (SVOCs)
- nitroaromatics and nitramines
- polynuclear aromatic hydrocarbons (PAHs)
- perchlorate
- Appendix IX constituents
- constituents of concern
- inorganic constituents
- dioxins and furans
- polychlorinated biphenyls (PCBs)
- chlorinated pesticides
- hydrazines
- surfactants

Inorganic constituents included:

- major cations (calcium, magnesium, potassium, and sodium)
- major anions (bicarbonate, carbonate, chloride, nitrate, and sulfate)
- total dissolved solids
- pH
- specific conductance
- alkalinity
- turbidity
- fluoride
- bromide

Metals included antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, molybdenum, nickel, selenium, silver, thallium, vanadium, and zinc. At wells sampled in response to DTSC's requirement to analyze unfiltered and filtered metals in groundwater for five quarters (DTSC, 2007a), aluminum, boron, magnesium, strontium, and tin were also analyzed. As part of the SMOU RFI groundwater investigation, hexavalent chromium, aluminum, boron, magnesium, strontium, tin, and zirconium were analyzed in select samples.

Water quality results for groundwater samples are tabulated in Tables III through XIV. Analytical results for trichloroethene (TCE) and cis-1,2-dichloroethene (cis-1,2-DCE), the most prevalent COCs detected in groundwater samples collected from the site, are posted on Figures 6 through 9 for the near-surface and Chatsworth Formation groundwater. Maximum concentrations of constituents of concern detected during 2008 are posted on Figures 10 through 13 and 15 through 36. Figures are not presented for the constituents of concern that were not detected in any groundwater samples collected during 2008. Figure 14 presents maximum perchlorate concentrations detected during the year. Figure 37 presents wells sampled for Appendix IX constituents during 2008. Concentrations of Appendix IX constituents detected during the second quarter 2008 at the seven point of compliance wells are posted on Figures 38 and 39.

Concentration versus time plots for constituents of concern at permitted wells are presented in Appendix F.

Monitoring for the various characterization efforts in progress at SSFL was conducted during 2008 as follows:

- As part of the CFOU RFI groundwater investigation, a number of wells were monitored for constituents of concern and perchlorate (Table XI).
- As part of the Happy Valley Interim Measures project (MWH, 2003f), perchlorate and bromide were analyzed in groundwater samples collected from wells in the vicinity of the biotreatment area located near former Building 359 (Tables IX and XII). Former Building 359 was located along Area I Road approximately 175 feet east southeast of well HAR-25 (Figures 2 and 40).
- As part of the Perchlorate Characterization Work Plan (MWH, 2003e), groundwater samples were collected from private wells located off-site, and Facility monitoring wells for the analysis of perchlorate and inorganic constituents (Tables IX and XII). Also, groundwater samples collected at well OS-09 were analyzed for stable hydrogen and oxygen isotopes (Table XII).

- In support of the SMOU RFI program, groundwater samples were collected as part of the SMOU Reporting Groups 1A, 2, 3, 4, 5, 6, 7, and 8 data gap investigations (Figure 40) for analysis. Analyses performed included one or more of the following:
  - VOCs, including 1,4-dioxane (Tables III and IV)
  - alcohols (Table IV)
  - extractable fuel hydrocarbons (EFHs; Table V)
  - metals, hexavalent chromium (Table VII)
  - SVOCs (Table VIII)
  - PAHs (Table VIII)
  - nitroaromatics and nitramines (Table VIII)
  - perchlorate (Tables IX)
  - formaldehyde and NDMA (Table XI)
  - inorganics (bromide, chloride, fluoride, nitrate, sulfate), pH (Table XII)
  - dioxins and furans (Table XIII)
  - chlorinated pesticides (Table XIII)
  - PCBs (Table XIII)
  - hydrazines (Table XIV)
  - surfactants (Table XIV)
  
- Pursuant to DTSC's requirement, groundwater samples were collected for the analysis of dissolved (filtered) and total (unfiltered) metals "in all groundwater monitoring wells in which metals are a contaminant of potential concern" from February 2007 through February 2008 (DTSC, 2007a). During the second quarter 2008, dissolved and total metals samples were collected from wells where five quarters of monitoring had not been completed (Table VII).
  
- During the first and second quarters, unfiltered groundwater samples were collected from wells scheduled for analysis of the radioisotope potassium-40 (K-40) and were analyzed for the metal potassium (Table VII).

As part of the Phase 3 Groundwater Site Conceptual Model Work Plan (MWH, 2007a), Snap Sampler passive groundwater sampling systems were installed and removed from wells HAR-07, HAR-08, HAR-11, HAR-18, HAR-23, RD-01, RD-35B, RD-41B, RD-49A, RD-49B, RD-55A, RD-55B, RD-67, and RD-77 during the third and fourth quarters. For quarterly groundwater monitoring, dedicated sampling equipment was reinstalled to allow sampling to be conducted per the current SAP (GWRC, 1995a, 1995b). Multiple anomalous constituent detections or concentrations were reported in groundwater samples collected after Snap Samplers had been installed and removed from Facility monitor wells. Compared to historical samples, anomalous results were noted in groundwater samples collected from HAR-08, HAR-11, RD-49A, and RD-55B as discussed in the following sections.

A quality assurance summary of the monitoring program is presented in Appendix D. As discussed in Appendix D, detections of carbon disulfide reported below the reporting limit by Lancaster Laboratories, Inc. appeared to be false positives due to a laboratory process issue (Lancaster, 2007).

### 2.2.1 Near-Surface Groundwater

Groundwater samples were collected from 48 shallow wells and 28 piezometers as part of the groundwater monitoring program in 2008. Some shallow wells scheduled for groundwater sampling were dry or contained insufficient water for sampling when monitored (Table II and Appendix A). Analytical results for each well are



summarized in Tables III and V through XIV. The analytical results were within historical ranges (GWRC, 2000; Haley & Aldrich, 2001 through 2008a, 2008c, 2008e, 2008f; MWH, 2003d), with the exceptions noted below. Deviations from historical water quality results for analytes exceeding the reporting limits are discussed below. Results of verification sampling are discussed below and in section 2.2.5.

In support of the SMOU RFI program, selected piezometers and shallow wells were sampled during 2008 as part of the Groups 1A, 2, 3, 4, 5, 6, 7, and 8 data gap investigations. Per DTSC's requirement, selected shallow wells were sampled for dissolved and total metals (DTSC, 2007a) during the first and second quarters.

#### 2.2.1.1 LUFT Program

Shallow wells RS-01, RS-30, RS-31, and RS-32 were scheduled for semiannual LUFT program sampling during 2008.

Volatile organic and gasoline range organic analytical results for groundwater samples collected from shallow wells RS-30, RS-31, and RS-32 were within historical ranges (Tables III and V).

Shallow well RS-01 had insufficient water for sampling throughout the year and was not sampled in 2008.

The next semiannual monitoring of shallow LUFT program wells is scheduled for the first quarter 2009.

#### 2.2.1.2 Evaluation Monitoring Program/Interim Corrective Action Program

VOC concentrations detected in groundwater samples collected from shallow evaluation monitoring wells and interim corrective action wells during 2008 were within historical ranges (Table III) with the exceptions noted below:

##### Newly Detected Analytes

Well	Quarter	Analyte	2008 Sample Concentration (µg/L)	MCL, NL, or AAL (µg/L)
ES-06	Third	1,1,1-Trichloroethane	0.2 J	200 MCL
ES-21	Third	1,4-Dioxane	1 J	3 NL
ES-32	Second	Carbon disulfide	0.8	160 NL
HAR-04	First	Benzene	0.2 J	1 MCL
HAR-11	Fourth	1,1,2-Trichloroethane	0.1 J	5 MCL
	Third	1,4-Dioxane	0.9 J	3 NL
	Third	Chloroethane	0.2 J	NA
	Fourth	Chloroform	0.2 J	80 TTHM MCL
	Third	Ethylbenzene	0.3 J	300 MCL
	Third	m-Xylene & p-Xylene	0.8	1750 total MCL
	Third	o-Xylene	0.6	1750 total MCL

J = Estimated value. Analyte detected at a level less than the reporting limit and greater than or equal to the MDL, or concentration estimated due to analytical quality control deficiencies (see Appendix D for details).

NA = Not applicable. No MCL, NL, or AAL has been established for this analyte.

Total = MCL for sum of xylene isomers.

TTHM = Total trihalomethanes MCL for bromoform, chloroform, bromodichloromethane, and dibromochloromethane.

Shallow well HAR-11 was sampled using procedures from the 1995 SAP (GWRC, 1995a, 1995b) after a Snap Sampler system had been installed and removed during the third and fourth quarters. Verification samples (primary, field duplicate, split, and field blank) for ethylbenzene, m-xylene & p-xylene, and o-xylene were collected from HAR-11 and analyzed during the fourth quarter 2008. These compounds were detected at estimated concentrations of 0.1, 0.43 (split), and 0.42 (split)  $\mu\text{g/L}$ , respectively. Verification samples will be scheduled during the first quarter 2009 to determine if the 1,1,2-trichloroethane and chloroform detections reported in HAR-11 groundwater samples during the fourth quarter are repeatable in consecutive groundwater samples.

Concentrations of the following analytes detected in groundwater samples collected during the year were greater than the concentrations detected in samples collected prior to 2008:

Well	Quarter	Analyte	2008 Sample Concentration ( $\mu\text{g/L}$ )	MCL,NL, or AAL ( $\mu\text{g/L}$ )
ES-21	Third	1,1-Dichloroethene (1,1-DCE)	2 J	6 MCL
	Third	cis-1,2-Dichloroethene (cis-1,2-DCE)	<b>320 J</b>	6 MCL
	Third	Vinyl chloride	3	0.5 MCL
ES-22	Third	cis-1,2-DCE	<b>54 J</b>	6 MCL
ES-23	First	cis-1,2-DCE	8	6 MCL
	Third	cis-1,2-DCE	<b>25</b>	6 MCL
HAR-11	Third	Acetone	6.2	NA
	Fourth	Chloroethane	0.53 J	NA
RS-21	First	1,1-DCE	1.5	6 MCL
	First	cis-1,2-DCE	<b>240</b>	6 MCL
	First	Vinyl chloride	0.4 J	0.5 MCL

J = Estimated value. Analyte detected at a level less than the reporting limit and greater than or equal to the MDL, or concentration estimated due to analytical quality control deficiencies (see Appendix D for details).

Bold results exceed MCL.

NA = Not applicable. No MCL, NL, or AAL has been established for this analyte.

Evaluation monitoring wells and interim corrective action wells are scheduled to be monitored semiannually for VOCs and every five years for COCs. The next VOC monitoring event for these wells is scheduled for the first quarter 2009. Constituent of concern monitoring is next scheduled for 2010.

### 2.2.1.3 Point of Compliance Program

Shallow point of compliance wells SH-04, RS-08, HAR-14, and HAR-15 were scheduled for groundwater sampling and analysis of Appendix IX constituents during the second quarter 2008 and semiannual VOCs during the second and fourth quarters 2008.

Results of the monitoring are reported in Section 2.2.3 and Table X.

Shallow point of compliance wells HAR-14 and HAR-15 were also monitored under SMOU RFI Reporting Group 3. Results of the monitoring are reported in section 2.2.1.5.

#### 2.2.1.4 Near-Surface Groundwater Radiochemistry Analyses

During the year, near-surface groundwater samples were collected from select wells for the analysis of gross alpha and gross beta radioactivity, Radium-226 (Ra-226), Radium-228 (Ra-228), tritium, gamma-emitting radionuclides, strontium-90 (Sr-90), isotopic thorium, and isotopic uranium using EPA Methods 900.0, 903.1, 904.0, 906.0, 901.1, 905.0, 907.0, and 908.0, respectively (Table VI). Samples were also collected for the analysis of additional radionuclide activities per EPA drinking water regulations (Federal Register, 2000):

- In the event gross alpha activity exceeded 15 picoCuries per liter (pCi/L), groundwater samples were analyzed for isotopic uranium using EPA Method 908.0.
- In the event gross beta activity exceeded 50 pCi/L, groundwater samples were analyzed for potassium-40 (K-40) and Sr-90 using EPA Methods 901.1 and 905.0, respectively. During the year, Sr-90 was analyzed at least once for each location regardless of the gross beta activity.

During the fourth quarter, gamma-emitting radionuclides analyzed were actinium-228, antimony-125, barium-133, cesium-134, cesium-137, cobalt-60, europium-152, europium-154, europium-155, manganese-54, potassium-40, radium-228, and sodium-22.

As discussed in Appendix D, project specific minimum detectable activities (MDAs) were not always attained due in part to matrix conditions (e.g., dissolved and suspended solids) and limitations in the prescribed analytical methods (e.g., sample volumes, counting times).

Results of analyses for groundwater samples collected from Facility wells are compared to California drinking water MCLs for discussion purposes only. Groundwater at SSFL is not used as a drinking water supply. Except for samples collected for tritium analysis by EPA Method 906.0, groundwater radiochemistry samples are field filtered.

Results of radiological analyses of near-surface groundwater samples are noted below and summarized in Table VI.

##### Gross Alpha Activity

Results for the 2008 gross alpha samples were within the historical ranges for near-surface groundwater (Haley & Aldrich, 2008a). According to the EPA drinking water regulations, the adjusted gross alpha MCL excludes uranium activity (Federal Register, 2000). When the sum of isotopic uranium activity

is excluded from gross alpha activity, the adjusted gross alpha results for 2008 samples did not exceed the adjusted gross alpha drinking water MCL of 15 pCi/L. Calculations of adjusted gross alpha are presented below for samples where gross alpha activity prior to uranium activity subtraction exceeded 15 pCi/L:

Well	Activity (pCi/L)		
	RS-11	RS-54	RS-54
Quarter	Second	First	Third
Uranium-233/234 (U-233/234)	22.8	11.2	11.8
Uranium-235 (U-235)	0.977 J	0.64 J	0.730 J
Uranium-238 (U-238)	20.3	10.8	10.9
Sum of isotopic uranium activity	44.1	22.6	23.4
Gross alpha	38.8	23	18
Adjusted gross alpha	<0	0.4	<0

### Gross Beta Activity

The gross beta activities detected in near-surface groundwater samples were less than the drinking water MCL of 50 pCi/L.

### Tritium Activity

Tritium was not detected in near-surface groundwater samples collected during the year.

### Radium-226 and Radium-228

The sum of Ra-226 and Ra-228 activities for near-surface groundwater samples was less than the drinking water MCL of 5 pCi/L for Ra-226 and Ra-228 combined.

### Gamma Emitters

Anthropogenic gamma emitters (cesium-134, cesium-137, cobalt-57, cobalt-60, europium-152, europium-154, manganese-54, and sodium-22) were not detected in near-surface groundwater samples collected during 2008. Some gamma-emitting radionuclides samples collected during the year were not analyzed because gross beta activities did not exceed 50 pCi/L. Potassium-40, a naturally occurring gamma emitter, was not detected in near-surface groundwater samples collected during the year.

### Strontium-90

Sr-90 was not detected in near-surface groundwater samples collected during 2008.

### Isotopic Thorium

Thorium isotopes were not detected in near-surface groundwater samples collected during 2008 with the following exception:

- Thorium-230 was detected for the first time in groundwater collected from shallow well RS-54 during the first quarter at a concentration of  $0.183 \pm 0.099$  pCi/L. Neither a drinking water MCL nor a California NL has been established for thorium-230.

### Uranium

The California MCL for uranium is 20 pCi/L. Groundwater samples collected from shallow wells RS-11, RS-18, RS-25, and RS-54 were analyzed for isotopic uranium. Uranium activity in the RS-11 and RS-54 groundwater samples exceeded the 20 pCi/L MCL based on the results of analyses for uranium isotope activities:

Well	Quarter	Activity (pCi/L)			Total
		U-233/234	U-235	U-238	
RS-11	Second	22.8	0.977 J	20.3	<b>44.1</b>
RS-18	First	4.33	0.174 J	3.75	8.3
RS-25	First	3.04	0.108 J	2.74	5.9
RS-54	First	11.2	0.64 J	10.8	<b>22.6</b>
	Third	11.8	0.730 J	10.9	<b>23.4</b>

Bold results exceed 20 pCi/L California MCL.

#### 2.2.1.5 Other Monitoring

Some shallow Facility wells sampled during the quarter were not part of the LUFT, evaluation, interim corrective action, or point of compliance programs. These wells are not included in any prescribed monitoring program. Results of this monitoring are summarized in Section A below, except for SMOU RFI data gap results which are discussed in Section B.

Pursuant to DTSC's requirement, groundwater samples collected from select wells were analyzed for dissolved (filtered) and total (unfiltered) metals for five quarters from February 2007 through February 2008 (DTSC, 2007a). During the second quarter 2008, additional filtered metals samples were collected and analyzed (Table VII).

Groundwater samples collected from a select group of shallow Area IV wells that were monitored for the radioisotope potassium-40 also were analyzed for the metal potassium during the first and second quarters (Table VII).

In support of the SMOU RFI program, groundwater samples were collected from piezometers and shallow wells as part of the data gap investigations for SMOU Reporting Groups 1A, 2, 3, 4, 5, 6, 7, and 8.

- A. *Other Monitoring Results* – Analytical results for VOCs, metals, cyanide, and perchlorate were within historical ranges with the exceptions noted below (Tables III, VII, and IX).

Concentrations of the following analytes detected in near-surface groundwater samples collected during the year were greater than the concentrations detected in previous samples collected from that location:

Well	Quarter	Analyte	2008 Sample Concentration (mg/L)	MCL, NL, or AAL (mg/L)
RS-18	First	Dissolved cadmium	0.00045	0.005 MCL
	First	Dissolved copper	0.00047	NA
	First	Dissolved iron	0.928	NA
	First	Dissolved lead	0.002	NA
	First	Dissolved manganese	0.0385	0.5 NL
	First	Dissolved vanadium	0.003 J	0.05 NL

J = Estimated value. Analyte detected at a level less than the reporting limit and greater than or equal to the MDL, or concentration estimated due to analytical quality control deficiencies (see Appendix D for details).

mg/L = milligrams per liter.

NA = Not applicable. No MCL, NL, or AAL has been established for this analyte.

### Potassium in Area IV Wells

Unfiltered groundwater samples collected from a select group of shallow wells in and near Area IV that were monitored for potassium-40 were analyzed for the metal potassium during the first and second quarters (Table VII). Potassium concentrations in unfiltered groundwater samples ranged from 0.625 mg/L (RS-11) to 6.76 mg/L (RS-25). Neither a drinking water MCL nor a California NL has been established for potassium.

### DTSC Metals

Pursuant to DTSC's requirement, groundwater samples collected from shallow wells ES-21, ES-24, and RS-54 were analyzed for dissolved (filtered) and total (unfiltered) metals for five quarters from February 2007 through February 2008 (DTSC, 2007a). During the second and third quarters 2008, additional metals samples were collected and analyzed (Table VII). Concentrations were below MCLs and NLs with the following exceptions:

- Nickel was detected in filtered and unfiltered groundwater samples collected from RS-54 during the first quarter at concentrations of 0.553 and 0.544 mg/L, respectively and during the second quarter at concentrations of 0.625 and 0.647 mg/L, respectively. These concentrations are above the MCL of 0.1 mg/L, and are consistent with historical results (GWRC, 2000; Haley & Aldrich, 2001 through 2008a).

Metals concentrations were consistent with historical results with the following exception:

- Mercury was reported for the first time in the filtered groundwater sample collected from ES-24 during the first quarter at an estimated concentration of 0.000098 mg/L. Dissolved mercury was not detected in the second quarter groundwater sample collected from ES-24. The MCL for mercury is 0.002 mg/L.

- B. *SMOU RFI Data Gap Results* - As part of the RFI data gap investigation for SMOU Reporting Groups 1A, 2, 3, 4, 5, 6, 7, and 8, piezometers and shallow wells were sampled during the year as listed below. Results are summarized in Tables III, V, VII, VIII, IX, XI, XII, XIII, and XIV.

Analysis	Monitoring Location
VOCs	ES-21, HAR-11, HAR-14, HAR-15, PZ-001D, PZ-001E, PZ-001F, PZ-007D, PZ-007E, PZ-007F, PZ-009C, PZ-009D, PZ-009E, PZ-009F, PZ-010D, PZ-010E, PZ-010F, PZ-010G, PZ-020, PZ-022, PZ-105, PZ-120, RS-28
1,4-Dioxane	ES-21, HAR-11, HAR-14, HAR-15
EFHs	ES-10, ES-21, HAR-11, HAR-14, HAR-15, PZ-001D, PZ-001E, PZ-007D, PZ-007E, PZ-007F, PZ-010F, PZ-020, PZ-022, PZ-050, PZ-105, PZ-121, PZ-122, RS-16, RS-28, RS-54
Filtered metals	ES-11, ES-21, HAR-11, HAR-14, HAR-15, PZ-001D, PZ-001E, PZ-001F, PZ-007D, PZ-007E, PZ-007F, PZ-009C, PZ-009E, PZ-009F, PZ-010E, PZ-010F, PZ-010G, PZ-020, PZ-022, PZ-045, PZ-050, PZ-056, PZ-105, PZ-106, PZ-109, PZ-116, PZ-117, PZ-121, PZ-122, RS-16, RS-18, RS-28, RS-54
Hexavalent chromium	ES-21, HAR-11, HAR-14, HAR-15, PZ-056
SVOCs	ES-21, HAR-11, HAR-14, HAR-15, PZ-001D, PZ-001E, PZ-007D, PZ-007E, PZ-007F, PZ-010F, PZ-020, PZ-022, PZ-050, PZ-106, RS-16, RS-28, RS-32
PAHs	PZ-006A, PZ-006C, PZ-006D, PZ-006E, PZ-023, PZ-025, PZ-026, PZ-027, PZ-028, SH-01, SH-02, SH-03, SH-04, SH-05, SH-08, SH-09, SH-10, SH-11
Perchlorate	PZ-108, PZ-121, PZ-122
Formaldehyde	PZ-006A, PZ-006C, PZ-006D, PZ-006E, PZ-023, PZ-025, PZ-026, PZ-027, PZ-028, SH-01, SH-02, SH-03, SH-04, SH-05, SH-08, SH-09, SH-10, SH-11
NDMA	RS-32
Inorganics (bromide, fluoride, nitrate, sulfate, chloride)	PZ-005, PZ-103, PZ-106, PZ-108, PZ-109, PZ-121, PZ-122
pH	PZ-121, PZ-122
Dioxins and furans	ES-10, ES-21, HAR-11, HAR-14, HAR-15, PZ-056, PZ-074
Chlorinated pesticides	SH-02, SH-03, SH-04, SH-05, SH-08, SH-09
PCBs	ES-11, ES-21, RS-16
Hydrazines	PZ-108, PZ-121, PZ-122
Surfactants	PZ-041

SVOCs, perchlorate, NDMA, PCBs, and hydrazines were not detected (Tables VIII, IX, XI, XIII, and XIV).

Surfactants were detected in one of two PZ-041 groundwater samples collected during the year at 0.3 mg/L (Table XIV).

Where detected, formaldehyde concentrations were below the formaldehyde NL of 100 µg/L (Table XI).

The results for pH in PZ-121 and PZ-122 are reported in Table XII.

Inorganic constituent concentrations were below drinking water MCLs with the following exceptions:

- Nitrate exceeded the 45 mg/L MCL in groundwater from PZ-005 during the first and third quarters at 64 mg/L and 71 mg/L, respectively, and in groundwater from PZ-103 during the first and fourth quarters at 49 mg/L and 61 mg/L, respectively (Table XII). Nitrate had not been analyzed in previous groundwater samples collected from these piezometers.

All results for hexavalent chromium and filtered metals analyzed for the SMOU RFI program were below MCLs and NLs (Table VII) with the following exceptions:

- Manganese was detected above the 0.5 mg/L NL in the filtered groundwater sample collected from HAR-11 during the third quarter at a concentration of 2.29 mg/L. This result is within the historical range of results for this well.
- As discussed earlier in this section, dissolved nickel was detected in the filtered groundwater samples collected from RS-54 during the first and second quarters at concentrations of 0.553 and 0.625 mg/L, respectively. These results are above the MCL of 0.1 mg/L for nickel, but are consistent with historical results.

Several chlorinated pesticides were detected for the first time in groundwater samples collected from shallow wells SH-02, SH-03, SH-04, SH-05, SH-08, and SH-09 (Table XIII). Chlorinated pesticide concentrations were below MCLs, NLs, or AALs with the following exceptions:

Well	Quarter	Analyte	Sample Type	2008 Sample Concentration (µg/L)	MCL, NL, or AAL (µg/L)
SH-02	Second	Heptachlor	Split	0.014 J	0.01 MCL
SH-04	Second	Aldrin	Split	0.0072 J	0.002 AAL
	Second	Heptachlor	Split	0.015 J	0.01 MCL
	First	Heptachlor epoxide	Primary	0.011	0.01 MCL
SH-08	Second	Aldrin	Primary	0.0055 J	0.002 AAL
	Second	Heptachlor	Split	0.01 J	0.01 MCL

J = Estimated value. Analyte detected at a level less than the reporting limit and greater than or equal to the MDL, or concentration estimated due to analytical quality control deficiencies (see Appendix D for details).



As discussed in Appendix D, spiked chlorinated pesticide samples prepared by Environmental Resource Associates were submitted as blind samples to Lancaster Laboratories during the first quarter. Data validation by MECX of the spiked samples and the groundwater samples resulted in MECX qualifying some pesticide results as tentatively identified at approximate concentrations (NJ). Verification sampling and analysis for chlorinated pesticides scheduled at SH-02, SH-03, SH-04, SH-05, SH-08, and SH-09 could not be collected during subsequent quarters because these wells had insufficient water for sampling. Verification samples (primary, duplicate, split, field blank, and equipment rinsate) will be rescheduled for the first quarter 2009 to determine if chlorinated pesticide detections reported in shallow well groundwater samples during the year are repeatable in consecutive groundwater samples.

PAHs were not detected in groundwater samples collected from shallow wells and piezometers except for phenanthrene detected in the second quarter groundwater sample collected from PZ-006E (Table VIII). Phenanthrene was detected at an estimated 0.042  $\mu\text{g/L}$ . PAHs had not been analyzed in prior samples collected from PZ-006E. Neither a drinking water MCL nor a California NL has been established for phenanthrene.

Extractable fuel hydrocarbons were detected in groundwater samples collected from HAR-11, PZ-105, and PZ-121 (Table V). HAR-11 and PZ-105 had not been sampled previously for EFH analysis. PZ-121 groundwater was sampled once in 2003 for EFH. EFHs were not detected in PZ-121 groundwater at that time. Neither a drinking water MCL nor a California NL has been established for EFHs.

The following VOC analytes, including 1,4-dioxane, were detected for the first time in groundwater from these shallow wells (Table III). HAR-11 was sampled using procedures from the 1995 SAP (GWRC, 1995a, 1995b) after a Snap Sampler system had been installed and removed from the well.

Well	Quarter	Analyte	2008 Sample Concentration ( $\mu\text{g/L}$ )	MCL or NL ( $\mu\text{g/L}$ )
ES-21	Third	1,4-Dioxane	1 J	3 NL
HAR-11	Fourth	1,1,2-Trichloroethane	0.1 J	5 MCL
	Third	1,4-Dioxane	0.9 J	3 NL
	Third	Chloroethane	0.2 J	NA
	Fourth	Chloroform	0.2 J	80 TTHM MCL
	Third	Ethylbenzene	0.3 J	300 MCL
	Third	m-Xylene & p-Xylene	0.8	1750 (total) MCL
HAR-11	Third	o-Xylene	0.6	1750 (total) MCL
RS-28	Fourth	Chloroform	0.1 J	80 TTHM MCL

J = Estimated value. Analyte detected at a level less than the reporting limit and greater than or equal to the MDL, or concentration estimated due to analytical quality control deficiencies (see Appendix D for details).

NA = Not applicable. No MCL or NL has been established for this analyte.  
 TTHM = Total trihalomethanes MCL for bromoform, chloroform, bromodichloromethane, and dibromochloromethane.

Concentrations of the following VOC analytes detected in shallow well groundwater samples collected for the SMOU RFI program during the year were greater than concentrations detected in samples collected prior to 2008:

Well	Quarter	Analyte	2008 Sample Concentration (µg/L)	MCL or NL (µg/L)
ES-21	Third	1,1-DCE	2 J	6 MCL
	Third	cis-1,2-DCE	<b>320 J</b>	6 MCL
	Third	Vinyl chloride	<b>3</b>	0.5 MCL
HAR-11	Third	Acetone	6.2	NA

J = Estimated value. Analyte detected at a level less than the reporting limit and greater than or equal to the MDL, or concentration estimated due to analytical quality control deficiencies (see Appendix D for details).

Bold results exceed MCL.

NA = Not applicable. No MCL or NL has been established for this analyte.

As discussed in Section 2.2.1.2, verification sampling will be scheduled at HAR-11 during the first quarter 2009 to determine if the newly detected VOCs 1,1,2-trichloroethane and chloroform are repeatable in consecutive groundwater samples or possible artifacts of field or laboratory contamination.

Several VOCs were detected for the first time in groundwater samples collected from the following piezometers. These piezometers had been sampled and analyzed for VOCs prior to 2008.

Well	Quarter	Analyte	2008 Sample Concentration (µg/L)	MCL or NL (µg/L)
PZ-001D	Second	Acetone	7 J	NA
	Second	trans-1,2-dichloroethene (trans-1,2-DCE)	4 J	10 MCL
PZ-001E	Second	trans-1,2-DCE	<b>12</b>	10 MCL
PZ-001F	Second	trans-1,2-DCE	6	10 MCL
PZ-007D	Second	trans-1,2-DCE	3 J	10 MCL
PZ-007E	Second	1,1-DCE	2 J	5 MCL
	Second	trans-1,2-DCE	9	10 MCL
	Second	Vinyl Chloride	<b>0.6 J</b>	0.5 MCL
PZ-007F	Second	cis-1,2-DCE	<b>120</b>	6 MCL
	Second	trans-1,2-DCE	<b>15</b>	10 MCL
	Second	TCE	<b>73</b>	5 MCL
PZ-009C	Second	cis-1,2-DCE	3 J	6 MCL
PZ-009D	Second	trans-1,2-DCE	0.9 J	10 MCL
PZ-009E	Second	trans-1,2-DCE	5 J	10 MCL
PZ-009F	Second	Acetone	25	NA
PZ-010D	Second	cis-1,2-DCE	<b>16</b>	6 MCL
	Second	Vinyl Chloride	<b>1</b>	0.5 MCL
PZ-010E	Second	cis-1,2-DCE	<b>10</b>	6 MCL
	Second	Vinyl Chloride	<b>5</b>	0.5 MCL

Well	Quarter	Analyte	2008 Sample Concentration (µg/L)	MCL or NL (µg/L)
PZ-010F	Second	Vinyl Chloride	<b>17</b>	0.5 MCL
PZ-010G	Second	Acetone	10 J	NA
	Second	Vinyl Chloride	<b>22</b>	0.5 MCL
PZ-020	Second	1,1-DCE	2 J	6 MCL
PZ-022	Second	Chloroform	0.1 J	80 TTHM MCL
PZ-120	Fourth	1,1,2-Trichloro-1,2,2-trifluoroethane	2.8	1200 MCL
	Fourth	1,1-Dichloroethane (1,1-DCA)	1.1	5 MCL
	Fourth	1,1-DCE	0.4 J	6 MCL
	Fourth	Chloroform	0.1 J	80 TTHM MCL
	Fourth	Trichlorofluoromethane	0.2 J	150 MCL

J = Estimated value. Analyte detected at a level less than the reporting limit and greater than or equal to the MDL, or concentration estimated due to analytical quality control deficiencies (see Appendix D for details).

Bold results exceed MCL.

NA = Not applicable. No MCL or NL has been established for this analyte.

TTHM = Total trihalomethanes MCL for bromoform, chloroform, bromodichloromethane, and dibromochloromethane.

In some piezometer groundwater samples collected for the SMOU RFI program, cis-1,2-DCE, trans-1,2-DCE, and TCE concentrations exceeded concentrations in samples collected prior to 2008:

Well	Quarter	Analyte	2008 Sample Concentration (µg/L)	MCL (µg/L)
PZ-001D	Second	cis-1,2-DCE	<b>67</b>	6
PZ-001E	Second	cis-1,2-DCE	<b>31</b>	6
PZ-001F	Second	cis-1,2-DCE	<b>16</b>	6
PZ-007D	Second	cis-1,2-DCE	<b>210</b>	6
PZ-007E	Second	cis-1,2-DCE	<b>390</b>	6
PZ-009D	Second	cis-1,2-DCE	5 J	6
PZ-009E	Second	cis-1,2-DCE	<b>15</b>	6
PZ-010F	Second	cis-1,2-DCE	<b>110</b>	6
PZ-010G	Second	cis-1,2-DCE	<b>39</b>	6
PZ-020	Second	cis-1,2-DCE	<b>400</b>	6
PZ-120	Fourth	cis-1,2-DCE	<b>7.5</b>	6
PZ-020	Second	trans-1,2-DCE	8	10
PZ-001E	Second	TCE	<b>32</b>	5
PZ-007D	Second	TCE	<b>220</b>	5
PZ-007E	Second	TCE	<b>230</b>	5
PZ-009D	Second	TCE	<b>51</b>	5
PZ-009E	Second	TCE	<b>64</b>	5
PZ-020	Second	TCE	<b>520</b>	5
PZ-120	Fourth	TCE	<b>31</b>	5

J = Estimated value. Analyte detected at a level less than the reporting limit and greater than or equal to the MDL, or concentration estimated due to analytical quality control deficiencies (see Appendix D for details).

Bold results exceed MCL.

Low concentrations of dioxins and furans were detected in groundwater samples collected from ES-10, HAR-14, and HAR-15. The following dioxins and furans were detected for the first time (Table XIII):

Well	Quarter	Analyte	2008 Sample Concentration (picograms per liter, pg/L)	MCL, NL, or AAL
ES-10	Second	OCDD	5.4 J	NA
HAR-14	Third	1,2,3,4,7,8,9-HpCDF	3.6 J	NA
	Third	1,2,3,4,7,8-HxCDF	4.4 J	NA
	Third	1,2,3,6,7,8-HxCDD	4.4 J	NA
	Third	2,3,4,6,7,8-HxCDF	0.77 J	NA
	Third	2,3,4,7,8-PeCDF	0.55 J	NA
	Third	OCDF	58	NA

J = Estimated value. Analyte detected at a level less than the reporting limit and greater than or equal to the MDL, or concentration estimated due to analytical quality control deficiencies (see Appendix D for details).

NA = Not applicable. No MCL, NL, or AAL has been established for this analyte.

The dioxins and furans reported in the third quarter groundwater sample from HAR-14 were not detected in the sample collected on 22 April 2008 (Table XIII).

Concentrations of the following dioxins and furans detected in groundwater samples collected during the year were greater than the concentrations detected in previous samples:

Well	Analyte	Third Quarter 2008 Sample Concentration (pg/L)	MCL, NL, or AAL
HAR-14	1,2,3,4,6,7,8-HpCDF	34 J	NA
	1,2,3,4,6,7,8-HpCDD	66	NA
	1,2,3,6,7,8-HxCDF	5.2 J	NA
	OCDD	290	NA

J = Estimated value. Analyte detected at a level less than the reporting limit and greater than or equal to the MDL, or concentration estimated due to analytical quality control deficiencies (see Appendix D for details).

NA = Not applicable. No MCL, NL, or AAL has been established for this analyte.

When converted to 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) toxic equivalency (TEQ) (van den Berg et al., 2006), the concentrations of the detected dioxin and furan congeners in the groundwater samples collected from ES-10, HAR-14, and HAR-15 were less than the drinking water MCL of 30 pg/L for 2,3,7,8-TCDD.

Well	Quarter	2,3,7,8-TCDD TEQ (pg/L)	2,3,7,8-TCDD MCL (pg/L)
ES-10	Second	0.0016 J	30
HAR-14	Third	2.8	30
HAR-15	Third	0.02 J	30

J = Estimated value. Analyte detected at a level less than the reporting limit and greater than or equal to the MDL, or concentration estimated due to analytical quality control deficiencies (see Appendix D for details).

### 2.2.2 Chatsworth Formation

Analytical results of Chatsworth Formation groundwater samples collected during 2008 are summarized in Tables IV through XIV. Overall, results were consistent with historical results (GWRC, 2000; Haley & Aldrich, 2001 through 2008a, 2008c, 2008e, 2008f). Deviations from past water quality results for analytes reported above the reporting limits are discussed below.

Chatsworth Formation groundwater samples were collected from 129 Facility wells and 12 private off-site wells as part of the groundwater monitoring program in 2008. Detection monitoring wells and background wells are scheduled to be sampled quarterly. For the Evaluation Monitoring Program, Chatsworth Formation evaluation monitoring wells and interim corrective action wells are scheduled to be monitored semiannually during the first and third quarters. Three Chatsworth Formation wells serving as point of compliance wells are scheduled to be monitored annually for Appendix IX parameters. As part of the CFOU RFI groundwater investigation, selected Chatsworth Formation wells are scheduled to be sampled quarterly for constituents of concern. In support of the SMOU RFI program's data gap investigation for SMOU Reporting Groups 5, 6, 7, and 8, groundwater from selected Chatsworth Formation wells was sampled and analyzed for

- alcohols (Table IV)
- EFHs (Table V)
- metals, hexavalent chromium (Table VII)
- SVOCs, nitroaromatics, nitramines, PAHs (Table VIII)
- perchlorate (Table IX)
- formaldehyde, NDMA (Table XI)
- dioxins and furans, PCBs (Table XIII)
- hydrazines (Table XIV)

Per DTSC's requirement, select Chatsworth Formation wells were sampled for the analysis of dissolved and total metals during the first and second quarters (DTSC, 2007a).

During 2008, groundwater samples were collected from FLUTE systems installed in wells RD-07, RD-21, RD-22, RD-23, RD-33A, RD-50, RD-54A, RD-57, RD-64, and RD-65. Benzene, chlorobenzene, ethylbenzene, and toluene reported in groundwater samples collected from these wells may be chemicals introduced by FLUTE system components (Table IV). Groundwater samples collected from these wells prior to FLUTE installation using the procedures described in the SAP did not have detectable concentrations of these compounds (GWRC, 2000; Haley & Aldrich, 2001, 2002a, 2003a). Based on communication with FLUTE system designer Carl Keller, concentrations of benzene and toluene have been observed in groundwater samples collected with FLUTE systems at other sites and may be attributed to equipment components (Keller, personal communication, 2003). Potential FLUTE-equipment contaminants are qualified "F" for benzene and toluene or "S" (Suspect) for chlorobenzene and ethylbenzene in Table IV and in the following text.

### 2.2.2.1 LUFT Program

VOC and gasoline range organics (GRO) analytical results for the semiannual sampling of Chatsworth Formation wells monitored under the LUFT program were within historical ranges during 2008 (Tables IV and V) with the following exceptions:

#### Newly Detected Analytes

Well	Quarter	Analyte	Sample Concentration (µg/L)	MCL or NL (µg/L)
RD-32	Third	Benzene	0.6	1 MCL
	Third	Methyl ethyl ketone	1.5 J	NA
	Third	m-Xylene & p-Xylene	9.7	1750 (total) MCL
	Third	o-Xylene	10	1750 (total) MCL
	Third	Tetrachloroethene (PCE)	0.5	5 MCL
RD-36D	First	Chloroethane	0.1 J	NA
	Third	1,1-DCE	0.2 J	6 MCL
	Third	PCE	0.2 J	5 MCL
	Third	trans-1,2-DCE	0.3 J	10 MCL

J = Estimated value. Analyte detected at a level less than the reporting limit and greater than or equal to the MDL, or concentration estimated due to analytical quality control deficiencies (see Appendix D for details).

NA = Not applicable. No MCL or NL has been established for this analyte.

#### 2008 Concentrations Greater than Previously Detected

Well	Quarter	Analyte	Sample Concentration (µg/L)	MCL (µg/L)
RD-32	Third	Acetone	8.1	NA
	Third	Ethylbenzene	3.8	300
	Third	GRO (C6-C12)	120	NA
	Third	PCE	0.5	5
	Third	Toluene	17	150
RD-36D	Third	cis-1,2-DCE	2	6
	Third	TCE	3.9	5

NA = Not applicable. No MCL or NL has been established for this analyte.

VOCs detected in the RD-32 groundwater sample collected during the third quarter are inconsistent with past and subsequent results. Verification samples collected during the fourth quarter determined that the third quarter VOC detections are not repeatable in consecutive samples. They are suspected to be a result of field contamination, laboratory contamination, or both.

Follow-up sampling (primary and split samples) and verification sampling for chloroethane was conducted at LUFT program well RD-36D during the second and third quarters. Chloroethane was detected only in one of the five samples collected from RD-36D during the second and third quarters at an estimated concentration of 0.1 µg/L. The newly detected compounds and maximum concentrations reported in the third quarter RD-36D sample were not detected or were reported at lower concentrations in the associated duplicate and split samples.

Semiannual monitoring of LUFT program wells is scheduled for the first quarter 2009.

#### 2.2.2.2 Detection Monitoring Program

VOCs were not detected above reporting limits in groundwater samples collected from detection monitoring and background wells during 2008 (Table IV) with the following exceptions:

- Benzene, m-xylene & p-xylene, and o-xylene were detected at concentrations of 0.6, 9.7, and 10  $\mu\text{g/L}$ , respectively, in groundwater collected from RD-32 during the third quarter. The MCLs for benzene, and total xylenes are 1 and 1,750  $\mu\text{g/L}$ , respectively. None of these analytes were detected in the primary, duplicate, or split samples collected from RD-32 during the fourth quarter.
- Acetone was detected at a new maximum concentration of 8.1  $\mu\text{g/L}$  in groundwater collected from RD-32 during the third quarter. Acetone was previously detected in RD-32 groundwater at a maximum concentration of 6.3  $\mu\text{g/L}$  in October 2002 (Haley & Aldrich, 2003b). Neither a drinking water MCL nor a California NL have been established for acetone. Acetone was not detected in the primary, duplicate, or split samples collected from RD-32 during the fourth quarter.
- Ethylbenzene was detected at a new maximum concentration of 3.8  $\mu\text{g/L}$  in groundwater collected from RD-32 during the third quarter. Ethylbenzene was detected once previously in RD-32 groundwater in August 1995 at a concentration of 0.3  $\mu\text{g/L}$  (GWRC, 2000). Ethylbenzene has an MCL of 300  $\mu\text{g/L}$ . Ethylbenzene was not detected in the primary, duplicate, or split samples collected from RD-32 during the fourth quarter.
- Tetrachloroethene (PCE) was detected at 0.5  $\mu\text{g/L}$  in groundwater collected from RD-32 during the third quarter. PCE was detected once previously in RD-32 groundwater in August 2002 at an estimated concentration of 0.19  $\mu\text{g/L}$  (Haley & Aldrich, 2003b). PCE has an MCL of 5  $\mu\text{g/L}$ . PCE was not detected in the primary, duplicate, or split samples collected from RD-32 during the fourth quarter.
- Toluene was reported at a new maximum concentration of 17  $\mu\text{g/L}$  in groundwater collected from RD-32 during the third quarter. Toluene was detected once previously in RD-32 groundwater in August 1995 at a concentration of 0.4  $\mu\text{g/L}$  (GWRC, 2000). Toluene has a MCL of 150  $\mu\text{g/L}$ . Toluene was not detected in the primary, duplicate, or split samples collected during the fourth quarter.
- Carbon disulfide was detected above reporting limits during the second quarter in the primary and duplicate samples collected from RD-05B at concentrations of 0.6 and 0.7  $\mu\text{g/L}$ , respectively, and from the primary sample collected from RD-43B at a concentration of 0.5

$\mu\text{g/L}$ . The NL for carbon disulfide is  $160 \mu\text{g/L}$ . Carbon disulfide was not detected in the primary, duplicate, or split samples collected from RD-05B or RD-43B during the fourth quarter.

VOCs detected below the reporting limit at estimated concentrations in groundwater samples collected during the year included:

- TCE was detected in groundwater collected from detection monitoring well RD-05B during the fourth quarter at an estimated concentration of  $0.4 \mu\text{g/L}$ . TCE was detected in two prior RD-05B samples ranging up to an estimated  $0.6 \mu\text{g/L}$  (Haley & Aldrich, 2004). The MCL for TCE is  $5 \mu\text{g/L}$ .
- TCE was detected in primary and duplicate groundwater samples collected from background monitoring well RD-13 during the fourth quarter at estimated concentrations of  $0.2$  and  $0.3 \mu\text{g/L}$ , respectively. These concentrations are consistent with past samples collected from RD-13 since 2000 (Haley & Aldrich, 2001). The MCL for TCE is  $5 \mu\text{g/L}$ .
- Carbon disulfide was detected for the first time at an estimated concentration of  $0.4 \mu\text{g/L}$  in primary and duplicate groundwater samples collected during the fourth quarter from detection monitoring well RD-16. Carbon disulfide was not detected above the  $0.45 \mu\text{g/L}$  MDL in the split sample. The California drinking water NL for carbon disulfide is  $160 \mu\text{g/L}$ .
- Concentrations of VOCs below reporting limits were reported in background and detection monitoring well samples. Subsequent verification sampling during the year indicated that the following detections were not repeatable in consecutive samples:
  - Acetone was not detected in consecutive samples collected from RD-37.
  - Benzene was not detected in consecutive samples collected from RD-43C.
  - Carbon disulfide was not detected in consecutive samples collected from RD-05B, RD-05C, RD-06, RD-48C, RD-51C, RD-52C, and RD-61.
  - Chloroethane was not detected in consecutive samples collected from RD-05B.
  - Methyl ethyl ketone was not detected in consecutive samples collected from RD-32.
  - Toluene was not detected in consecutive samples collected from RD-43C.
  - TCE was not detected in consecutive samples collected from RD-06, RD-37, and RD-51C.

Proposed as a replacement background well for RD-48B (Boeing, 2007), well RD-67 was scheduled during 2008 for quarterly groundwater sampling and analysis of constituents of concern and background monitoring parameters per the Post-Closure Permits.



NDMA was not detected in groundwater samples collected from well RD-67 (Table VIII). VOCs, 1,4-dioxane, and SVOCs were not detected in RD-67 groundwater (Tables IV, VIII, and XI) with one exception:

- Bis(2-ethylhexyl) phthalate was detected at 7  $\mu\text{g}/\text{L}$  during the third quarter. This detection exceeds the 4  $\mu\text{g}/\text{L}$  drinking water MCL for bis(2-ethylhexyl) phthalate. This compound was not detected in groundwater samples collected from RD-67 in the first, second, and fourth quarters.

Other constituents of concern in groundwater samples collected from background well RD-67 were less than detectable concentrations or, if detected, did not exceed drinking water MCLs or California NLs (Table XI).

Background monitoring parameters in RD-67 groundwater (Table XI) did not exceed primary drinking water MCLs.

Beginning in 2009, RD-67 will be scheduled for quarterly VOC sampling and analysis.

Verification samples scheduled at detection monitoring well RD-39A could not be collected during the year because the well did not contain sufficient water to collect representative samples. TCE was detected in the RD-39A groundwater sample at 1  $\mu\text{g}/\text{L}$  during the first quarter 2007 (Haley & Aldrich, 2008a). Verification sampling at RD-39A will be scheduled for the first quarter 2009 to determine if TCE is repeatable in consecutive groundwater samples. Based on results of the fourth quarter analyses, verification samples will be scheduled for collection during the first quarter 2009 at detection monitoring well RD-05B to determine if TCE is repeatable in consecutive groundwater samples.

Results of verification sampling conducted during the fourth quarter are presented in Section 2.2.5 below. For detection monitoring and background wells, verification sampling results indicated that

- Benzene and toluene were not detected in groundwater samples collected from monitor well RD-43C.
- VOCs were not detected in groundwater samples collected from well RD-32.

Some detection wells were sampled for additional constituents as part of other monitoring programs, and those results are discussed in the respective sections within this report.

Chatsworth Formation detection monitoring and background wells are scheduled to be monitored quarterly for VOCs and every five years for COCs.

### 2.2.2.3 Evaluation Monitoring Program/Interim Corrective Action Program

Concentrations of VOCs in groundwater samples collected from Chatsworth Formation evaluation monitoring wells and interim corrective action wells

sampled during the year were within historical ranges with the exceptions noted below (Table IV):

#### Newly Detected Analytes

Well	Quarter	Sample Type	Analyte	2008 Sample Concentration (µg/L)	MCL or NL (µg/L)
RD-10	Second	Primary	1,1-DCE	0.2 J	6 MCL
	Second	Dup	1,1-DCE	0.1 J	6 MCL
	Second	Primary	Carbon tetrachloride	0.1 J	0.5 MCL
	Second	Dup	Carbon tetrachloride	0.1 J	0.5 MCL
	Second	Primary	Vinyl chloride	0.2 J	0.5 MCL
	Second	Dup	Vinyl chloride	0.2 J	0.5 MCL
RD-47	First	Primary	Chloroethane	0.1 J	NA
RD-55A	Fourth	Primary	1,1,2-Trichloro-1,2,2-trifluoroethane	0.9	1200 MCL
RD-55B	First	Primary	Chloroethane	0.1 J	NA
	Third	Primary	o-Xylene	0.2 J	1750 (total) MCL
	Third	Dup	o-Xylene	0.2 J	1750 (total) MCL
	Third	Primary	Toluene	0.9	150 MCL
	Third	Dup	Toluene	0.9	150 MCL
	RD-58A	Second	Primary	Vinyl chloride	0.2 J
WS-06	Fourth	Primary	1,1-DCA	0.5	5 MCL
	Fourth	Primary	1,2-Dichloroethane (1,2-DCA)	0.1 J	0.5 MCL
WS-09A	Second	Split	Carbon disulfide	0.2 J	160 NL

J = Estimated value. Analyte detected at a level less than the reporting limit and greater than or equal to the MDL, or concentration estimated due to analytical quality control deficiencies (see Appendix D for details).

NA = Not applicable. No MCL or NL has been established for this analyte.

Dup = Duplicate.

#### 2008 Concentrations Greater than Previously Detected

Concentrations of the following analytes detected in groundwater samples collected during the year were greater than the concentrations detected in previous samples:

Well	Quarter	Sample Type	Analyte	2008 Sample Concentration (µg/L)	MCL or NL (µg/L)
HAR-17	Fourth	Primary	1,1,2-Trichloro-1,2,2-trifluoroethane	68	1200 MCL
RD-04	Fourth	Split	cis-1,2-DCE	190	6 MCL
RD-09	Fourth	Primary	1,4-Dioxane	2.3	3 NL
	Fourth	Split	cis-1,2-DCE	80	6 MCL
RD-45B	First	Primary	Vinyl chloride	0.1 J	0.5 MCL
RD-46A	Third	Primary	cis-1,2-DCE	840	6 MCL
RD-55B	Third	Primary	Acetone	87	NA
	Third	Primary	Chloromethane	0.3 J	NA
	Fourth	Primary	cis-1,2-DCE	17	6 MCL
	First	Primary	Vinyl chloride	0.2 J	0.5 MCL
	Third	Primary	m-Xylene & p-Xylene	0.3 J	1750 (total) MCL
RD-58A	Second	Primary	Carbon disulfide	5.6 J	160 NL
RD-60	First	Primary	Trans-1,2-DCE	2 J	10 MCL

Well	Quarter	Sample Type	Analyte	2008 Sample Concentration ( $\mu\text{g/L}$ )	MCL or NL ( $\mu\text{g/L}$ )
WS-06	Fourth	Primary	1,1-DCE	<b>11</b>	6 MCL
	Fourth	Primary	cis-1,2-DCE	<b>510 J</b>	6 MCL
	Fourth	Primary	Trichloroethene	<b>980 J</b>	5 MCL
WS-09A	Fourth	Duplicate	Carbon disulfide	0.5 J	160 NL

J = Estimated value. Analyte detected at a level less than the reporting limit and greater than or equal to the MDL, or concentration estimated due to analytical quality control deficiencies (see Appendix D for details).

NA = Not applicable. No MCL or NL has been established for this analyte.

Bold results exceed the MCL or NL.

Third and fourth quarter sampling at RD-55B was conducted according to procedures described in the 1995 SAP (GWRC, 1995a, 1995b). However, prior to sampling in both quarters, Snap Sampler systems were installed for temporary use and then removed.

The use of Snap Samplers corresponds with the first-time detection of toluene and o-xylene, and the detection of new maximum concentrations of m-xylene & p-xylene, chloromethane, and acetone during the third and fourth quarters.

Semiannual VOC analysis of groundwater samples collected from Chatsworth Formation evaluation monitoring wells and interim corrective action wells is scheduled to be conducted during the first and third quarters of the calendar year. Chatsworth Formation evaluation monitoring wells are scheduled to be monitored every five years for COCs.

#### 2.2.2.4 Chatsworth Formation Operable Unit Constituents of Concern Analyses

As part of the ongoing CFOU RFI investigation, quarterly groundwater sampling and analysis for constituents of concern is conducted at 26 wells located in seven areas: Canyon, Bowl, Alfa, Bravo, ELV/B204, Delta, and STL-IV (Figures 2 and 40). Groundwater samples for perchlorate analysis are also collected from these wells, although not part of the CFOU RFI sampling plan.

During 2008, 25 of the 26 CFOU RFI wells were sampled for the analysis of COCs (Table XI; Figures 6 through 36). RD-51A had insufficient water for sampling during 2008.

Fluoride and nitrate concentrations were below drinking water MCLs of 2.0 mg/L and 45 mg/L, respectively, in groundwater samples collected from wells in the CFOU RFI investigation during 2008. Ammonia concentrations detected in 2008 ranged up to 0.89 mg/L, which was detected in the groundwater sample collected from HAR-07 during the fourth quarter. Neither a drinking water MCL nor a California NL have been established for ammonia.

Formaldehyde was detected at a concentration greater than the California drinking water NL of 100  $\mu\text{g/L}$  in the groundwater samples collected from well RD-49A during the first quarter and WS-09A during the fourth quarter at an estimated concentration of 110  $\mu\text{g/L}$  and at 110  $\mu\text{g/L}$ , respectively. The formaldehyde concentration in RD-49A groundwater was within the

concentration range of past samples collected from this well. The formaldehyde concentration in WS-09A was the highest detected concentration in a sample collected from this well. Previous concentrations of formaldehyde in groundwater collected from WS-09A ranged up to 27 µg/L during the third quarter 2007.

NDMA concentrations were within historical ranges in groundwater samples collected from CFOU RFI wells during 2008. NDMA was detected at concentrations equal to or greater than the California drinking water NL of 0.01 µg/L in groundwater samples collected from wells HAR-07, HAR-08, HAR-18, HAR-20, RD-01, and RD-49B (Table XI).

VOC concentrations, including 1,4-dioxane, were within historical ranges in groundwater collected from the CFOU RFI wells during the year (Table IV) with the exceptions noted below:

#### Newly Detected VOC Analytes

Well	Quarter	Sample Type	Analyte	2008 Sample Concentration (µg/L)	MCL or NL (µg/L)
HAR-08	Third	Primary	Ethylbenzene	0.4 J	300 MCL
	Third	Primary	m-Xylene & p-Xylene	1.5	1750 (total) MCL
	Third	Primary	o-Xylene	1.2	1750 (total) MCL
HAR-20	Second	Primary	1,1,2-Trichloro-1,2,2-trifluoroethane	0.2 J	1200 MCL
RD-10	Second	Primary	1,1-DCE	0.2 J	6 MCL
	Second	Dup	1,1-DCE	0.1 J	6 MCL
	Second	Primary	Carbon tetrachloride	0.1 J	0.5 MCL
	Second	Dup	Carbon tetrachloride	0.1 J	0.5 MCL
	Second	Primary	Vinyl chloride	0.2 J	0.5 MCL
	Second	Dup	Vinyl chloride	0.2 J	0.5 MCL
RD-55A	Fourth	Primary	1,1,2-Trichloro-1,2,2-trifluoroethane	0.9	1200 MCL
RD-55B	First	Primary	Chloroethane	0.1 J	NA
	Third	Primary	o-Xylene	0.2 J	1750 (total) MCL
	Third	Dup	o-Xylene	0.2 J	1750 (total) MCL
	Third	Primary	Toluene	0.9	150 MCL
	Third	Dup	Toluene	0.9	150 MCL
RD-58A	Second	Primary	Vinyl chloride	0.2 J	0.5 MCL
WS-06	Fourth	Primary	1,1-DCA	0.5	0.5 MCL
	Fourth	Primary	1,2-DCA	0.1 J	0.5 MCL
WS-09A	Second	Split	Carbon disulfide	0.2 J	160 NL

J = Estimated value. Analyte detected at a level less than the reporting limit and greater than or equal to the MDL, or concentration estimated due to analytical quality control deficiencies (see Appendix D for details).

Dup = Duplicate

NA = Not applicable. No MCL or NL has been established for this analyte.

## 2008 VOC Concentrations Greater than Previously Detected

Concentrations of the following analytes detected in groundwater samples collected during the year were greater than the concentrations detected in previous samples:

Well	Quarter	Sample Type	Analyte	2008 Sample Concentration (µg/L)	MCL or NL (µg/L)
HAR-08	Fourth	Primary	cis-1,2-DCE	<b>20</b>	6 MCL
	Fourth	Dup	cis-1,2-DCE	<b>20</b>	6 MCL
RD-04	Fourth	Split	cis-1,2-DCE	<b>190</b>	6 MCL
RD-09	Fourth	Primary	1,4-Dioxane	2.3	3 NL
	Fourth	Split	cis-1,2-DCE	<b>80</b>	6 MCL
RD-41B	First	Primary	Trans-1,2-DCE	<b>62</b>	10 MCL
RD-49C	Third	Primary	1,1-DCE	0.3 J	6 MCL
RD-55B	Third	Primary	Acetone	87	NA
	Third	Primary	Chloromethane	0.3 J	NA
	Fourth	Primary	cis-1,2-DCE	<b>17</b>	6 MCL
	First	Primary	Vinyl chloride	0.2 J	0.5 MCL
	Third	Primary	m-Xylene & p-Xylene	0.3 J	1750 (total) MCL
RD-58A	Second	Primary	Carbon disulfide	5.6 J	160 NL
WS-06	Fourth	Primary	1,1-DCE	<b>11</b>	6 MCL
	Fourth	Primary	cis-1,2-DCE	<b>510 J</b>	6 MCL
	Fourth	Primary	Trichloroethene	<b>980 J</b>	5 MCL
WS-09A	Fourth	Dup	Carbon disulfide	0.5 J	160 MCL

J = Estimated value. Analyte detected at a level less than the reporting limit and greater than or equal to the MDL, or concentration estimated due to analytical quality control deficiencies (see Appendix D for details).

Dup = Duplicate.

NA = Not applicable. No MCL or NL has been established for this analyte.

Bold results exceed the MCL or NL.

Wells HAR-08 and RD-55B were sampled using procedures from the 1995 SAP (GWRC, 1995a, 1995b) after Snap Sampler systems were installed and removed during the third and fourth quarters.

Following the removal of the Snap systems in the fourth quarter, verification (primary, duplicate, split and field blank) samples were collected from HAR-08 and RD-55B according to the 1995 SAP procedures. Results of the verification samples are presented in Section 2.2.5. The HAR-08 verification samples demonstrated that acetone, methyl ethyl ketone, xylenes, and toluene detections are not repeatable in consecutive groundwater samples. The RD-55B verification samples indicated that low concentrations of acetone were present in RD-55B groundwater samples. Low concentrations of xylenes and toluene were reported in primary and duplicate samples, but not in split samples, collected from RD-55B.

Perchlorate concentrations in groundwater samples collected from CFOU RFI wells during 2008 were within historical ranges with the following exception (Table IX):

- Perchlorate was detected for the first time in the primary groundwater sample collected from interim corrective action well WS-05 during the first quarter at an estimated concentration of 6.4 µg/L.

Perchlorate was not detected above the 0.47  $\mu\text{g/L}$  MDL in the split sample collected from WS-05. Perchlorate was not detected in subsequent quarterly samples collected from WS-05. The MCL for perchlorate is 6  $\mu\text{g/L}$ .

SVOCs were not detected in groundwater samples collected from CFOU RFI wells during 2008 with the following exceptions (Table VIII):

- Bis(2-ethylhexyl) phthalate was detected in the groundwater sample collected from well RD-09 for the first time during the third quarter at an estimated concentration of 3  $\mu\text{g/L}$ . The California MCL for bis(2-ethylhexyl) phthalate is 4  $\mu\text{g/L}$ .
- Benzo(ghi)perylene was detected for the first time in the groundwater sample collected from well RD-55B during the first quarter 2008 at an estimated concentration of 1.1  $\mu\text{g/L}$ . Neither a drinking water MCL nor a California NL have been established for benzo(ghi)perylene.
- Bis(2-ethylhexyl) phthalate was detected in groundwater samples collected from well RD-49A during the first, second, and third quarters 2008 at concentrations of 17, 5, and 160  $\mu\text{g/L}$ , respectively. The previous detection of bis(2-ethylhexyl) phthalate in RD-49A groundwater in 2003 was identified as a laboratory contaminant (Haley & Aldrich, 2004). The detected concentrations exceeded the bis(2-ethylhexyl) phthalate MCL of 4  $\mu\text{g/L}$ . In the third quarter, well RD-49A was sampled using procedures from the 1995 SAP (GWRC, 1995a, 1995b) after a Snap Sampler system had been installed and removed between the second and third quarters. Bis(2-ethylhexyl) phthalate was not analyzed in samples collected from the Snap system.

#### 2.2.2.5 Monitoring of Perimeter Wells and Private Off-Site Wells and Springs

Analytical results indicated that VOCs were not detected above the reporting limits in groundwater samples collected from perimeter wells and private off-site wells during the year (Table IV) with the following exceptions:

- Acetone was detected at 15, 11, and 6.7  $\mu\text{g/L}$  in the groundwater samples collected from the RD-22 FLUTE, RD-57 FLUTE, and well RD-68A, respectively, during the third quarter. Acetone was detected in 6 of 49 prior samples collected from RD-68A, and attributed to field or laboratory contamination. Acetone was not detected in groundwater samples collected prior to FLUTE installation at wells RD-22 and RD-57.
- Carbon disulfide was reported for the first time in groundwater collected from private off-site well OS-17 during the first quarter at a concentration above the reporting limit at 1.4  $\mu\text{g/L}$ . In verification samples (primary, field duplicate, split, and field blank samples) collected during the second and third quarters, carbon disulfide was detected in only one of the samples at an estimated concentration of

0.2 µg/L. The verification samples indicate that carbon disulfide detections are not repeatable in OS-17 groundwater samples. The California drinking water NL for carbon disulfide is 160 µg/L.

- Carbon disulfide was detected in the second quarter groundwater sample collected from RD-70 at 0.7 µg/L. Carbon disulfide was not detected in the verification samples (primary, field duplicate, split and field blank samples) collected during the third quarter. The California drinking water NL for carbon disulfide is 160 µg/L.
- Chlorobenzene was detected above the reporting limit in groundwater samples collected from the FLUTE systems installed in perimeter wells RD-22 and RD-57 at maximum concentrations of 1 and 0.5 µg/L, respectively. Groundwater samples collected from RD-22 and RD-57 prior to FLUTE installation using the procedures described in the Sampling and Analysis Plan (SAP) did not have detectable concentrations of this compound (GWRC, 2000; Haley & Aldrich, 2001, 2002a, 2003a). The drinking water MCL for chlorobenzene is 70 µg/L.
- Toluene was detected in groundwater samples collected from the FLUTE system installed in perimeter well RD-50 at concentrations of 0.9 and 9.1 µg/L. Toluene was not detected in groundwater samples collected prior to FLUTE installation at well RD-50. The MCL for toluene is 150 µg/L.

Groundwater samples collected from RD-22, RD-50, and RD-57 prior to FLUTE installation using the procedures described in the Sampling and Analysis Plan (SAP) did not have detectable concentrations of acetone, chlorobenzene, or toluene (GWRC, 2000; Haley & Aldrich, 2001, 2002a, 2003a). The acetone, chlorobenzene, and toluene reported in wells RD-22, RD-50, and RD-57 may be chemicals introduced by FLUTE system components. Based on communication with FLUTE system designer Carl Keller, concentrations of benzene and toluene have been observed in groundwater samples collected with FLUTE systems at other sites and may be attributed to equipment components (Keller, personal communication, 2003).

Results of analyses for perchlorate, stable isotope, and inorganic constituents in groundwater samples collected from private off-site wells included in the Perchlorate Characterization Work Plan are discussed in Section 2.2.4.

Results of analyses for hexavalent chromium and dissolved metals in groundwater samples collected from perimeter wells as part of SMOU RFI data gap investigations are discussed in Section 2.2.2.8.

Results of analyses for the metal potassium from a select group of Chatsworth Formation Area IV wells also monitored for the radioisotope potassium-40 are discussed in Section 2.2.2.8.

#### 2.2.2.6 Point of Compliance Program

During 2008, Chatsworth Formation point of compliance wells HAR-07, HAR-16, and HAR-17 were monitored for Appendix IX constituents. Appendix IX analytical results are presented in Section 2.2.3 and Table X.

Point of compliance wells were scheduled for semiannual VOC sampling and analysis during the second and fourth quarters (Table IV).

#### 2.2.2.7 Chatsworth Formation Radiochemistry Analyses

During the year, Chatsworth Formation groundwater samples were collected from select wells for the analysis of gross alpha and gross beta radioactivity, gamma-emitting radionuclides, Ra-226, Ra-228, Sr-90, tritium, isotopic thorium, and isotopic uranium using EPA Methods 900.0, 901.1, 903.1, 904.0, 905.0, 906.0, 907.0, and 908.0, respectively (Table VI). Samples were also collected for the analysis of additional radionuclide activities per EPA drinking water regulations (Federal Register, 2000):

- In the event gross alpha activity exceeded 15 pCi/L, groundwater samples were analyzed for isotopic uranium using EPA Method 908.0.
- In the event gross beta activity exceeded 50 pCi/L, groundwater samples were analyzed for K-40 and Sr-90 using EPA Methods 901.1 and 905.0, respectively. During the year, Sr-90 was analyzed at least once for each location where groundwater samples were collected for analysis of gross beta activity.

During the fourth quarter, the gamma-emitting radionuclides analyzed were actinium-228, antimony-125, barium-133, cesium-134, cesium-137, cobalt-60, europium-152, europium-154, europium-155, manganese-54, potassium-40, radium-228, and sodium-22.

Results of radionuclide analyses of groundwater samples collected at well RD-98, constructed during 2008, are noted below and summarized in Table VI. In addition to the analyses listed above, RD-98 groundwater samples were also analyzed for americium-241, plutonium-238, and plutonium-239 by method HASL-300.

As discussed in Appendix D, project specific minimum detectable activities (MDAs) were not always attained due in part to matrix conditions (e.g., dissolved and suspended solids) and limitations in the prescribed analytical methods (e.g., sample volumes, counting times).

Results of analyses for groundwater samples collected from Facility wells are compared to California drinking water MCLs for discussion purposes only. Groundwater at SSFL is not used as a drinking water supply.

Except for samples collected for tritium analysis by EPA Method 906.0, groundwater radiochemistry samples are field filtered. During the fourth quarter, both filtered and unfiltered samples were collected for the scheduled



analytical methods except for EPA method 906.0. Unfiltered samples were collected for tritium analysis.

Results of radiological analyses of Chatsworth Formation groundwater samples are noted below and summarized in Table VI.

#### Gross Alpha Activity

Results for the 2008 gross alpha samples were within historical ranges for Chatsworth Formation groundwater (Haley & Aldrich, 2008a). According to EPA drinking water regulations, the gross alpha MCL excludes uranium activity (Federal Register, 2000). When the sum of isotopic uranium activity is excluded from gross alpha activity, the adjusted gross alpha results for the 2008 samples were less than the adjusted gross alpha drinking water MCL of 15 pCi/L. Calculations of adjusted gross alpha are presented below for samples where isotopic uranium activity was analyzed and where gross alpha activity prior to uranium activity subtraction exceeded 15 pCi/L:

Well	Activity (pCi/L)				
	RD-07		RD-29	RD-34A	
Quarter	First	Third	First	First	Third
U-233/234	26.3	19.1	10.9	9.56	9.22
U-235	1.17	0.45 U	0.528 J	0.554 J	0.485 J
U-238	21.3	15.4	10.6	10.3	9.85
Sum of isotopic uranium activity	48.8	34.95	22.0	20.4	19.6
Gross alpha	43.1	26.4	16.8	23.5	16.4
Adjusted gross alpha	<0	<0	<0	3.1	<0

#### Gross Beta Activity

The gross beta activities detected in Chatsworth Formation groundwater samples were less than the drinking water MCL of 50 pCi/L (Table IX).

#### Gamma Emitters

Anthropogenic gamma emitters were not detected in Chatsworth Formation groundwater samples collected during 2008. Potassium-40 also was not detected in Chatsworth Formation groundwater samples collected during the year. Potassium-40 is naturally occurring.

#### Tritium Activity

The results of analyses for tritium in Chatsworth Formation groundwater samples collected during the year were less than the drinking water MCL of 20,000 pCi/L and were comparable to past results (Haley & Aldrich, 2008a, 2008c, 2008e).

#### Radium-226 and Radium-228

The sum of Ra-226 and Ra-228 activities for each Chatsworth Formation groundwater sample was less than the drinking water MCL of 5 pCi/L for Ra-226/228 combined with the following exceptions:

- The combined Ra-226 and Ra-228 activities in a groundwater sample collected from RD-27 during the third quarter totaled 5.12 pCi/L. The sum of Ra-226 and Ra-228 activities in RD-27 groundwater was comparable to historical results (Haley & Aldrich, 2008a).
- The combined Ra-226 and Ra-228 activities in a groundwater sample collected from RD-33A during the first quarter totaled 6.82 pCi/L. The sum of Ra-226 and Ra-228 activities in RD-33A groundwater was comparable to historical results (Haley & Aldrich, 2008a).

#### Plutonium-238 and Plutonium-239

Plutonium-238 and Plutonium-239 were not detected in groundwater samples collected from RD-98.

#### Strontium-90

Strontium-90 (Sr-90) was not detected in groundwater samples collected during 2008 except in samples collected from well RD-98. The June, September, and November filtered samples from RD-98 had detectable Sr-90 at 2.35 +/- 0.52 pCi/L, 2.18 +/- 0.42 pCi/L, and 2.63 +/- 0.51 pCi/L, respectively. The unfiltered sample collected from RD-98 in November had Sr-90 activity of 2.3 +/- 0.46 pCi/L. These values are less than the drinking water MCL of 8 pCi/L. Sr-90 has not been detected in previous groundwater samples collected from wells at the site (Haley & Aldrich, 2008a). Well RD-98 was installed at the RMHF leachfield as a part of the on-going Data Gap Investigation for Radiological Constituents in Groundwater in Area IV of the SSFL (Haley & Aldrich, 2008b).

#### Isotopic Thorium

Thorium isotopes were not detected in Chatsworth Formation groundwater samples collected during 2008.

#### Uranium

The California MCL for uranium is 20 pCi/L. Analysis of uranium isotope activity indicates that uranium activity in groundwater collected from Chatsworth Formation wells did not exceed the MCL except in groundwater samples collected from RD-07, and one of a pair of samples collected from RD-29 and RD-34A.

Well	Quarter	Activity Concentration (pCi/L)			
		U-233/U-234	U-235	U-238	Total
RD-07	First	26.3	1.17	21.3	<b>48.8</b>
	Third	19.1	0.45 U	15.4	<b>35.0</b>
RD-15	First	3.51	0.272 J	3.15	6.9
RD-21	First	4.31	0.148 J	3.5	8.0
	Third	3.95	0.197 J	3.35	7.5
RD-29	First	10.9	0.528 J	10.6	<b>22.0</b>
	Third	8.05	0.435 J	7.87	16.4

Well	Quarter	Activity Concentration (pCi/L)			
		U-233/U-234	U-235	U-238	Total
RD-34A	First	9.56	0.554 J	10.3	<b>20.4</b>
	Third	9.22	0.485 J	9.85	19.6
RD-34B	First	1.34	0.04 J	1.18	2.6
RD-54A	First	7.18	0.279 J	5.82	13.3
RD-64	First	2.96	0.161 J	2.18	5.3
	Third	2.88	0.112 J	2.35	5.3
RD-98	Second	2.8	0.11 J	2.14	5.0
	Third	2.4	0.09 J	1.85	4.3

Bold results exceed 20 pCi/L California MCL.

#### 2.2.2.8 Other Monitoring

Some Chatsworth Formation Facility wells sampled during the year were not perimeter wells, were not part of the perchlorate characterization or the CFOU RFI investigation, nor the LUFT, detection monitoring, evaluation monitoring, interim corrective action, or point of compliance programs. These wells are not included in any prescribed monitoring program. All results of this monitoring are summarized in Sections A through C below.

Pursuant to DTSC's requirement, groundwater samples collected from select wells were analyzed for dissolved (filtered) and total (unfiltered) metals for five quarters from February 2007 through February 2008 (DTSC, 2007a). During the second quarter 2008, additional filtered metals samples were collected and analyzed (Table VII).

Groundwater samples collected from a select group of Chatsworth Formation Area IV wells that were monitored for the radioisotope potassium-40 also were analyzed for the metal potassium during the first and second quarters (Table VII).

In support of the SMOU RFI program, groundwater samples were collected from Chatsworth Formation wells as part of the data gap investigation for SMOU Reporting Groups 5, 6, 7, and 8.

HAR-07, HAR-18, and RD-55A were sampled using procedures from the 1995 SAP (GWRC, 1995a, 1995b) after Snap Sampler systems had been installed and removed during the third and fourth quarters.

A. *Other Monitoring Results* - Analytical results for VOCs, fuel hydrocarbons, metals, cyanide, and perchlorate were within historical ranges with the exceptions noted below (Tables IV, V, VII, and IX).

- Toluene was reported above the reporting limit in the groundwater samples collected from the FLUTE system installed in well RD-33A at a concentration of 0.9 µg/L. This result is not consistent with groundwater samples collected from this well prior to FLUTE installation using sampling equipment and procedures described in the Sampling and Analysis Plan (GWRC, 1995a, 1995b). Low-level concentrations of benzene and toluene have been observed in

groundwater samples collected with FLUTE systems at other sites and may be attributed to equipment components (Keller, personal communication, 2003).

- Ethylbenzene and chlorobenzene results for groundwater collected from RD-21 and RD-33A are qualified as suspect (S). Samples collected at these wells were collected from FLUTE systems and ethylbenzene and chlorobenzene may have been introduced by FLUTE equipment components.

The following VOCs and dissolved metals were detected in groundwater samples for the first time during the year (Tables IV and VII):

Well	Quarter	Analyte	2008 Sample Concentration	MCL, NL, or AAL	Units
RD-21	Third	Ethylbenzene	2 J,S	300 MCL	µg/L
RD-33A	First	Acetone	3.6 J	NA	µg/L
RD-34B	Third	1,1-DCA	0.2 J	5 MCL	µg/L
RD-59B	Third	Dissolved beryllium	0.0008	0.004 MCL	mg/L
RD-59C	Third	Dissolved beryllium	0.00097	0.004 MCL	mg/L

J = Estimated value. Analyte detected at a level less than the reporting limit and greater than or equal to the MDL, or concentration estimated due to analytical quality control deficiencies (see Appendix D for details).

S = Suspect result. Result is not representative of past groundwater samples.

NA = Not applicable. No MCL, NL, or AAL has been established for this analyte.

Concentrations of the following VOCs and dissolved metals detected in groundwater samples collected during the year were greater than the concentrations detected in samples collected prior to 2008 (Tables IV and VII).

Well	Quarter	Analyte	2008 Sample Concentration	MCL, NL, or AAL	Units
RD-15	First	Carbon disulfide	2.9	160 NL	µg/L
	First	Dissolved copper	0.0035	NA	mg/L
	First	Dissolved lead	0.0046	NA	mg/L
RD-21	Third	Acetone	95	NA	µg/L
	Third	Dissolved iron	0.153 J	NA	mg/L
	Third	cis-1,2-DCE	740	6 MCL	µg/L
	Third	Methyl ethyl ketone	11	NA	µg/L
RD-23	First	cis-1,2-DCE	160	6 MCL	µg/L
	First	Dissolved molybdenum	0.0047 J	NA	mg/L
RD-33A	Third	Chlorobenzene	0.6 S	NA	µg/L
	First	cis-1,2-DCE	4.7	6 MCL	µg/L
	Third	trans-1,2-DCE	0.7	10 MCL	µg/L
RD-34B	First	Dissolved beryllium	0.000069 J	0.004 MCL	mg/L
	First	Dissolved copper	0.0019 J	NA	mg/L

Well	Quarter	Analyte	2008 Sample Concentration	MCL, NL, or AAL	Units
RD-54A	First	trans-1,2-DCE	0.9 J	10 MCL	µg/L
RD-54B	First	Vinyl chloride	0.5 J	0.5 MCL	µg/L
RD-59B	Third	Dissolved arsenic	0.00098 J	0.01 MCL	mg/L
RD-59C	Third	Dissolved copper	0.0023	NA	mg/L
RD-64	First	Vinyl chloride	<b>0.6 J</b>	0.5 MCL	µg/L
RD-65	First	cis-1,2-DCE	<b>42</b>	6 MCL	µg/L

J = Estimated value. Analyte detected at a level less than the reporting limit and greater than or equal to the MDL, or concentration estimated due to analytical quality control deficiencies (see Appendix D for details).

S = Suspect result. Result is not representative of past groundwater samples.

NA = Not applicable. No MCL, NL, or AAL has been established for this analyte.

Bold results exceed MCL, NL, or AAL.

#### Potassium in Area IV Wells

Unfiltered groundwater samples collected from a select group of Chatsworth Formation wells in and near Area IV that were monitored for potassium-40 also were analyzed for potassium during the first and second quarters (Table VII). Potassium concentrations in unfiltered groundwater samples ranged from 2.26 mg/L (RD-59C) to 5.9 mg/L (RD-17). Neither a drinking water MCL nor a California NL have been established for potassium.

#### DTSC Metals

Pursuant to DTSC's requirement, groundwater samples collected from select wells were analyzed for dissolved (filtered) and total (unfiltered) metals for five quarters from February 2007 through February 2008 (DTSC, 2007a). During the second and third quarters 2008, additional metals samples were collected and analyzed (Table VII).

List of Dissolved and Total DTSC Metals Samples, 2008				
SMOU RFI Group	Chatsworth Formation Wells	First Quarter	Second Quarter	Third Quarter
1A	HAR-16	Dissolved, total	Dissolved, total	Dissolved
	RD-73	Dissolved, total	Dissolved	Dissolved
1B	RD-46A	Dissolved, total	Dissolved	Dissolved
2	RD-09	Not sampled	Dissolved, total	Dissolved
3	RD-04, RD-60, WS-09	Dissolved, total	Dissolved	Dissolved
	RD-49A	Dissolved, total	Dissolved, total	Not sampled
4	HAR-07	Dissolved, total	Dissolved	Dissolved

List of Dissolved and Total DTSC Metals Samples, 2008				
SMOU RFI Group	Chatsworth Formation Wells	First Quarter	Second Quarter	Third Quarter
5	HAR-18, RD-55A	Dissolved, total	Dissolved	Dissolved
6	RD-86	Dissolved, total	Dissolved, total	Dissolved
7	RD-34A	Dissolved, total	Dissolved	Dissolved
9	WS-09A	Dissolved, total	Dissolved, total	Dissolved

Concentrations of metals were below MCLs and NLs (Table VII) except for some manganese results from HAR-07, RD-49A, and RD-73 groundwater samples that exceeded the 0.5 mg/L NL for manganese.

- B. *SMOU RFI Data Gap Results* - as part of the RFI data gap investigation for SMOU Reporting Groups 5, 6, 7, and 8, select Chatsworth Formation wells were sampled and analyzed for select constituents during the year as listed below. Results are summarized in Tables IV, V, VII, VIII, IX, XI, XIII, and XIV.

Analysis	Wells
Alcohols	RD-86
VOCs	RD-98
EFHs	RD-07, RD-19, RD-30, RD-86, RD-98
Filtered metals	RD-07, RD-14, RD-15, RD-18, RD-19, RD-21, RD-22, RD-23, RD-27, RD-30, RD-33A, RD-33B, RD-50, RD-54A, RD-54C, RD-57, RD-59A, RD-85,
Filtered metals (cont'd)	RD-86, RD-92, RD-98
Hexavalent Chromium	RD-18, RD-86
SVOCs	RD-30
PAHs	HAR-26, RD-08, RD-11, RD-12
Nitroaromatics, nitramines	RD-13
Perchlorate	RD-13
NDMA	RD-13
Formaldehyde	HAR-26, RD-08, RD-11, RD-12, RD-13
Dioxins/Furans	RD-18, RD-20
PCBs	RD-19, RD-86
Hydrazines	RD-13

Alcohols, EFHs, hexavalent chromium, SVOCs, nitroaromatics, nitramines, perchlorate, NDMA, PCBs, and hydrazines were not detected (Tables IV, V, VII, VIII, IX, XI, XIII, and XIV).

Where detected, formaldehyde concentrations were below the formaldehyde NL of 100 µg/L (Table XI).

Results for filtered metals analyzed for the SMOU RFI program were below MCLs and NLs (Table VII) with the following exceptions:

- Arsenic was detected above the 0.01 mg/L MCL in the filtered groundwater sample collected from RD-21 during the first quarter at a concentration of 0.0117 mg/L. This result is within the historical range of dissolved arsenic concentrations for this well.
- Arsenic was detected above the 0.01 mg/L MCL in the filtered groundwater sample collected from RD-57 during the third quarter at a concentration of 0.142 mg/L. This result is greater than the historical range of results. Arsenic was previously detected in groundwater samples collected from well RD-57 in March 2005 at a maximum concentration of 0.006 mg/L (Haley & Aldrich, 2006).
- Manganese was detected above the 0.5 mg/L NL in the filtered groundwater samples collected from RD-85 during the third quarter at a concentration of 1.15 mg/L. This result is greater than the historical range of results. Prior to 2008, the maximum dissolved manganese concentration detected in RD-85 groundwater samples was 0.37 mg/L in the third quarter of 2007 (Haley & Aldrich, 2008a).

PAHs were not detected in groundwater samples collected from Chatsworth Formation wells except for anthracene detected in groundwater samples collected from HAR-26, RD-08, and RD-11 (Table VIII). Anthracene concentrations during 2008 were an estimated 0.021  $\mu\text{g/L}$  to an estimated 0.079  $\mu\text{g/L}$  in HAR-26 samples, an estimated 0.02 to an estimated 0.041  $\mu\text{g/L}$  in RD-08 samples, and 0.19  $\mu\text{g/L}$  in an RD-11 sample. Anthracene had not been detected in prior samples collected from these wells. Neither a drinking water MCL nor a California NL has been established for anthracene.

During the fourth quarter, the VOC sample collected from RD-98 in support of the SMOU RFI program did not contain analytes at concentrations exceeding drinking water MCLs or California NLs with the following exception (Table IV):

- TCE was detected above the 5  $\mu\text{g/L}$  MCL at a concentration of 10  $\mu\text{g/L}$  in the November sample.

Dioxins and furans were not detected in groundwater samples collected from RD-18 and RD-20 with the following exception (Table XIII):

- OCDD was detected at an estimated 2.2  $\text{pg/L}$  in the RD-20 groundwater sample collected during the second quarter. OCDD was not detected in RD-20 groundwater samples collected during the first, third, and fourth quarters. Dioxin analyses had not been performed on RD-20 samples collected prior to 2008. Neither a drinking water MCL or California NL has been established for OCDD.

When converted to 2,3,7,8-TCDD TEQ (van den Berg et al., 2006), the concentration of the detected dioxin and furan congeners in the groundwater sample collected from RD-20 was less than the drinking water MCL of 30 pg/L for 2,3,7,8-TCDD.

Well	Quarter	2,3,7,8-TCDD TEQ (pg/L)	2,3,7,8-TCDD MCL (pg/L)
RD-20	Second	2.2 J	30

J = Estimated value. Analyte detected at a level less than the reporting limit and greater than or equal to the MDL, or concentration estimated due to analytical quality control deficiencies (see Appendix D for details).

C. *New Well Monitoring* - Groundwater monitor well RD-98 was constructed in June 2008 at the former Radioactive Materials Handling Facility (RMHF) Leach Field in Area IV (Haley & Aldrich, 2008b). RD-98 groundwater was sampled and analyzed for VOCs, EFHs, dissolved (filtered) radionuclides, dissolved (filtered) and total (unfiltered) metals, SVOCs, perchlorate, and inorganic constituents in June and September 2008 (Tables IV, V, VI, VII, VIII, IX, and XII). RD-98 was sampled for VOCs, dissolved (filtered) and total (unfiltered) radionuclides, and dissolved (filtered) metals in November 2008 (Tables IV, VI, and VII). Results of radiochemistry analyses are discussed in Section 2.2.2.7 of this report. EFHs, SVOCs, and perchlorate were not detected (Tables V, VIII, and IX). Dissolved (filtered) and total (unfiltered) metals did not exceed MCLs or NLs (Table VII). Inorganic constituents did not exceed primary drinking water MCLs (Table XII).

Concentrations of VOCs in RD-98 groundwater were below MCLs and NLs (Table IV) with the following exceptions:

- TCE was detected above the 5 µg/L MCL in the samples at concentrations ranging from 8.8 to 10 µg/L.

### 2.2.3 Appendix IX Sampling

During the second quarter 2008, the seven point of compliance wells (shallow wells SH-04, RS-08, HAR-14, and HAR-15; and Chatsworth Formation wells HAR-07, HAR-16, and HAR-17) were scheduled for sampling and analysis of Appendix IX constituents. The point of compliance wells were also scheduled for sampling of VOCs during the fourth quarter.

#### 2.2.3.1 Data Validation

Results of 2008 analyses were subjected to a data validation process in accordance with guidance from the "USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review" (EPA540/R-99/008, October 1999), "USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review" (EPA 540-R-01-008, July 2002), and the EPA method-specific protocol criteria, where applicable. A summary of the data validation process is included in Appendix D.



### 2.2.3.2 Analytical Results

Appendix IX and VOC analytical results are presented in Tables X, III, and IV. Appendix IX and VOC analytical results for point of compliance wells were within historical ranges with the exceptions noted below.

#### Newly Detected Analytes

Well	Sample Type	Analyte	Second Quarter 2008 Sample Concentration (µg/L)	MCL, NL, or AAL (µg/L)
SH-04	Split	4,4'-DDD	0.013 J	NA
	Primary	4,4'-DDE	0.0052 J	NA
	Split	4,4'-DDE	0.023 J	NA
	Split	Endosulfan-II	0.0076 J	NA
HAR-07	Primary	OCDF	5.8 J pg/L	NA
	Primary	1,2,3,4,7,8,9-HpCDF	2 J pg/L	NA
HAR-14	Primary	Dissolved thallium	0.000028 J mg/L	0.002 MCL
HAR-16	Primary	OCDF	4 J pg/L	NA

J = Estimated value. Analyte detected at a level less than the reporting limit and greater than or equal to the MDL, or concentration estimated due to analytical quality control deficiencies (see Appendix D for details).

NA = Not applicable. No MCL, NL, or AAL has been established for this analyte.

Data validation confirmed these detections. Neither drinking water MCLs nor California NLs have been established for 4,4'-DDD, 4,4'-DDE, endosulfan-II, OCDF, or 1,2,3,4,7,8,9-HpCDF.

#### 2008 Concentrations Greater than Previously Detected

Concentrations of the following analytes detected in groundwater samples collected during the second quarter were greater than the concentrations detected in previous samples. These results did not exceed MCLs or NLs except for the heptachlor result.

Well	Analyte	Second Quarter 2008 Sample Concentration	MCL or NL	Units
HAR-14	Dissolved arsenic	0.00096 J	0.01 MCL	mg/L
	Dissolved cobalt	0.00044 J	NA	mg/L
	Dissolved nickel	0.0062	0.1 MCL	mg/L
	Dissolved vanadium	0.0015 J	0.05 NL	mg/L
HAR-16	1,2,3-Trichloropropane	<b>0.014</b>	0.005 NL	µg/L
HAR-17	OCDF	3.1 J	NA	pg/L
RS-08	Dissolved arsenic	0.0056	0.01 MCL	mg/L
SH-04	Heptachlor	<b>0.015 J</b>	0.01 MCL	µg/L

J = Estimated value. Analyte detected at a level less than the reporting limit and greater than or equal to the MDL, or concentration estimated due to analytical quality control deficiencies (see Appendix D for details).

Bold results exceed the MCL or NL.

NA = Not applicable. No MCL or NL has been established for this analyte.

When converted to 2,3,7,8-TCDD TEQ (van den Berg et al., 2006), the concentrations of the detected furan congeners in the groundwater samples collected from HAR-07, HAR-16, and HAR-17 were less than the drinking water MCL of 30 pg/L for 2,3,7,8-TCDD.

Well	2,3,7,8-TCDD TEQ (pg/L)
HAR-07	0.02 J
HAR-16	0.0012 J
HAR-17	0.0009 J

Other chlorinated pesticides detected in the primary and/or split groundwater samples collected from SH-04 during the second quarter had been detected in previous groundwater samples:

- Delta-BHC was detected at an estimated 0.0069  $\mu\text{g/L}$  in the primary sample. Delta-BHC was previously detected in an SH-04 groundwater sample at 0.0084  $\mu\text{g/L}$  in February 2008 (Table XIII). Neither a drinking water MCL nor a California NL have been established for delta-BHC.
- Aldrin was detected at an estimated 0.0072  $\mu\text{g/L}$  in the split sample. Aldrin was previously detected in an SH-04 groundwater sample at 0.37  $\mu\text{g/L}$  in February 1999. The California drinking water AAL for aldrin is 0.002  $\mu\text{g/L}$ .

Primary, duplicate, and field blank samples were collected during the third quarter 2008 to determine if dioxin and furan detections reported in HAR-07, HAR-16, and HAR-17 groundwater samples during the second quarter were repeatable in consecutive groundwater samples.

No dioxins or furans were detected in third quarter groundwater samples collected from these wells (Table X).

Verification samples scheduled for the analysis of chlorinated pesticides at well SH-04 could not be collected because this well had insufficient water for sampling during the third and fourth quarters. Verification samples (primary, duplicate, split, and field blank) will be rescheduled during the first quarter 2009 to determine if chlorinated pesticide detections reported in SH-04 groundwater samples during the second quarter are repeatable in consecutive groundwater samples.

Per the Post-Closure Permits, the point of compliance wells are scheduled to be monitored annually for Appendix IX constituents and semiannually for VOCs. Point of compliance wells are scheduled for sampling during the second quarter 2009 for Appendix IX constituents and during the second and fourth quarters for VOCs.

#### 2.2.4 Perchlorate Characterization Sampling

Groundwater sampling for the analysis of perchlorate in Facility groundwater has been conducted since 1997. Characterization and remediation activities were conducted in Happy Valley in Area I, and investigation of perchlorate was conducted in drainages north and east of the Facility (Figure 40; MWH, 2003a, 2003b, 2003c, 2003f). As part of the Perchlorate Characterization Work Plan (MWH, 2003e), well OS-09 is monitored quarterly and other wells identified in the work plan are monitored annually.

The analytical results of perchlorate groundwater sampling conducted during the year as part of the Perchlorate Characterization Work Plan and the Happy Valley Interim Measures program are reported in this section.

#### 2.2.4.1 Monitoring

Groundwater samples collected from selected wells were analyzed for perchlorate and general mineral constituents as described in the Perchlorate Characterization Work Plan (MWH, 2003e). Water samples collected from well OS-09 also were submitted for analysis of the stable isotopes deuterium and oxygen-18 (Table XII). Results of analyses for perchlorate in groundwater are summarized in Table IX and for general minerals in Table XII.

General mineral constituent analyses included major anions (carbonate, bicarbonate, chloride, and sulfate), major cations (calcium, magnesium, sodium, and potassium), nitrate, specific conductance, total dissolved solids, and pH (Table XII).

Wells scheduled and sampled for perchlorate characterization during the year are listed below.

Perchlorate Characterization Sampling, 2008	
Wells Sampled	OS-02, OS-03, OS-04, OS-05, OS-09, OS-10, OS-16, OS-17, OS-25(partial), OS-26, OS-27, OS-28, RD-32, RD-36B, RD-36C, RD-36D, RD-37, RD-38A, RD-38B, RD-39B, RD-43A, RD-43B, RD-43C, RD-45B, RD-45C, RD-51B, RD-51C, RD-52B, RD-52C, RD-59A, RD-59B, RD-59C, RD-66, RD-68A, RD-68B, RD-70, RD-71, RD-75, RD-77, RD-78, RD-80, RD-81, RD-82, RD-83, RD-84, WS-04A, WS-09B, WS-12, WS-13, WS-14
Wells Not Sampled due to Lack of Groundwater	PZ-062, RD-36A, RD-39A, RD-51A, RD-52A
Wells Not Sampled for Other Reasons	OS-15 (no access agreement) OS-24 (FLUTE liner not removed) RD-45A (borehole collapsed) RD-76 (borehole collapsed)

As part of the Happy Valley Interim Measures project, wells RS-02, RD-73, RD-77, HAR-24, and HAR-25 and piezometers PZ-003, PZ-067A, PZ-067B, and PZ-068 were monitored for perchlorate and bromide. During the year, Chatsworth Formation wells RD-73, RD-77, HAR-24, and HAR-25 contained sufficient water for sampling.

## 2.2.4.2 Perchlorate Results

### Perchlorate Characterization Work Plan

Perchlorate was not detected in the groundwater samples from well OS-09 or the other Perchlorate Characterization Work Plan wells except from well RD-77 (Table IX). Perchlorate concentrations in RD-77 during 2008 ranged from 234 to 267  $\mu\text{g/L}$  and were consistent with historical samples collected from this well (Haley & Aldrich, 2004 through 2008a, 2008c, 2008e, 2008f). RD-77 perchlorate concentrations in past samples have ranged from 170 to 680  $\mu\text{g/L}$ .

Perchlorate was not detected in groundwater samples collected from off-site wells.

### Happy Valley Interim Measures

Perchlorate was detected in each of the groundwater samples collected in support of the Happy Valley Interim Measures project: RD-73, RD-77, HAR-24, and HAR-25 (Table IX). Perchlorate concentrations in RD-73, RD-77, and HAR-25 were within historical ranges as shown below (GWRC, 2000; Haley & Aldrich, 2001, 2002a, 2003a, 2004, 2005, 2006, 2007, 2008a, 2008c, 2008e, 2008f). The MCL for perchlorate is 6  $\mu\text{g/L}$ .

Perchlorate Concentrations ( $\mu\text{g/L}$ )		
Well	2008 Concentration Range	Range of Previous Sample Concentrations
RD-73	14.9 - 120	4.4 - 244
RD-77	234 - 267	170 - 680
HAR-24	169 - 210	3 - 750
HAR-25	27.6 J - 33.1	4 U - 480

J = Estimated value. Analyte detected at a level less than the reporting limit and greater than or equal to the MDL, or concentration estimated due to analytical quality control deficiencies (see Appendix D for details).

U = Not detected. Numerical value represents the MDL.

Verification procedures for perchlorate sampling and analysis are presented in the Quality Assurance Project Plan (QAPP) for the Perchlorate Characterization Work Plan (MWH, 2003e).

## 2.2.4.3 Bromide Results

Bromide was detected in groundwater samples collected in support of the Happy Valley Interim Measures project at wells RD-73, RD-77, and HAR-24 at concentrations similar to those of previous samples (Table XII). Across the site, bromide concentrations in samples collected by the University of Waterloo ranged from 0.05 to 1.1  $\text{mg/L}$  (Pierce, 2005).

Bromide Concentrations ( $\text{mg/L}$ )		
Well/Piezometer	2008 Concentration Range	Range of Previous Sample Concentrations
RD-73	0.85 - 1.4	0.34 J - 2.4
RD-77	0.4 U - 0.62	0.16 U - 0.48 J
HAR-24	0.4 U - 1.2	0.35 U - 0.93

Bromide Concentrations (mg/L)		
Well/Piezometer	2008 Concentration Range	Range of Previous Sample Concentrations
HAR-25	0.4 U	0.25 U – 0.36 J
Site Wide*	---	0.05 – 1.1

\* University of Waterloo sample results (Pierce, 2005).

J = Estimated value. Analyte detected at a level less than the reporting limit and greater than or equal to the MDL, or concentration estimated due to analytical quality control deficiencies (see Appendix D for details).

U = Not detected. Numerical value represents the MDL.

#### 2.2.4.4 General Mineral Results

Inorganic constituents in groundwater samples (Table XII) did not exceed primary drinking water MCLs with the following exceptions:

- Fluoride was detected above the MCL in OS-02 groundwater collected during the first and fourth quarters at concentrations of 6 and 5.4 mg/L, respectively. The MCL for fluoride is 2 mg/L. Fluoride was detected in OS-02 groundwater samples collected in June and July 1985 at 5.4 mg/L each and in 1987 at 4.6 mg/L (GWRC, 2000).

#### 2.2.4.5 Stable Isotope Results

Results of stable isotope analyses for groundwater samples collected from well OS-09 are presented in Table XII. The isotopes are naturally occurring and are not indicators of site activities. The ratio of deuterium to hydrogen expressed as the deviation from Vienna Standard Mean Ocean Water (V-SMOW) ranged from -53.3 to -50.2 parts per thousand (per mil) in OS-09 groundwater. The ratio of oxygen-18 to oxygen-16 expressed as the deviation from V-SMOW ranged from -7.51 to -7.36 per mil in OS-09 groundwater.

### 2.2.5 Results of Fourth Quarter 2008 Verification Sampling

Verification groundwater samples (primary, field duplicate, split, and field blank samples) were collected during the fourth quarter following detections of analytes in groundwater collected from Post-Closure Permit or other wells during the third quarter 2008 or earlier. The table below summarizes fourth quarter 2008 verification sampling results. The VOCs reported in groundwater collected from wells HAR-11 and RD-55B may be due to field contamination related to the Snap Sampler program.

Fourth Quarter 2008 Verification Sampling		Constituent(s)	Sample Concentration (µg/L, unless otherwise noted)			
Well Identifier	Monitoring Program		Primary	Duplicate	Split	Field Blank
HAR-08	CFOU RFI	Acetone	3 U	3 U	1.9 U	3 U
		Ethylbenzene	0.1 U	0.1 U	0.16 U	0.1 U
		Methyl ethyl ketone	1 U	1 U	1.8 U	1 U
		m-Xylene & p-Xylene	0.1 U	0.1 J	0.34 U	0.1 U
		o-Xylene	0.1 U	0.1 U	0.19 U	0.1 U
		Toluene	0.1 U	0.1 U	0.17 U	0.1 U

Fourth Quarter 2008 Verification Sampling

Well Identifier	Monitoring Program	Constituent(s)	Sample Concentration ( $\mu\text{g/L}$ , unless otherwise noted)			
			Primary	Duplicate	Split	Field Blank
HAR-11	Evaluation	Acetone	3.8 J	3.9 J	1.9 U	3 U
		Chloroethane	0.4 J	0.4 J	0.53 J	0.1 U
		Ethylbenzene	0.1 J	0.1 J	0.16 U	0.1 U
		m-Xylene & p-Xylene	0.4 J	0.4 J	0.43 J	0.1 U
		o-Xylene	0.4 J	0.3 J	0.42 J	0.1 U
RD-32	Detection	Acetone	3 U	3 U	1.9 U	3 U
		Benzene	0.1 U	0.1 U	0.16 U	0.1 U
		Ethylbenzene	0.1 U	0.1 U	0.16 U	0.1 U
		Methyl ethyl ketone	1 U	1 U	1.8 U	1 U
		m-Xylene & p-Xylene	0.1 U	0.1 U	0.34 U	0.1 U
		o-Xylene	0.1 U	0.1 U	0.19 U	0.1 U
		Tetrachloroethene (PCE)	0.1 U	0.1 U	0.2 U	0.1 U
		Toluene	0.1 U	0.1 U	0.17 U	0.1 U
	LUFT	GRO	50 U	50 U	13 U	50 U
RD-43C	Detection	Benzene	0.1 U	0.1 U	0.16 U	0.1 U
		Toluene	0.1 U	0.1 U	0.16 U	0.1 U
RD-55B	Evaluation	Acetone	5 J	4.8 J	5.7 J	3 U
		Chloromethane	0.2 U	0.2 U	0.3 U	0.2 U
		Ethylbenzene	0.1 U	0.1 U	0.16 U	0.1 U
		Methyl ethyl ketone	1 U	1 U	1.8 U	1 U
		m-Xylene & p-Xylene	0.2 J	0.2 J	0.34 U	0.1 U
		o-Xylene	0.1 J	0.1 J	0.19 U	0.1 U
		Toluene	0.3 J	0.4 J	0.17 U	0.1 U

J = Estimated value. Analyte detected at a level less than the reporting limit and greater than or equal to the MDL, or concentration estimated due to analytical quality control deficiencies (see Appendix D for details).

U = Not detected. Numerical value represents the MDL.

### 2.2.6 Proposed First Quarter 2009 Groundwater Monitoring Schedule

The schedule proposed for the first quarter 2009 groundwater monitoring complies with that specified in the 1995 Post-Closure Permits. The fourth quarter 2008 and previous results indicated that additional sampling be conducted during the first quarter of 2009 to confirm if the following constituents are detectable in groundwater samples:

Well	Monitoring Program	Constituent	Samples Scheduled
HAR-11	SMOU RFI	1,1,2-Trichloroethane Chloroform	Verification
RD-05B	Detection	TCE	Verification
RD-39A	Detection	TCE	Verification
SH-02	SMOU RFI	Chlorinated pesticides	Verification and equipment rinsate
SH-03	SMOU RFI	Chlorinated pesticides	Verification and equipment rinsate
SH-04	SMOU RFI Point of Compliance	Chlorinated pesticides	Verification and equipment rinsate
SH-05	SMOU RFI	Chlorinated pesticides	Verification and equipment rinsate

Well	Monitoring Program	Constituent	Samples Scheduled
SH-08	SMOU RFI	Chlorinated pesticides	Verification and equipment rinsate
SH-09	SMOU RFI	Chlorinated pesticides	Verification and equipment rinsate

Verification = primary, field duplicate, split, and field blank samples.

### 3. REMEDIAL SYSTEMS

#### 3.1 Remedial Systems Activities

There are five permitted remedial systems (Alfa, Bravo, Delta, STL-IV, and WS-05 Area) at SSFL. The Area I Road and Canyon air-stripping units and the RD-09 ultra-violet (UV)/hydrogen peroxide system were placed on "stand-by" status in 2001 as part of a Post-Closure Permit modification granted by DTSC (DTSC, 2001). Operation of the Delta system was discontinued in August 2007, and operation of the WS-05 Area UV/hydrogen peroxide system was discontinued in December 2007. Construction permitting for a new treatment system was initiated in October 2007, and construction is slated for completion in the first half of 2009. Operational data for each permitted system during the quarter are presented in monthly reports from EnviroSolve Corporation (2008a through 2008i).

The 20 shallow and 12 Chatsworth Formation extraction wells were not in operation during the quarter. Table XVI summarizes the cumulative groundwater extraction volume for the remedial systems.

Because the treatment systems were not in operation, water quality samples were not collected during the quarter. Cumulative VOC mass removed by each treatment system is presented in Table XVII.

Monthly groundwater level monitoring has been suspended at the inactive extraction wells. Groundwater levels measured during the quarterly groundwater monitoring event are presented in Table XV.

In July 2008, Boeing, NASA, and DOE submitted to DTSC a revised Work Plan for groundwater interim measures at SSFL. The objective of the work plan is to comply with DTSC's requirements for conducting groundwater interim measures at SSFL as specified in the May 16, 2008 letter (DTSC, 2008a). Comments by DTSC on the interim measures work plan were received in November, 2008 (DTSC, 2008b).



#### 4. SURFACE WATER DISCHARGE

Surface water discharge is regulated by NPDES permit No. CA-0001309. Discharge limits and results of water quality analyses of surface water samples collected at Outfalls 001 and 002 (Figure 40) during 2008 are presented in Appendix G, Tables G-I through G-VII. Discharge Monitoring Reports (DMR) for the SSFL NPDES outfalls are available at [www.boeing.com/aboutus/environment/santa\\_susana/water\\_quality.html](http://www.boeing.com/aboutus/environment/santa_susana/water_quality.html).

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