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01 December 2010
File No. 20090-456/556/656-M489

The Boeing Company
Santa Susana Field Laboratory
5800 Woolsey Canyon Road
Canoga Park, California  91304-1148

Attention:    Ms. Deborah A. Taege

Subject:    Site-Wide Water Quality Sampling and Analysis Plan
Revision 1
Santa Susana Field Laboratory
Ventura County, California
December 2010

Dear Ms. Taege:

Transmitted herewith is the Site-Wide Water Quality Sampling and Analysis Plan (Site-Wide WQSAP), Revision 1, for the Santa Susana Field Laboratory, Ventura County, California.

The Site-Wide WQSAP is one of the required deliverables stipulated in Section 3.4.13 of the Consent Order for Corrective Action dated August 16, 2007 and issued to The Boeing Company, the National Aeronautics and Space Administration (NASA), and the U.S. Department of Energy (DOE). The groundwater monitoring program described in the Site-Wide WQSAP formalizes groundwater monitoring conducted in support of the RCRA Facility Investigation (RFI) program, which compliments current groundwater monitoring programs required under the 2010 facility Post-Closure Permit modifications. Please advise if you have any questions, or wish further discussion of this Site-Wide WQSAP.

Haley & Aldrich, Inc. appreciates the opportunity to support The Boeing Company, NASA, and DOE in the development of this program.

Sincerely yours,
HALEY & ALDRICH, INC.

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**SITE-WIDE WATER QUALITY SAMPLING AND ANALYSIS PLAN**
**SANTA SUSANA FIELD LABORATORY**
**VENTURA COUNTY, CALIFORNIA**
**REVISION 1**

**Prepared for**

**The Boeing Company,**
**National Aeronautics and Space Administration (NASA),**
**and**
**U.S. Department of Energy (DOE)**
**Ventura County, California**

**by**

**Haley & Aldrich, Inc.**
**Tucson, Arizona**

**File No. 20090-456/556/656/M489**
**December 2010**

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# 1. INTRODUCTION

This revised Site-Wide Water Quality Sampling and Analysis Plan (Site-Wide WQSAP) presents methodologies for sampling, analyses, data interpretation, and reporting for the Site-Wide groundwater quality monitoring at the Santa Susana Field Laboratory (SSFL, the Facility) located in Ventura County, California. The monitoring program outlined in this Site-Wide WQSAP incorporates comments provided by the California Department of Toxic Substances Control (DTSC) on the December 2007 submittal, which served to comply with Section 3.4.13 of the Consent Order for Corrective Action issued on 16 August 2007 by DTSC, and on the draft revision submitted in December 2009.

This Site-Wide WQSAP presents the proposed groundwater monitoring network, monitoring parameters, sampling frequency and sampling methods for groundwater monitoring conducted pursuant to the above Consent Order. The Site-Wide groundwater monitoring program establishes procedures for low-flow purging and sampling, and supports the overall groundwater investigation and remediation strategy for SSFL by establishing a groundwater quality data collection program that is consistent with Groundwater Protection and Cleanup Policies for Resource Conservation and Recovery Act (RCRA) Corrective Action (USEPA, 2004) and California Health and Safety Code (CHSC) Division 20, Chapter 6.8.

The Site-Wide WQSAP conforms to U.S. Environmental Protection Agency (EPA) Protection and Cleanup Policies by establishing a groundwater data collection program to monitor attainment of Short-Term Protection Goals for groundwater during the on-going Remedial Investigation (RI) program. This program may be modified, as appropriate, to support selection of Intermediate Performance Goals, including the feasibility and appropriateness of source removal (groundwater interim measures) and prioritization of groundwater characterization efforts leading to the determination of appropriate and protective cleanup objectives that will establish the Final Cleanup Goals (USEPA, 2004).

The Site-Wide Groundwater Monitoring Program is separate from, and in addition to, the Regulated Unit Groundwater Monitoring Programs, conducted pursuant to Post-Closure Permits PC-94/95-3-02 (Mod. SC3-111904-A) and PC-94/95-3-03 (Mod.SC3-111904-B).

## 1.1 Facility History and Description

SSFL is located in eastern Ventura County, California (Figure 1). SSFL was established in 1947. Operations at SSFL have included chemical and engineering research, development, and testing; liquid propelled rocket engine systems and fuels research and testing; and nuclear systems research and development. Wastewater from the testing of rocket engines and engine components was contained in the nine closed surface impoundments (Regulated Units) in Areas I, II, and III (Figure 1). Environmental investigations have shown that the groundwater beneath SSFL has been impacted by past releases from operational activities, with trichloroethene (TCE) generally being the chemical detected at the highest concentration and with the greatest frequency.

A closure process for the nine closed surface impoundments was initiated in 1985 and completed in 1995 when Boeing and NASA submitted a notification closure to DTSC. In May 1995, DTSC issued two post-closure permits for the site:

- Permit Number PC-94/95-3-02 (EPA ID Number CAD093365435) for Areas I and III was issued to The Boeing Company as owner and operator and successor in interest to the original permit issued to Rockwell International Corporation – Rocketdyne Division; and

- Permit Number PC-94/95-3-03 (EPA ID Number CAD1800090010) for Area II was issued to the National Aeronautics & Space Administration (NASA) as owner and The Boeing Company as operator.

These permits were modified in 2001 (DTSC, 2001). The expiration date for both permits was 11 May 2005. Timely and administratively complete applications for new permits were submitted by Boeing and NASA, extending the terms of the permits.

The post-closure permits were modified by DTSC in 2004 (DTSC, 2004). The conditions of the modified permits were appealed by Boeing and NASA. In 2009, the conditions of the 2004 permit modification were adopted as indicated by the appeal decision and order (DTSC, 2009). Post-closure permit modifications were subsequently issued in January 2010 (DTSC, 2010). The conditions of the 2010 Permit Modifications stipulate a Regulated Unit Groundwater Monitoring Program (Haley & Aldrich, 2010b and 2010c).

In addition to the former surface impoundments, between 1991 and 1994, Region IX of the U.S. Environmental Protection Agency (EPA) identified 125 solid waste management units (SWMUs) and areas of concern (AOCs) at SSFL where chemicals of potential concern (COPCs) were or may have been released into the environment. Ten additional SWMUs and AOCs have been identified, for a total of 135.

In 1992, the California DTSC issued a Stipulated Enforcement Order (DTSC, 1992) to impose RCRA Corrective Action requirements at SSFL. Currently, the RCRA Facility Investigation, equivalent to a Remedial Investigation conducted pursuant to CHSC Division 20, Chapter 6.8, is in progress. A revised Consent Order for Corrective Action was issued on August 16, 2007 (DTSC, 2007). This order includes schedules and timelines to complete the RCRA Corrective Action program by 2017, which is the functional equivalent of a response action conducted pursuant to CHSC Division 20, Chapter 6.8.

In SSFL Administrative Area IV (Figure 1), the Department of Energy (DOE) owns facilities operated by The Boeing Company including the Hazardous Waste Management Facility (HWMF) and the Radioactive Materials Handling Facility (RMHF). Permitted in 1993, the HWMF includes sodium treatment and storage units, and is currently inactive and subject to closure requirements (Permit Number 93-3-TS-002, EPA ID Number CAD000629972). Closure is pending for the RMHF which was permitted in 1989 as a mixed waste facility (Interim Status Document EPA ID Number CA3890090001).

### 1.2 Groundwater Conditions

Groundwater occurs at SSFL in the alluvium, weathered bedrock, and unweathered bedrock (Montgomery Watson, 2000). 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). 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, 2003).

Perched groundwater has been observed at locations within SSFL (MWH, 2003), though the presence of perched groundwater is transient and dependent on frequency and duration of precipitation and water distribution during site operations. 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.

### 1.2.1 Near-Surface Groundwater

Near-surface groundwater conditions have been characterized by a network of over 90 near-surface groundwater wells and over 160 piezometers. Groundwater levels in near-surface wells and piezometers are generally higher in the first and second quarters of each year and lower during the third and fourth quarters (Haley & Aldrich, 2009, 2010a).

Near-surface groundwater is indicated to occur in Quaternary alluvium distributed primarily in the Burro Flats area 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. These discharges have ceased.

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, 2003).

### 1.2.2 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, 2000; MWH, 2002, 2007). The Chatsworth Formation groundwater conditions have been described by a network of over 170 Chatsworth Formation wells.

Static depths to water in Chatsworth Formation wells have ranged from above land surface at artesian wells to depths in excess of 450 feet below land surface. Water level elevations in Chatsworth Formation monitor wells have ranged from approximately 1,220 feet above mean sea level (MSL) to a high of greater than 1,890 feet above MSL.

The water level contour map, presented in Figure 2, was prepared using April 2009 water level elevations from the shallowest well in each Chatsworth Formation cluster, and from individual Chatsworth Formation wells at non-cluster locations.

The development of groundwater elevation contour maps in fractured-porous media aquifers is problematic due to the heterogeneity and anisotropy exhibited in this type of aquifer setting. These types of aquifer systems are characterized by both fracture and matrix transmissivity for which there is no established convention for developing groundwater elevation contour maps, or determining groundwater flow directions. The groundwater elevation contours depicted in Figure 2 are not used to infer groundwater flow directions or rates of groundwater movement for the reasons indicated above, and additional site-specific conditions including:

- Several hydraulically significant geologic features such as fault zones and shale beds are present at SSFL and may act as impediments to groundwater flow across them.

- 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 monitor wells. The water levels shown represent composite heads over the screened or open interval.

- Groundwater flow directions and rates are likely influenced by the heterogeneity of the Chatsworth Formation due to the orientation and interconnection of the bedrock fracture network, characteristics of the bedrock matrix, and possibly the orientation of structural features and stratigraphy.

## 1.3 Conceptual Site Model

The Conceptual Site Model (CSM; Cherry, et al., 2007) establishes a hydrogeologic conceptual model where groundwater present in alluvium, weathered bedrock, and unweathered bedrock forms a hydrologic continuum in which flow from the alluvium and weathered bedrock predominantly discharges into the unweathered bedrock (i.e., Chatsworth Formation). The fracture network which characterizes the Chatsworth Formation is a systematic network of bedding-parallel fractures and steeply-dipping joints. The fracture network is generally well interconnected hydraulically, both horizontally and vertically.

The bulk hydraulic conductivity is low to moderate, and there is low to moderate large-scale transmissivity across and along the faults and shear zones. The rock matrix porosity is orders of magnitude greater than the bulk fracture porosity. Studies conducted in support of the Conceptual Site Model indicate that the combined low bulk rock matrix permeability and small fracture apertures significantly retard chemical migration (Cherry, et al., 2007).

TCE and other chemicals of potential concern (COPCs) occur in the vicinity of former input locations as dissolved and sorbed phases. Areas of impacted groundwater are created by advective transport of dissolved TCE and other COPCs through the fracture network and diffusive transport into the bedrock matrix. Soluble chemicals and radionuclides diffuse into, and out of, the porous rock matrix. The contaminant fronts migrate very slowly, at velocities much smaller than the generally rapid mean groundwater velocity in the fracture networks, thus forming stable plume fronts. Additional investigation of hydrogeologic conditions at SSFL indicates that the Chatsworth Formation contains reactive minerals and organic matter which support degradation of COPCs through natural attenuation processes (Pierce, 2005). The combination of hydrogeologic and hydrogeochemical properties of the Chatsworth Formation serve to naturally attenuate chemical migration (Cherry et al., 2007).

## 1.4 Site-Wide Groundwater Monitoring Program

The Site-Wide Groundwater Monitoring Program was developed based on review of data representing over 20 years of groundwater characterization activities at SSFL. Groundwater monitoring programs have been in place at SSFL since the early 1980s. Beginning in 1995, a groundwater monitoring program was established pursuant to Post-Closure Permit PC-94/95-3-03 for Area II (NASA), and Post-Closure Permit No. PC-94/95-3-02 for Areas I & III (Boeing). These groundwater monitoring programs were focused primarily on determining the nature and extent of volatile organic compounds (VOCs) released from the nine former surface impoundments (Regulated Units). Concurrent with the Post-Closure groundwater monitoring programs, extensive groundwater characterization activities were conducted at SSFL as part of the RCRA Facility Investigation (RFI). Hundreds of additional wells and piezometers have been constructed and monitored as part of the RFI site characterization program. The RFI is equivalent to a Remedial Investigation conducted pursuant to CHSC Division 20, Chapter 6.8.

Building on the CSM and the current understanding of the distribution of groundwater contaminants and contaminant transport, the Site-Wide Groundwater Monitoring Program has been developed.

Groundwater impact areas (GIAs) have been identified and used to determine the monitor well network for the Site-Wide Groundwater Monitoring Program. The identified GIAs and selected wells are shown on Figure 3. General characteristics of the groundwater impact areas are summarized in Table I. Well construction details of the selected wells are presented in Table II. Table III specifies the monitoring network and chemical constituents that will be analyzed as part of the Site-Wide Groundwater Monitoring Program. Table IV specifies the monitoring schedule for groundwater sampling during the first year. Table V specifies the monitoring schedule for groundwater sampling following the first year.

Groundwater monitoring programs conducted pursuant to the Regulated Unit Post-Closure Permits continue to be in effect, and are administered concurrently with the Site-Wide Program. Wells included in both the Site-Wide program and the Regulated Unit monitoring programs will be sampled according to the conditions of each monitoring program, and results will be reported as part of a single comprehensive groundwater monitoring report for SSFL.

The well network for the Site-Wide Groundwater Monitoring Program consists of wells installed and owned by NASA, DOE, and The Boeing Company. The monitoring network also includes wells and springs located on private property adjacent to the SSFL site. Full implementation of the monitoring network is contingent on legal access to sampling sites on private property. Site access agreements, obtained by Boeing, will be in effect for off-site wells at the time of sampling.

In addition, it is anticipated that the Site-Wide Groundwater Monitoring Program will be supplemented, from time to time, by monitoring of other select wells and springs as part of the on-going investigation of groundwater conditions at SSFL. This program may be modified, as appropriate, to support selection of Intermediate Performance Goals, including the feasibility and appropriateness of groundwater interim measures and prioritization of groundwater characterization efforts leading to the determination of appropriate and protective cleanup objectives for SSFL (USEPA, 2004).

### 1.5 Groundwater Impact Areas

The Site-Wide Groundwater Monitoring Program is designed to complement ongoing monitoring and characterization activities, including the Regulated Unit Post-Closure Permit groundwater monitoring programs (Haley & Aldrich, 2010b, 2010c), by providing data to evaluate potential impacts to groundwater near the perimeter of the SSFL site, and to identify potential off-site migration of impacted groundwater.

Wells within the Site-Wide Monitoring Network were selected to optimize geographic coverage of the site perimeter, with emphasis on areas adjacent to known groundwater impacts. Wells were also selected to monitor potential vertical migration of groundwater impacts near the SSFL site perimeter.

Table I summarizes the identified groundwater impacts areas and the primary chemicals of potential concern (COPCs) in each area. Each well in the Site-Wide Monitoring Network is associated with an area of known groundwater impact, as indicated below. Figure 3 illustrates the Site-Wide Groundwater Monitoring Network and GIAs. Table II presents the well construction details for wells in the monitoring network. Tables III, IV, and V list the specific analytes indicated for each well in the Site-Wide Monitoring Program.

#### 1.5.1 Groundwater Impact Area 1

Groundwater Impact Area 1 is located in the northeastern quadrant of the SSFL site (Figure 3, Table I). Identified groundwater impacts associated with this area include VOCs, 1,4-dioxane, N-Nitrosodimethylamine (NDMA), 1,2,3-trichloropropane (1,2,3-TCP), and perchlorate.

Twenty wells will monitor groundwater conditions along the periphery of SSFL in the vicinity of Groundwater Impact Area 1 (Table I, Figure 3). The groundwater monitoring network includes wells RD-01, RD-10, RD-32, RD-35A, RD-35B, RD-37, RD-38B, RD-39A, RD-39B, RD-43A, RD-43B, RD-43C, RD-66, RD-71, RD-78, RS-20, OS-13, OS-16, OS-25, and OS-26.

These wells were selected to monitor potential migration of groundwater impacts off-site to the north and east of the identified impacted area, and across the bedrock shear zone which currently bounds the area of impacted groundwater on the west (Figure 3). Well clusters will monitor deep aquifer zones for potential vertical migration of groundwater impacts. The RD-35 cluster will also monitor any temporal changes in trichloroethene (TCE) concentrations in the center of Groundwater Impact Area 1.

### 1.5.2 Groundwater Impact Area 2

Groundwater Impact Area 2 comprises a small area (Figure 3, Table I) located in the eastern third of the SSFL site. Identified groundwater impacts associated with this area include perchlorate.

Five wells and piezometers make up the monitoring network in the vicinity of Groundwater Impact Area 2 (Figure 3). Well RD-76 and piezometer PZ-074 are located near the southern margin of the perchlorate-impacted groundwater, and will monitor this area for potential migration of perchlorate-impacted groundwater. Well RD-10 is located near the northern margin of the impacted area and will also be monitored for VOCs and 1,4-dioxane (Table III). Well RD-75 and PZ-123 are located near the eastern margin of SSFL, down-gradient of Groundwater Impact Area 2.

### 1.5.3 Groundwater Impact Area 3

Groundwater Impact Area 3 is located south of Groundwater Impact Area 1 in the eastern third of the SSFL site (Figure 3, Table I). Identified groundwater impacts associated in this area include VOCs, NDMA, and 1,4-dioxane. Wells RD-02 and RD-44 will monitor groundwater conditions southeast of Groundwater Impact Area 3 (Figure 3). These wells will also be monitored for hydrazine and formaldehyde (Table III).

### 1.5.4 Groundwater Impact Area 4

Groundwater Impact Area 4 is located in the eastern third of the SSFL site, south of Groundwater Impact Area 3 (Figure 3, Table I). Identified groundwater impacts associated with this area include VOCs, 1,4-dioxane, and 1,2,3-TCP.

Eleven wells and piezometers will monitor groundwater impacts associated with Groundwater Impact Area 4 for potential migration towards the SSFL site boundary to the south. Well clusters will monitor deep aquifer zones for potential vertical migration of COPCs. Wells in the monitoring network include ES-01, RD-03, RD-46B, RD-48A, RD-48B, RD-48C, RD-61, and RD-62. Piezometers include PZ-076, PZ-077, and PZ-078.

Chloride and nitrate also will be monitored at these locations. Dioxins will be monitored for annually (Table III).

### 1.5.5 Groundwater Impact Area 5

Groundwater Impact Area 5 is located in the north-central part of the SSFL site (Figure 3, Table I). Identified groundwater impacts associated with this area include VOCs and 1,4-dioxane.

Two wells (RD-69 and WS-04A) and a piezometer (PZ-095) will monitor groundwater conditions near the SSFL site perimeter to the east of Groundwater Impact Area 5. Well RD-81 will monitor downgradient groundwater conditions near the western edge of Groundwater Impact Area 5.

### 1.5.6 Groundwater Impact Area 6

Groundwater Impact Area 6 is located in the north-central part of the SSFL site, west of Groundwater Impact Area 5 (Figure 3, Table I). Identified groundwater impacts associated with this area include VOCs.

Wells RD-09, RD-51A, RD-51B, RD-51C, RD-70, RD-83, OS-09, and OS-09R will monitor potential migration of groundwater impacts associated with Groundwater Impact Area 6 at the northern perimeter of SSFL. Wells RD-09, RD-51A, and RD-51B will also be monitored for 1,4-dioxane (Table III).

### 1.5.7 Groundwater Impact Area 7

Groundwater Impact Area 7 is located in the north-central part of the SSFL site, west of Groundwater Impact Area 6 (Figure 3, Table I). Identified groundwater impacts associated with this area include VOCs and 1,2,3-TCP.

Well RD-60 will monitor groundwater impacts in the center of Groundwater Impact Area 7. Wells RD-56A and RD-56B will monitor potential groundwater impacts within the northern portion of Groundwater Impact Area 7. Well RD-14 will monitor the western margin of Groundwater Impact Area 7. Wells RD-68A and RD-68B will monitor the area north of the SSFL site boundary for potential migration of impacted groundwater.

Each well in this GIA will also be monitored for fluoride. Wells RD-14, RD-56A, RD-56B, and RD-60 will monitor for the potential presence of radionuclides within and near GIA 7 (Table III).

### 1.5.8 Groundwater Impact Area 8

This Groundwater Impact Area is not in proximity to the SSFL site boundary, but is located in the central portion of the facility near the former Alfa/Bravo Skim Pond (ABSP), the Storable Propellant Area 1 (SPA-1), and Storable Propellant Area 2 (SPA-2) impoundments (Figure 3, Table I). The groundwater in the general vicinity of these three closed impoundments is monitored under the auspices of the Post-Closure Permit monitoring programs (Haley & Aldrich, 2010b).

### 1.5.9 Groundwater Impact Area 9

Groundwater Impact Area 9 encompasses a large area (Table I) in the southern third of the SSFL site (Figure 3). Identified groundwater impacts associated with this area include VOCs, NDMA, and 1,4-dioxane.

Eleven wells (RD-05A, RD-05B, RD-05C, RD-06, RD-40, RD-41B, RD-42, RD-58B, RD-58C, RD-67, and WS-09A) will monitor groundwater conditions near the southern margin of GIA 9, and along the southern part of SSFL administrative areas II and III (Figure 3). Well clusters will monitor deep aquifer zones for potential vertical migration of COPCs. Surficial discharge of groundwater along the southern margin of the SSFL site will be monitored at springs FDP-835 and FDP-890 as part of the Site-Wide program.

### 1.5.10 Groundwater Impact Area 10

This Groundwater Impact Area is not in proximity to the SSFL site boundary, but is located in the west-central portion of the facility near the former Systems Test Laboratory IV-1 and Systems Test Laboratory IV-2 (STL IV-1 and STL IV-2) impoundments (Figure 3, Table I). The groundwater in the general vicinity of these two closed impoundments is monitored under the auspices of the Post-Closure Permit monitoring programs (Haley & Aldrich, 2010c).

### 1.5.11 Groundwater Impact Area 11

This Groundwater Impact Area is not in proximity to the SSFL site boundary, but is located in the west-central portion of the facility near the former Engineering Chemistry Laboratory (ECL) impoundment (Figure 3, Table I). The groundwater in the general vicinity of this closed impoundment is monitored under the auspices of the Post-Closure Permit monitoring programs (Haley & Aldrich, 2010c).

### 1.5.12 Groundwater Impact Area 12

This Groundwater Impact Area is located in the west-central portion of the facility near the former STL IV-1 and STL IV-2 impoundments (Figure 3, Table I). Identified groundwater impacts associated with this area include VOCs.

Wells ES-14 and ES-29 will monitor groundwater within GIA 12. The groundwater in this general vicinity also is monitored as part of the Post-Closure Permit groundwater monitoring programs (Haley & Aldrich, 2010c).

Wells in this GIA also will be monitored for nitrate and chloride (Table III).

### 1.5.13 Groundwater Impact Area 13

Groundwater Impact Area 13 is located near the northwestern perimeter of the SSFL site (Figure 3, Table I). Identified groundwater impacts associated with this area include VOCs and tritium.

Fifteen wells (RD-18, RD-19, RD-34A, RD-34B, RD-34C, RD-59A, RD-59B, RD-59C, RD-63, RD-85, RD-86, OS-02, OS-03, OS-04, and OS-05) will monitor groundwater near the northern margin of the SSFL site, near GIA 13 and off-site to the north. Cluster wells will monitor deep aquifer zones for potential vertical migration of COPCs. Wells associated with GIA 13 will also serve to monitor groundwater for the potential presence of radionuclides in SSFL Area IV.

Wells in this GIA also will be monitored for fluoride, sodium, and metals. 1,4-Dioxane will be monitored at wells RD-18, RD-34A, RD-34C, RD-63, and RD-85 (Table III).

### 1.5.14 Groundwater Impact Area 14

Groundwater Impact Area 14 is located in the northwestern part of the SSFL site, west of Groundwater Impact Area 13 (Figure 3, Table I). Identified groundwater impacts associated with this area include VOCs and tritium.

Seven wells (RD-59A, RD-59B, RD-59C, OS-02, OS-03, OS-04, and OS-05) will monitor the potential migration of impacted groundwater associated with Groundwater Impact Area 14 towards the site perimeter. Wells associated with GIA 14 will also serve to monitor groundwater for the potential presence of radionuclides in SSFL Area IV. Fluoride will be monitored at wells OS-02, OS-03, OS-04, and OS-05 (Table III).

### 1.5.15 Groundwater Impact Area 15

This Groundwater Impact Area is located in the western portion of the facility and is not in proximity to the SSFL site boundary (Figure 3, Table I). Identified groundwater impacts associated with this area include VOCs.

Piezometer PZ-108 will monitor groundwater within Groundwater Impact Area 15.

Metals also will be monitored for GIA 15 (Table III).

### 1.5.16 Groundwater Impact Area 16

Groundwater Impact Area 16 is located in the northwestern part of the SSFL site (Figure 3, Table I). Identified groundwater impacts associated with this area include VOCs.

Wells RD-07 and RD-96 and piezometer PZ-124 will monitor groundwater conditions in or near the SSFL site boundary north of Groundwater Impact Area 16. Wells RD-59A, RD-59B, RD-59C, OS-02, OS-03, OS-04, and OS-05, discussed above (section 1.5.14), are also located downgradient of Groundwater Impact Area 16. Wells associated with GIA 16 will also serve to monitor groundwater for the potential presence of radionuclides in SSFL Area IV. Fluoride will be monitored at wells OS-02, OS-03, OS-04, and OS-05 (Table III).

### 1.5.17 Groundwater Impact Area 17

Groundwater Impact Area 17 is located at the western end of the SSFL site (Figure 3, Table I). Identified groundwater impacts associated with this area include VOCs and perchlorate.

Fifteen wells and piezometers (PZ-097, RD-33A, RD-33B, RD-33C, RD-50, RD-54A, RD-57, RD-59A, RD-59B, RD-59C, RS-18, OS-02, OS-03, OS-04, and OS-05) will monitor groundwater conditions within the center of and along the margins of Groundwater Impact Area 17 and the site perimeter to the west of this area. Nested wells will monitor deep aquifer zones for potential vertical migration of COPCs. Wells associated with GIA 17 will also serve to monitor groundwater for the potential presence of metals and radionuclides in SSFL Area IV. Fluoride will be monitored at wells OS-02, OS-03, OS-04, and OS-05 (Table III).

### 1.5.18 Groundwater Impact Area 18

Groundwater Impact Area 18 is located to the east of Groundwater Impact Area 17 in the western part of the SSFL site (Figure 3, Table I). Identified groundwater impacts associated with this area include VOCs.

This area is not in proximity to the SSFL site boundaries. Well RD-13 will monitor groundwater conditions within the SSFL site, between Groundwater Impact Areas 17 and 18. Well RD-20 will monitor groundwater conditions within the SSFL site, between Groundwater Impact Areas 16 and 18. These wells will also serve to monitor groundwater for the potential presence of radionuclides in SSFL Area IV (Table III).

## 2. SITE-WIDE GROUNDWATER MONITORING PROGRAM

### 2.1 Purpose, Scope and Objectives

The purpose of the Site-Wide Monitoring Program is to monitor known groundwater impact areas at the facility, and to monitor for potential migration of COPCs at the facility perimeter.

This Site-Wide WQSAP presents the approach and scope of groundwater monitoring activities to be implemented pursuant to the Site-Wide program. The Site-Wide groundwater monitoring program will supplement the current and future Post-Closure groundwater monitoring programs, and will provide technically sound data to detect potential off-site migration of COPCs from groundwater impact areas near the facility perimeter. The primary objectives of the Site-Wide WQSAP are:

- Monitoring for temporal changes in COPCs and/or general water quality near select groundwater impact areas and at the facility perimeter;
- Provide data to help determine if the spatial distribution of affected groundwater is stable or migrating; and
- Provide data to help evaluate whether affected groundwater poses an unacceptable risk to human health or the environment or contributes to degradation of water resources.

In order to meet these objectives, the scope of the Site-Wide WQSAP includes the following elements:

- Procedures describing the process of sampling;
- The designated monitoring points;
- The frequency of monitoring;
- The monitoring parameters associated with the Groundwater Impact Areas; and
- The frequency of reporting.

### 2.2 Site-Wide Groundwater Monitoring Network

The wells selected for the Site-Wide Groundwater Monitoring Program circumscribe the facility and are located near or in groundwater impact areas. These wells are intended to monitor water quality at the perimeter of the SSFL and allow for the detection of potential off-site migration of COPCs. Monitor wells included in the Site-Wide Groundwater Monitoring Program are shown on Figure 3 and identified on Table I. Well construction information for each of the selected wells incorporated in the Site-Wide Groundwater Monitoring Program is included in Table II.

Water level measurements and sample collection will be performed at each of these wells in accordance with the monitoring frequency described in Tables IV, V, and VI. Two depth intervals will be sampled at wells equipped with FLUTe systems: the deepest interval and the interval with the highest reported concentration of trichloroethene or perchlorate. Laboratory analysis of the samples will include monitoring parameters listed in Tables III, IV, and V and will be performed in accordance with the requirements of the Quality Assurance Project Plan (QAPP) and Field Sampling Plan (FSP). Future modifications to this program will be developed, as appropriate, to support the objectives of the Site-Wide Groundwater Monitoring Program.

### 2.3 Monitoring Frequency

During the first year, wells included in the Site-Wide Groundwater Monitoring Program are generally scheduled to be sampled on a semi-annual basis as shown in Table IV. Off-site wells and springs are scheduled to be sampled annually. Following the first year, all locations are scheduled to be sampled annually as shown in Table V. Water levels will be measured on a quarterly basis, as indicated in Section 2.5.2.

### 2.4 Monitoring Parameters

Monitoring parameters are selected on a well by well basis. Facility process knowledge, historical water quality data and input from DTSC were used to develop the monitoring parameters for each groundwater impact area. Monitoring parameters and analytical methods for the specific wells which comprise the Site-Wide Groundwater Monitoring Network are shown in Tables III, IV, and V. Radiological samples will be collected unfiltered as described in the Field Sampling Plan (FSP, Appendix A) and analyzed as described in the Quality Assurance Project Plan (QAPP, Appendix B).

### 2.5 Monitoring Elements

#### 2.5.1 Well Conditions

Prior to measuring groundwater elevation and purging the well, the well will be visually inspected for proper identification, integrity of surface seals, well security, and vegetation overgrowth. Wells requiring maintenance or repairs will be identified by field personnel and scheduled for maintenance.

#### 2.5.2 Water Level Measurements

A comprehensive suite of water levels will be collected from accessible wells at the SSFL site each calendar quarter (Table VI, Figure 4). Measurements of the depth to water will be used to calculate water level elevations. Water level measurement will be conducted according to procedures described in the Field Sampling Plan (FSP, Appendix A).

#### 2.5.3 Purging and Sampling

Groundwater from monitor wells will be purged using low-flow/low-purge methods. Monitor wells in the Site-Wide Groundwater Monitoring Program will generally be equipped with dedicated sampling equipment, either variable frequency electric submersible pumps or positive-displacement bladder pumps, depending on the hydraulic properties of each well.

Groundwater purging and sampling will be conducted according to the procedures described in the Field Sampling Plan (Appendix A). Following the procedures in the FSP and the Quality Assurance Project Plan (Appendix B), the groundwater samples will be labeled, entered into the chain-of-custody form, packaged in preparation for submittal to the designated laboratory, and analyzed as specified in the FSP. Quality assurance/quality control (QA/QC) samples will be included as specified in the QAPP (Appendix B).

### 2.6 Waste Disposal

Liquids generated during groundwater sampling activities will be contained, labeled, and disposed of according to procedures described in the Field Sampling Plan (Appendix A).

## 3. SITE-WIDE SAMPLING AND ANALYSIS PLAN ELEMENTS

The Site-Wide WQSAP contains specific information that will aid in assuring that the information collected for this groundwater monitoring program is consistent and meets the objectives of the WQSAP. These elements include:

- Specific procedures describing the physical process of sampling using low-flow/low-purge sampling methods;
- Quality assurance/quality control procedures that assure the quality of data collected during the Site-Wide groundwater monitoring activities; and
- Field safety procedures and personal protection monitoring.

These program elements are stand-alone documents, described below, and are included as appendices to this WQSAP.

### 3.1 Field Sampling Plan

The Field Sampling Plan (FSP) provides procedures for the groundwater sampling activities including equipment and instrumentation use sample preservation and storage, maintenance of field records, decontamination procedures, sample transport and chain-of-custody protocols. The FSP is included as Appendix A of this document.

### 3.2 Quality Assurance Project Plan

The Quality Assurance Project Plan (QAPP) provides procedures necessary to assure the quality of data collected during the Site-Wide Groundwater Monitoring Program sampling activities at SSFL. The QAPP includes field sampling quality control procedures, sample control and chain-of-custody procedures, analytical quality control procedures, corrective action procedures, and reporting. The QAPP is included as Appendix B of this document.

### 3.3 Site-Specific Health and Safety Plan

The Site-Specific Health and Safety Plan (HASP) summarizes field safety procedures and personal protection monitoring. This plan will be followed by field staff conducting work as part of the Site-Wide Groundwater Monitoring Program. The HASP is included as Appendix C of this document.

## 4. ANALYSIS OF DATA

Data generated during the Site-Wide Groundwater Monitoring Program will include water level data, field water quality parameters, and laboratory analytical data. The data will be subjected to various analyses including generation of groundwater elevation maps, time-series plots, and may include statistical analyses. The following will be performed as part of the reporting for the Site-Wide Groundwater Monitoring Program.

### 4.1 Contour Maps

A comprehensive suite of water levels will be collected quarterly from accessible wells (Table VI) at the SSFL site. From this data, a contour map depicting the approximate equipotential surface of groundwater in the uppermost Chatsworth Formation will be prepared. Water level data will be posted to a base map, and contour lines will be constructed by interpolating values between sample points. Contour lines will be drawn manually, or by computer using contouring software, or a combination of both procedures.

The development of groundwater elevation contour maps in fractured, porous media aquifers is problematic due to the heterogeneity and anisotropy of the aquifer media. These types of aquifer systems are characterized by both fracture and matrix transmissivity, for which there is no established convention for developing groundwater elevation contour maps or determining groundwater flow directions. Therefore, groundwater elevation contours will not be used to infer groundwater flow directions or rates of groundwater movement.

### 4.2 Time-Series Plots

Time-series plots of laboratory analytical data will be generated for the monitoring locations listed in Table III. Time-series plots of water level data will be generated for accessible wells and piezometers listed in Table VI. Water level monitoring is not possible at some private off-site wells where the well construction does not provide access to measure water levels. Information plotted on the graphs will have the following characteristics:

- Water level hydrographs will be prepared by plotting water level data on the y-axis and time on the x-axis.
- Analyte concentrations or parameter values will be plotted on the y-axis and date will be plotted on the x-axis.
- If the concentration of an analyte is below the method detection limit (MDL), it will be displayed such that the viewer can ascertain that the analyte was not detected.
- If the concentration of an analyte is below the reporting limit but above the method detection limit (indicated with a "J" flag in the analytical results), it will be displayed such that the viewer can determine that it was an estimated value.
- To the extent practicable, the graphs will depict the y-axis for a given analyte concentration at the same scale.

# 5. REPORTING

This section describes the reporting schedule for the Site-Wide Groundwater Monitoring Program. Included are report content, submittal dates, and the title and address of the person at DTSC to whom reports and notifications will be addressed. A comprehensive annual report will include results of monitoring activities conducted pursuant to the Regulated Unit Groundwater Monitoring Programs (Haley & Aldrich, 2010b, 2010c), the Site-Wide program (this document), or other programs. Reports will be submitted according the schedule in Section 5.2.

## 5.1 Report Contents

Results generated from activities conducted pursuant to the Site-Wide WQSAP will be submitted as part of the facility groundwater monitoring reports, prepared as part of the Post-Closure Groundwater Monitoring Programs (Haley & Aldrich, 2010b, 2010c). Three quarterly progress reports and a comprehensive annual report presenting the results of groundwater sampling and analysis will be prepared and submitted each year. Report contents and submittal schedules are summarized below. All monitoring reports will include the signature and license number of a Geologist or Engineer, registered in the State of California, who takes responsibility for the technical content of the report.

### 5.1.1 Quarterly Reporting

Three quarterly progress reports will be prepared (following the end of the first, second, and third calendar quarters). In addition to content reported specifically for Regulated Unit Groundwater Monitoring Programs (Haley & Aldrich, 2010b, 2010c), the quarterly progress reports will contain the following items related to the Site-Wide Groundwater Monitoring Program:

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- summary tables of water level and water quality monitoring activities;
- summary tables of current water level data;
- groundwater elevation contour maps from water level data obtained during the calendar quarter;
- a summary of modifications made to monitoring equipment during the sampling event, if any; and
- a summary of deviations from the WQSAP, if any, reasons for those deviations, and corrective measures.

Each report will include a section that tracks unresolved issues and/or follow-up work (e.g., verification sampling of apparently significant evidence of a release; repair or replacement of wells or equipment).

### 5.1.2 Annual Reporting

The Annual Monitoring Report will provide a comprehensive summary of groundwater monitoring activities for the calendar year. In addition to content reported specifically for Regulated Unit Groundwater Monitoring Programs (Haley & Aldrich, 2010b, 2010c), the Annual Monitoring Report will include the following items related to the Site-Wide Groundwater Monitoring Program:

- An executive summary of the year's sampling events that identifies monitoring conducted pursuant to the Site-Wide program, and describes significant findings;

- The monitoring activities conducted during the calendar year, including, but not limited to:

  - a summary of the monitoring programs and sampling activities conducted during the calendar year;
  - a summary of maintenance inspections of monitored wells;
  - a summary of modifications made to monitoring equipment during the calendar year, if any; and
  - a summary of deviations from the WQSAP, if any, reasons for those deviations, and corrective measures.

- A summary and interpretation of the monitoring program results during the previous calendar year, including, but not limited to:

  - groundwater elevation measurements, including a summary table and groundwater elevation contour maps;
  - water level hydrographs prepared by plotting water level data on the y-axis and time on the x-axis;
  - results of laboratory analyses presented in summary tables. Laboratory analytical reports and sample custody documents will be provided electronically. Upon request, hard copies of these documents will be provided to DTSC, under separate cover;
  - results of quality assurance / quality control (QA/QC) sampling and analysis. The report will provide an assessment of data quality, including accuracy, precision, and completeness. The report will indicate proposed corrective measures if necessary (e.g., re-sampling);
  - concentrations of select constituents in groundwater samples from the Site-Wide monitor wells will be presented on maps;
  - time-series graphs showing concentrations of select constituents, and a discussion of evident trends;
  - summary tables indicating monitoring parameter results that lie outside of historical range for each monitoring location; and
  - a discussion of significant events which may influence the occurrence, movement, or quality of groundwater, including precipitation events, and importation of water.

- An assessment of the effectiveness of the monitoring program and a recommendation of modifications, if any.

Annual reports will include a section that tracks outstanding issues and/or follow-up work (e.g., repair or replacement of wells or equipment, additional sampling, or modification of equipment). Any unresolved issue will be addressed in subsequent reports until the outstanding issue is resolved.

## 5.2 Submittal Dates

### 5.2.1 Quarterly Monitoring Reports

Quarterly reports will be submitted June 1, September 1, and December 1, following the end of the first, second, and third calendar quarters. Results of quarterly monitoring during the fourth quarter will be presented in the annual report. Dates for quarterly data collection and reporting are:

| Period | Data Collection Schedule | Report Date |
|---|---|---|
| 1st Calendar Quarter | January 1 - March 31 | June 1 |
| 2nd Calendar Quarter | April 1 - June 30 | September 1 |
| 3rd Calendar Quarter | July 1 - September 30 | December 1 |

### 5.2.2 Annual Monitoring Reports

An annual report will be submitted on March 1 of each year that summarizes the monitoring activities of the previous year.

## 5.3 DTSC Contacts

Unless otherwise specifically stated elsewhere in this WQSAP, Boeing, NASA, and DOE will submit required notifications and/or report submittals to the Department of Toxic Substances Control at the address listed below.

Department of Toxic Substances Control
Attn: SSFL Project Director
1001 "I" Street, 25th Floor
Post Office Box 806
Sacramento, CA 95812-0806

## 6. ANNUAL EVALUATION OF SITE-WIDE WQSAP

After 2011, monitoring frequency for groundwater quality will decrease from semi-annual to annual for Site-Wide locations that are not also part of the Regulated Unit Groundwater Monitoring Program unless DTSC specifically directs that semi-annual monitoring continue.

The Annual Groundwater Monitoring Report will include an assessment of the effectiveness of this WQSAP and a recommendation of modifications, if any. The assessment may include evaluating the coverage of monitoring wells, the adequacy of the monitoring program to define contaminant plumes, and data trends or variability. Based on this assessment, the Facility may recommend modifications to the monitoring program.

Analytical results for the target constituents monitored for Groundwater Impact Areas may be analyzed further for trends if review of the tabulated data and concentration plots indicates an increase in concentration which is sustained over multiple monitoring events, and both of the following conditions:

- Concentrations of target constituents exceed Concentration Limits established for Regulated Units within or near the Groundwater Impact Area (or California drinking water Maximum Contaminant Levels [MCLs] if Concentration Limits are not available), and

- The analytical results for the target constituents exceed at least twice the historical maximum concentration(s).

Based on a review of analytical results and trends (if performed), modifications to the Site-Wide Groundwater Monitoring Program may be recommended. Conditions which may result in recommendations to modify the program include:

- An increasing trend that both exceeds Concentration Limits (or MCLs if Concentration Limits are not available) and exceeds historical maximum concentrations by a factor of 2, may warrant increased monitoring frequency, or the addition of monitoring locations, or the addition of target constituents, or some combination of these items. If an increasing trend is observed at the edge of a Groundwater Impact Area, additional locations may be recommended for monitoring.

- Indication of a stable or decreasing concentration trend at a given location may result in reduced monitoring frequency, or the suspension of monitoring for the target constituent at the location.

If the Regulated Unit Groundwater Monitoring Program identifies a new constituent of concern (COC) within a Groundwater Impact Area, the Facility may recommend adding the COC to the list of target constituents for the GIA, if appropriate.

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5. ------, 2007. Docket No. P3-07/08-003, "Consent Order for Corrective Action." 16 August 2007.

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10. ------, 2010a. "Report on Annual Groundwater Monitoring, 2009, Santa Susana Field Laboratory, Ventura County, California." 26 February 2010.

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**TABLE I**
GROUNDWATER IMPACT AREAS AND THE SITE-WIDE GROUNDWATER MONITORING PROGRAM
SANTA SUSANA FIELD LABORATORY
VENTURA COUNTY, CALIFORNIA

| GIA Number | Administrative Area | Location Name | Identified Groundwater Impacts* | Areal Extent of Impacted Groundwater (in Acres) | Monitoring Locations Included in Site-Wide Groundwater Monitoring Network* | Regulated Unit Post-Closure Permit (PCP) Wells |
|---|---|---|---|---|---|---|
| 1 | I | Northeast | VOCs, 1,4-dioxane, NDMA, 1,2,3-TCP, Perchlorate | 124.0 | OS-13, OS-16, OS-25, OS-26, RD-01, RD-10, RD-32, RD-35A, RD-35B, RD-37, RD-38B, RD-39A, RD-39B, RD-43A, RD-43B, RD-43C, RD-66, RD-71, RD-78, RS-20 | RD-37, RD-38B, RD-39A, RD-39B, RD-43A, RD-43B, RD-43C |
| 2 | I | Happy Valley | Perchlorate | 3.1 | PZ-074, PZ-123, RD-10, RD-75, RD-76 | |
| 3 | I | Bowl | VOCs, NDMA, | 4.7 | RD-02, RD-44 | |
| 4 | I | CTL-III | VOCs, 1,4-dioxane, 1, 2, 3-TCP | 30.9 | ES-01, PZ-076, PZ-077, PZ-078, RD-03, RD-46B, RD-48A, RD-48B, RD-48C, RD-61, RD-62 | RD-03, RD-46B, RD-48A, RD-48B, RD-48C |
| 5 | I (NASA) | LOX | VOCs, 1,4-dioxane | 5.0 | RD-69, RD-81, PZ-095, WS-04A | |
| 6 | II | RD-09/ELV | VOCs | 9.6 | OS-09, OS-09R, RD-09, RD-51A, RD-51B, RD-51C, RD-70, RD-83 | RD-51A, RD-51B, RD-51C |
| 7 | II | Building 204 | VOCs, 1,2,3-TCP | 8.4 | RD-14, RD-56A, RD-56B, RD-60, RD-68A, RD-68B | RD-68A, RD-68B |
| 8 | II | Alfa-Bravo | VOCs, 1,4-dioxane, NDMA | 70.0 | | |
| 9 | II & III | Coca/ Delta/ STL IV | VOCs, 1,4-dioxane, NDMA | 104.0 | FDP-835, FDP-890, RD-05A, RD-05B, RD-05C, RD-06, RD-40, RD-41B, RD-42, RD-58B, RD-58C, RD-67, WS-09A | RD-05A, RD-05B, RD-05C, RD-06, RD-58B, RD-58C |
| 10 | III | Compound A | VOCs, Perchlorate | 2.5 | | |
| 11 | III | ECL | VOCs, 1,2,3-TCP | 2.3 | | |
| 12 | III | EEL | VOCs | 8.7 | ES-14, ES-29 | |
| 13 | IV | RMHF | VOCs, Tritium | 1.8 | OS-02, OS-03, OS-04, OS-05, RD-18, RD-19, RD-34A, RD-34B, RD-34C, RD-59A, RD-59B, RD-59C, RD-63, RD-85, RD-86 | |
| 14 | IV | Building 10 Leach Field | VOCs, Tritium | 2.0 | OS-02, OS-03, OS-04, OS-05, RD-59A, RD-59B, RD-59C | |

**TABLE I**
GROUNDWATER IMPACT AREAS AND THE SITE-WIDE GROUNDWATER MONITORING PROGRAM
SANTA SUSANA FIELD LABORATORY
VENTURA COUNTY, CALIFORNIA

| GIA Number | Administrative Area | Location Name | Identified Groundwater Impacts* | Areal Extent of Impacted Groundwater (in Acres) | Monitoring Locations Included in Site-Wide Groundwater Monitoring Network* | Regulated Unit Post-Closure Permit (PCP) Wells |
|---|---|---|---|---|---|---|
| 15 | IV | Hazardous Materials Storage | VOCs | 3.7 | PZ-108 | |
| 16 | IV | Building 56 Area | VOCs | 2.3 | OS-02, OS-03, OS-04, OS-05, PZ-124, RD-07, RD-59A, RD-59B, RD-59C, RD-96 | |
| 17 | IV | FSDF | VOCs, Perchlorate | 18.6 | OS-02, OS-03, OS-04, OS-05, PZ-097, RD-33A, RD-33B, RD-33C, RD-50, RD-54A, RD-57, RD-59A, RD-59B, RD-59C, RS-18 | |
| 18 | IV | Leach field (B363 & B373) | VOCs | 8.0 | RD-13, RD-20 | |
| | | **Total Acreage of GIAs=** | | **533.6** | | |

NOTES AND ABBREVIATIONS:
Evaluation of contaminant mix does not include metals.
CTL III = Components Test Laboratory III
ECL = Engineering Chemistry Laboratory
EEL =Engineering Effects Laboratory
ELV = Expendable Launch Vehicle
FSDF = Former Sodium Disposal Facility
GIA = Groundwater Impact Area
LOX = Liquid oxygen
NASA = National Aeronautics and Space Administration
NDMA = n-nitrosodimethylamine
RMHF = Radioactive Materials Handling Facility
STL IV = Systems Test Laboratory IV
1,2,3-TCP = 1,2,3-Trichloropropane
VOCs = Volatile organic compounds
* = See Table III for which monitoring locations will be sampled for the constituents identified in the groundwater impact areas.

| Well Identifier | Sponsor | Well Depth (ft bls) | Borehole Diameter (inches) | Borehole Interval (feet) | Casing Inside Diameter (inches) | Casing Interval (feet) | Sealed Interval (feet) | Perforated Interval (feet) | Measuring Point Elevation (ft MSL) | Low-Flow Pump Type | Low-Flow Pump Setting** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ***NEAR-SURFACE GROUNDWATER PIEZOMETERS*** | | | | | | | | | | | |
| PZ-074 | Boeing | 24 | 8 | 0-25 | 2 | 0-20 | 0-8.5 | 10-20 | 1772.73 | Bladder[2] | --- |
| PZ-076 | Boeing | 46 | 8 | 0-60 | 2 | 0-46 | 0-32 | 36-46 | 1767.09 | Bladder[2] | --- |
| PZ-077 | Boeing | 25 | 8 | 0-37 | 2 | 0-25 | 0-12 | 15-25 | 1753.42 | Bladder[2] | --- |
| PZ-078 | Boeing | 25 | 8 | 0-48 | 2 | 0-25 | 0-12 | 15-25 | 1755.77 | Bladder[2] | --- |
| PZ-095 | NASA | 24 | 8 | 0-37.5 | 2 | 0-24 | 0-11 | 14-24 | 1760.02 | Bladder[2] | --- |
| PZ-097 | DOE | 43 | 8 | 0-44.5 | 2 | 0-43 | 0-31 | 33-43 | 1761.87 | Bladder[2] | --- |
| PZ-108 | DOE | 28.5 | 8 | 0-30 | 2 | 0-26 | 0-13 | 16-26 | 1763.01 | Bladder[2] | --- |
| PZ-123 | Boeing | 21.5 | 8 | 0-23.5 | 2 | 0-21.5 | 0-8.7 | 11.5-21.5 | 1610.81 | Bladder[2] | --- |
| PZ-124 | DOE | 24.7 | 8 | 0-31 | 2 | 0-24.7 | 0-11.5 | 14.7-24.7 | 1764.11 | Bladder[2] | --- |
| ***SHALLOW WELLS*** | | | | | | | | | | | |
| ES-01 | Boeing | 26 | 15 | 0 - 26 | 6 | (v)1.3 - 25.5 | 0 - 6 | 15.5 - 25.5 | 1782.20 | Bladder | 24 (1) |
| ES-14 | Boeing | 24.6 | 15 | 0 - 24.6 | 6 | 0 - 23.5 | 0 - 9.4 | 12.9 - 23.5 | 1728.69 | Bladder | 22 (1) |
| ES-29 | Boeing | 28 | 12 | 0 - 28 | 6 | 0 - 28 | 0 - 8.4 | 11.6 - 28 | 1760.47 | Bladder | 21 (1) |
| RS-18 | DOE | 13 | 16 | 0 - 13 | 4 | 0 - 13 | 0 - 6 | 7.5 - 13 | 1802.86 | Bladder[2] | --- |
| RS-20 | Boeing | 20.5 | 16 | 0 - 20.5 | 4 | 0 - 20.5 | 0 - 8.5 | 10.5 - 20.5 | 1823.77 | Bladder[2] | --- |
| ***CHATSWORTH FORMATION*** | | | | | | | | | | | |
| RD-01 | Boeing | 506 | 15 | 0 - 26 | 10-1/8 | 0 - 26 | 0 - 26 | | 1935.89 | Bladder | 257-502* |
| | | | 8-5/8 | 26 - 506 | --- | --- | | Open Hole | | | |
| RD-02 | Boeing | 400 | 15 | 0 - 26 | 10-1/8 | 0 - 26 | 0 - 26 | | 1873.92 | ES-VFD | 286 |
| | | | 8-5/8 | 26 - 400 | --- | --- | | Open Hole | | | |
| RD-03 | Boeing | 300 | 15 | 0 - 27 | 10-1/8 | 0 - 27 | 0 - 27 | | 1743.50(A) | ES-VFD | 165 |
| | | | 8-5/8 | 27 - 300 | --- | --- | | Open Hole | | | |
| RD-05A | NASA | 158 | 12-1/4 | 0 - 29.5 | 8-1/4 | 0 - 29.5 | 0 - 29.5 | | 1704.66(A) | Bladder | 120.7 |
| | | | 6-1/4 | 29.5 - 158 | --- | --- | | Open Hole | | | |
| RD-05B | NASA | 310 | 15 | 0 - 27 | 10-1/8 | 0 - 27 | 0 - 27 | | 1705.89(A) | Bladder | 283.5 (3) |
| | | | 9-7/8 | 27 - 310 | 5 | 0 - 310 | 0 - 248 | 257.6 - 310 | | | |
| RD-05C | NASA | 480 | 17-1/2 | 0 - 29 | 12-1/8 | 0 - 28 | 0 - 29 | | 1705.25(A) | Bladder | 436 (3) |
| | | | 11-7/8 | 29 - 421 | 6-1/4 | 0 - 418 | 0 - 421 | | | | |
| | | | 6-1/4 | 421 - 480 | --- | --- | | Open Hole | | | |
| RD-06 | Boeing | 260 | 15 | 0 - 27 | 10-1/8 | 0 - 27 | 0 - 27 | | 1617.21(A) | ES-VFD | 167 |
| | | | 9-7/8 | 27 - 136 | 6-1/4 | 0 - 140 | | 70 - 140 | | | |
| | | | 8-5/8 | 136 - 260 | --- | --- | | Open Hole | | | |

See last page of table for notes and abbreviations.

**TABLE II**
SITE-WIDE GROUNDWATER MONITORING PROGRAM, WELL CONSTRUCTION DETAILS
SANTA SUSANA FIELD LABORATORY
VENTURA COUNTY, CALIFORNIA

| Well Identifier | Sponsor | Well Depth (ft bls) | Borehole Diameter (inches) | Borehole Interval (feet) | Casing Inside Diameter (inches) | Casing Interval (feet) | Sealed Interval (feet) | Perforated Interval (feet) | Measuring Point Elevation (ft MSL) | Low-Flow Pump Type | Low-Flow Pump Setting** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| RD-07 | DOE | 300 | 15 | 0 - 25 | 10-1/8 | 0 - 25 | 0 - 25 | | 1812.82 | FLUTe (4) | --- |
| | | | 8-5/8 | 25 - 300 | --- | --- | | Open Hole (4) | | | |
| RD-09 | Boeing | 200 | 15 | 0 - 37 | 10-1/8 | 0 - 37 | 0 - 37 | | 1768.20 | Bladder | 40-195* (1) |
| | | | 8-5/8 | 37 - 200 | --- | --- | | Open Hole | | | |
| RD-10 | NASA | 400 | 15 | 0 - 30 | 10-1/8 | 0 - 30 | 0 - 30 | | 1904.43 | ES-VFD | 293 |
| | | | 8-3/8 | 30 - 400 | --- | --- | | Open Hole | | | |
| RD-13 | DOE | 160 | 12 | 0 - 30 | 8-1/4 | 0 - 30 | 0 - 30 | | 1840.27 | Bladder | 75-155* |
| | | | 6-1/2 | 30 - 160 | --- | --- | | Open Hole | | | |
| RD-14 | DOE | 125 | 12 | 0 - 30 | 8-1/4 | 0 - 30 | 0 - 30 | | 1824.29 | Bladder | 115 |
| | | | 6-1/2 | 30 - 125 | --- | --- | | Open Hole | | | |
| RD-18 | DOE | 240 | 12 | 0 - 30 | 8-1/4 | 0 - 30 | 0 - 30 | | 1839.49 | Bladder | 110-235* |
| | | | 6-1/2 | 30 - 240 | --- | --- | | Open Hole | | | |
| RD-19 | DOE | 135 | 12 | 0 - 30 | 8-1/4 | 0 - 30 | 0 - 30 | | 1853.13 | Bladder | 107 |
| | | | 6-1/2 | 30 - 135 | --- | --- | | Open Hole | | | |
| RD-20 | DOE | 127 | 12 | 0 - 30 | 8-1/4 | 0 - 30 | 0 - 30 | | 1819.72 | Bladder | 87 (1) |
| | | | 6-1/2 | 30 - 127 | --- | --- | | Open Hole | | | |
| RD-32 | NASA | 150 | 17-1/2 | 0 - 19 | 12-1/8 | 0 - 19 | 0 - 19 | | 1808.47 | Bladder | 125 |
| | | | 11-7/8 | 19 - 99 | 6-1/4 | 0 - 99 | 0 - 99 | | | | |
| | | | 5-7/8 | 99 - 150 | --- | --- | | Open Hole | | | |
| RD-33A | DOE | 320 | 17-1/2 | 0 - 11 | 12-1/8 | 0 - 11 | 0 - 11 | | 1792.97 | FLUTe (4) | --- |
| | | | 11 | 11 - 100 | 6-1/4 | 0 - 100 | 0 - 100 | | | | |
| | | | 5-1/2 | 100 - 320 | --- | --- | | Open Hole (4) | | | |
| RD-33B | DOE | 415 | 17-1/2 | 0 - 20 | 12-1/8 | 0 - 20 | 0 - 20 | | 1793.21 | Bladder | 387 |
| | | | 11 | 20 - 360 | 6-1/4 | 0 - 360 | 20 - 360 | | | | |
| | | | 6-1/4 | 360 - 415 | --- | --- | | Open Hole | | | |
| RD-33C | DOE | 520 | 17-1/2 | 0 - 10 | 12-1/8 | 0 - 10 | 0 - 10 | | 1793.54 | Bladder | 500 |
| | | | 11 | 10 - 480 | 6-1/4 | 0 - 480 | 0 - 480 | | | | |
| | | | 6-1/4 | 480 - 520 | --- | --- | | Open Hole | | | |
| RD-34A | DOE | 60 | 12-1/4 | 0 - 16 | 8-1/4 | 0 - 16 | 0 - 16 | | 1761.83 | Bladder | 58 |
| | | | 6-1/2 | 16 - 60 | --- | --- | | Open Hole | | | |
| RD-34B | DOE | 240 | 17-1/2 | 0 - 30 | 12-1/8 | 0 - 30 | 0 - 30 | | 1762.51 | Bladder | 210 |
| | | | 11 | 30 - 180 | 6-1/4 | 0 - 180 | 0 - 180 | | | | |
| | | | 6-1/4 | 180 - 240 | --- | --- | | Open Hole | | | |

See last page of table for notes and abbreviations.

**TABLE II**
SITE-WIDE GROUNDWATER MONITORING PROGRAM, WELL CONSTRUCTION DETAILS
SANTA SUSANA FIELD LABORATORY
VENTURA COUNTY, CALIFORNIA

| Well Identifier | Sponsor | Well Depth (ft bls) | Borehole Diameter (inches) | Borehole Interval (feet) | Casing Inside Diameter (inches) | Casing Interval (feet) | Sealed Interval (feet) | Perforated Interval (feet) | Measuring Point Elevation (ft MSL) | Low-Flow Pump Type | Low-Flow Pump Setting** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| RD-34C | DOE | 450 | 17-1/2 | 0 - 30 | 12-1/8 | 0 - 30 | 0 - 30 | | 1762.60 | Bladder | 415 |
| | | | 11 | 30 - 380 | 6-1/4 | 0 - 380 | 0 - 380 | | | | |
| | | | 6-1/4 | 380 - 450 | --- | --- | | Open Hole | | | |
| RD-35A | NASA | 110 | 12-1/4 | 0 - 19.5 | 8-1/4 | 0 - 19.5 | 0 - 19.5 | | 1908.62 | Bladder | 100 (1) |
| | | | 6-1/4 | 19.5 - 110 | 4 | 0 - 105.5 | 0 - 30 | 65 - 105.5 | | | |
| RD-35B | NASA | 328 | 24 | 0 – 10 | 18 | 0 - 10 | 0 - 10 | | 1905.65 | Bladder | 293 (1) |
| | | | 17-1/2 | 10 – 162 | 12 | 0 - 158 | 0 - 162 | | | | |
| | | | 9-7/8 | 162 – 328 | 4 | 0 - 324 | 0 - 292 | 303 - 324 | | | |
| | | | 3 | 328 – 359 | --- | --- | 328 - 359 | | | | |
| RD-37 | Boeing | 400 | 17-1/2 | 0 – 38 | 12-1/8 | 0 - 38 | 0 - 38 | | 1870.01(A) | Bladder | 339 |
| | | | 11-7/8 | 38 – 260 | 4 | 0 - 377 | | | | | |
| | | | 7-7/8 | 260 – 400 | | | | 272 - 377 | | | |
| RD-38B | Boeing | 370 | 24 | 0 - 6 | 18 | 0 - 6 | 0 - 6 | | 1881.45(A) | ES-VFD | 346 |
| | | | 17-1/2 | 6 - 170 | 12 | 0 - 161 | 0 - 170 | | | | |
| | | | 11-7/8 | 170 - 279 | 6 | 0 - 277 | 0 - 279 | | | | |
| | | | 5-1/2 | 279 - 370 | --- | --- | | Open Hole | | | |
| RD-39A | Boeing | 159 | 17-1/2 | 0 – 20 | 12-1/8 | 0 - 20 | 0 - 20 | | 1960.23(A) | Bladder | 157.8 |
| | | | 6-1/2 | 20 – 159 | --- | --- | | Open Hole | | | |
| RD-39B | Boeing | 477 | 24 | 0 – 12 | 16 | 0 - 12 | 0 - 12 | | 1959.48(A) | Bladder | 456.2 (3) |
| | | | 15 | 12 – 213 | 10 | 0 - 210 | 0 - 213 | | | | |
| | | | 9-1/2 | 213 – 477 | 4 | 0 – 470 | 0 – 424 | 440 - 470 | | | |
| | | | 6-1/2 | 477 – 500 | --- | --- | 477 – 500 | | | | |
| RD-40 | NASA | 300 | 12-1/4 | 0 - 19.5 | 8-1/4 | 0 - 19.5 | 0 - 19.5 | | 1972.02 | Bladder | 294 (1) |
| | | | 6-1/4 | 19.5 - 300 | --- | --- | | Open Hole | | | |
| RD-41B | NASA | 390 | 17-1/2 | 0 - 19.5 | 12-1/8 | 0 - 19.5 | 0 - 19.5 | | 1774.71 | Bladder | 365 |
| | | | 11-7/8 | 19.5 - 340 | 6-1/4 | 0 - 336 | 0 - 340 | | | | |
| | | | 5-7/8 | 340 - 390 | --- | --- | | Open Hole | | | |
| RD-42 | NASA | 120 | 12-1/4 | 0 - 19.5 | 8-1/4 | 0 - 19.5 | 0 - 19.5 | | 1945.46 | Bladder | 88 (1) |
| | | | 6-1/4 | 19.5 - 120 | --- | --- | | Open Hole | | | |
| RD-43A | Boeing | 98 | 17-1/2 | 0 - 19.5 | 12-1/8 | 0 - 19.5 | 0 - 19.5 | | 1680.16(A) | Bladder | 70.7 |
| | | | 6-1/2 | 19.5 - 98 | --- | --- | | Open Hole | | | |
| RD-43B | Boeing | 295 | 17-1/2 | 0 - 20 | 12-1/8 | 0 - 20 | 0 - 20 | | 1680.21(A) | ES-VFD | 270 |
| | | | 11-7/8 | 20 - 240.5 | 6-1/4 | 0 – 240.5 | 0 – 30.5 | | | | |
| | | | 6-1/2 | 240.5 – 295 | --- | --- | 115.5 – 240.5 | Open Hole | | | |

See last page of table for notes and abbreviations.

**TABLE II**
SITE-WIDE GROUNDWATER MONITORING PROGRAM, WELL CONSTRUCTION DETAILS
SANTA SUSANA FIELD LABORATORY
VENTURA COUNTY, CALIFORNIA

| Well Identifier | Sponsor | Well Depth (ft bls) | Borehole Diameter (inches) | Borehole Interval (feet) | Casing Inside Diameter (inches) | Casing Interval (feet) | Sealed Interval (feet) | Perforated Interval (feet) | Measuring Point Elevation (ft MSL) | Low-Flow Pump Type | Low-Flow Pump Setting** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| RD-43C | Boeing | 439.5 | 17-1/2 | 0 - 20 | 12-1/8 | 0 - 20 | 0 - 20 | | 1679.31(A) | Bladder | 404 (3) |
| | | | 11-7/8 | 20 - 370 | 6-1/4 | 0 - 370 | 5 - 140 | | | | |
| | | | 6-1/2 | 370 - 439.5 | --- | --- | 183 - 219 | Open Hole | | | |
| | | | | | | | 318 - 368 | | | | |
| RD-44 | NASA | 485 | 17-1/2 | 0 - 20 | 12-1/8 | 0 - 20 | 0 - 20 | | 2035.92 | Bladder | 442 |
| | | | 6-1/4 | 20 - 485 | --- | --- | | Open Hole | | | |
| RD-46B | Boeing | 328 | 24 | 0 - 20 | 18 | 0 - 20 | 0 - 20 | | 1807.19(A) | Bladder | 310.5 (3) |
| | | | 17-1/2 | 20 - 193 | 12 | 0 - 190 | 0 - 193 | | | | |
| | | | 9-7/8 | 193 - 328 | 4 | 0 - 325 | 0 - 281 | 293 - 325 | | | |
| | | | 3 | 328 - 366 | --- | --- | 328 - 366 | | | | |
| RD-48A | Boeing | 110 | 12-1/4 | 0 - 20 | 8-1/4 | 0 - 20 | 0 - 20 | | 1736.54(A) | Bladder | 110.4 |
| | | | 6-1/2 | 20 - 110 | --- | --- | | Open Hole | | | |
| RD-48B | Boeing | 248 | 17-1/2 | 0 - 29.5 | 12-1/8 | 0 - 29.5 | 0 - 29.5 | | 1735.40(A) | Bladder | 225 |
| | | | 11-1/4 | 29.5 - 200 | 6-1/4 | 0 - 200 | 0 - 198.5 | | | | |
| | | | 6-1/4 | 200 - 248 | --- | --- | | Open Hole | | | |
| RD-48C | Boeing | 438 | 17-1/2 | 0 - 30 | 12-1/8 | 0 - 30 | 0 - 30 | | 1734.95(A) | ES-VFD | 406 |
| | | | 11-1/4 | 30 - 371 | 6-1/4 | 0 - 371 | 0 - 371 | | | | |
| | | | 6-1/4 | 371 - 438 | --- | --- | | Open Hole | | | |
| RD-50 | DOE | 195 | 12-3/4 | 0 - 18.5 | 8-1/4 | 0 - 18.5 | 0 - 18.5 | | 1914.88 | FLUTe (4) | --- |
| | | | 6-1/4 | 18.5 - 195 | --- | --- | | Open Hole (4) | | | |
| RD-51A | Boeing | 250 | 24 | 0 - 50 | 12-1/8 | 0 - 50 | 0 - 50 | | 1832.51(A) | Bladder | 249.5 |
| | | | 11-3/4 | 50 - 160 | 6-1/4 | 0 - 160 | 0 - 160 | | | | |
| | | | 5-1/2 | 160 - 250 | --- | --- | | Open Hole | | | |
| RD-51B | Boeing | 370 | 24 | 0 - 48 | 12-1/8 | 0 - 48 | 0 - 48 | | 1832.68(A) | ES-VFD | 337 |
| | | | 11-3/4 | 48 - 300 | 6-1/4 | 0 - 300 | 0 - 300 | | | | |
| | | | 5-1/2 | 300 - 370 | --- | --- | | Open Hole | | | |
| RD-51C | Boeing | 602 | 14 | 0 - 13.5 | 12-1/8 | 0 - 13.5 | 0 - 13.5 | | 1831.65(A) | ES-VFD | 547.5 |
| | | | 11-3/4 | 13.5 - 510 | 6-1/4 | 0 - 510 | 0 - 510 | | | | |
| | | | 5-1/2 | 510 - 602 | --- | --- | | Open Hole | | | |
| RD-54A | DOE | 278 | 17-1/2 | 0 - 19 | 12-1/8 | 0 - 19 | 0 - 19 | | 1841.72 | FLUTe (4) | --- |
| | | | 11-1/4 | 19 - 119 | 6-1/4 | 0 - 119 | 0 - 119 | | | | |
| | | | 5-7/8 | 119 - 278 | --- | --- | | Open Hole (4) | | | |
| RD-56A | NASA | 397.5 | 17-1/2 | 0 - 20.5 | 12-1/8 | 0 - 20.5 | 0 - 20.5 | | 1758.62 | Bladder | 378 (1) |
| | | | 6-1/2 | 20.5 - 397.5 | --- | --- | | Open Hole | | | |

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**TABLE II**
SITE-WIDE GROUNDWATER MONITORING PROGRAM, WELL CONSTRUCTION DETAILS
SANTA SUSANA FIELD LABORATORY
VENTURA COUNTY, CALIFORNIA

| Well Identifier | Sponsor | Well Depth (ft bls) | Borehole | | Casing | | Sealed Interval (feet) | Perforated Interval (feet) | Measuring Point Elevation (ft MSL) | Low-Flow Pump Type | Low-Flow Pump Setting** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Diameter (inches) | Interval (feet) | Inside Diameter (inches) | Interval (feet) | | | | | |
| RD-56B | NASA | 463 | 22 | 0 - 10 | 16 | 0 - 10 | 0 -10 | | 1761.83 | ES-VFD | 458 (1) |
| | | | 15 | 10 - 453 | 10 | 0 - 443 | 0 - 443 | | | | |
| | | | 6-1/2 | 453 - 463 | --- | --- | | Open Hole | | | |
| RD-57 | DOE | 419 | 17-1/2 | 0 - 19.5 | 12-1/8 | 0 - 19.5 | 0 - 19.5 | | 1774.15 | FLUTe (4) | --- |
| | | | 6-1/2 | 19.5 - 419 | --- | --- | | Open Hole (4) | | | |
| RD-58B | Boeing | 268 | 17-1/2 | 0 - 20 | 12-1/8 | 0 - 20 | 0 - 20 | | 1761.34(A) | Bladder | 245.5 (3) |
| | | | 11-7/8 | 20 - 220 | 6-1/4 | 0 - 220 | 0 - 220 | | | | |
| | | | 6-1/2 | 220 - 268 | --- | --- | | Open Hole | | | |
| RD-58C | Boeing | 498 | 17-1/2 | 0 - 19 | 12-1/8 | 0 - 19 | 0 - 19 | | 1759.59(A) | Bladder | 475.5 (3) |
| | | | 11-7/8 | 19 - 450 | 6-1/4 | 0 - 450 | 0 - 450 | | | | |
| | | | 6-1/2 | 450 - 498 | --- | --- | | Open Hole | | | |
| RD-59A | DOE | 58 | 17-1/2 | 0 - 21 | 12-1/8 | 0 - 21 | 0 - 21 | | 1340.50 | Bladder | 43 |
| | | | 6-1/2 | 21 - 58 | --- | --- | | Open Hole | | | |
| RD-59B | DOE | 214 | 17-1/2 | 0 - 19.5 | 12-1/8 | 0 - 19.5 | 0 - 19.5 | | 1342.49 | Artesian | --- |
| | | | 6-1/2 | 19.5 - 214 | 2 | 0 - 209 | 0 - 161 | 178 - 209 | | | |
| RD-59C | DOE | 398 | 17-1/2 | 0 - 19 | 12-1/8 | 0 - 19 | 0 - 19 | | 1345.41 | Artesian | --- |
| | | | 6-1/2 | 19 - 398 | 2 | 0 - 397 | 0 - 186 | | | | |
| | | | | | | | 250 - 328 | 345.5 - 397 | | | |
| RD-60 | Boeing | 126 | 12-1/4 | 0 - 19.5 | 8-1/4 | 0 - 19.5 | 0 - 19.5 | | 1870.40 | Bladder | 108 (1) |
| | | | 6-1/4 | 19.5 - 126 | --- | --- | | Open Hole | | | |
| RD-61 | NASA | 129 | 17-1/2 | 0 - 19 | 12-1/8 | 0 - 19 | 0 - 19 | | 1845.87 | Bladder | 127 |
| | | | 6-1/4 | 19 - 129 | --- | --- | | Open Hole | | | |
| RD-62 | NASA | 238 | 17-1/2 | 0 - 20.7 | 12-1/8 | 0 - 20.7 | 0 - 19.5 | | 1837.20 | Bladder | 222 |
| | | | 6-1/2 | 20.7 - 238 | --- | --- | | Open Hole | | | |
| RD-63 | DOE | 230 | 12-3/4 | 0 - 20 | 8-1/4 | 0 - 20 | 0 - 20 | | 1764.85 | Bladder | 55-225* |
| | | | 6-1/2 | 20 - 230 | --- | --- | | Open Hole | | | |
| RD-66 | NASA | 225 | 22 | 0 - 19 | 12 | 0 - 19 | 0 - 19 | | 1730.79 | Bladder | 197 |
| | | | 6-1/2 | 19 - 225 | --- | --- | | Open Hole | | | |
| RD-67 | NASA | 102 | 17-1/2 | 0 - 20 | 12 | 0 - 20 | 0 - 20 | | 1901.71 | Bladder | 79 |
| | | | 6-1/2 | 20 - 102 | --- | --- | | Open Hole | | | |
| RD-68A | NASA | 90 | 17-1/2 | 0 - 19 | 12 | 0 - 19 | 0 - 19 | | 1307.64 | Artesian | --- |
| | | | 6-1/4 | 19 - 90 | --- | --- | | Open Hole | | | |
| RD-68B | NASA | 272 | --- | 0 - 52 | 12 | 0 - 52 | 0 - 224 | 240 - 270 | 1312.44 | Artesian | --- |
| | | | 11-7/8 | 52 - 272 | 4 | 0 - 270 | | | | | |

See last page of table for notes and abbreviations.

**TABLE II**
SITE-WIDE GROUNDWATER MONITORING PROGRAM, WELL CONSTRUCTION DETAILS
SANTA SUSANA FIELD LABORATORY
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| Well Identifier | Sponsor | Well Depth (ft bls) | Borehole | | Casing | | Sealed Interval (feet) | Perforated Interval (feet) | Measuring Point Elevation (ft MSL) | Low-Flow Pump Type | Low-Flow Pump Setting** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Diameter (inches) | Interval (feet) | Inside Diameter (inches) | Interval (feet) | | | | | |
| RD-69 | NASA | 103 | 17-1/2 | 0 - 19 | 12 | 0 - 19 | 0 - 19 | | 1831.28 | Bladder | 76 |
| | | | 6-1/4 | 19 - 103 | --- | --- | | Open Hole | | | |
| RD-70 | NASA | 278 | 17-1/2 | 0 - 19 | 12 | 0 - 19 | 0 - 19 | | 1732.26 | ES-VFD | 214 |
| | | | 6-1/2 | 19 - 278 | --- | --- | | Open Hole | | | |
| RD-71 | NASA | 281 | 17-1/2 | 0 - 20 | 12 | 0 - 20 | 0 - 20 | | 1740.02 | Bladder | 191-276* |
| | | | 6-1/2 | 20 - 281 | --- | --- | | Open Hole | | | |
| RD-75 | Boeing | 425 | 12-3/4 | 0 - 30 | 8 | 0 - 30 | 0 - 30 | | 1613.30 | ES-VFD | 407 |
| | | | 4-4/5 | 30 - 425 | --- | --- | | Open Hole | | | |
| RD-76 | Boeing | 153 | 12-3/4 | 0 - 30 | 8 | 0 - 30 | 0 - 30 | | 1772.27 | Bladder | 143 |
| | | | 6 | 30 - 153 | 4 | 0 - 153 | --- | 133 - 153 | | | |
| | | | 5-1/2 | 153-185 | --- | --- | Fill 153-185 | | | | |
| RD-78 | Boeing | 333 | 12-3/4 | 0 - 40 | 8 | 0 - 40 | 0 - 40 | | 1819.84 | Bladder | 288 |
| | | | 5-1/2 | 40 - 333 | --- | --- | | Open Hole | | | |
| RD-81 | NASA | 205 | 12-3/4 | 0 - 20 | 8 | 0 - 20 | 0 - 20 | | 1705.77 | Bladder | 170 (1) |
| | | | 6 | 20 - 205 | --- | --- | | Open Hole | | | |
| RD-83 | NASA | 143 | 12-3/4 | 0 - 20 | 8 | 0 - 20 | 0 - 20 | | 1661.18 | Bladder | 104 |
| | | | 6 | 20 - 143 | --- | --- | | Open Hole | | | |
| RD-85 | DOE | 90 | 13-3/8 | 0 - 20 | 8 | 0 - 20 | 0 - 20 | | 1849.09 | Bladder | 75 |
| | | | 5 | 20 - 90 | --- | --- | | Open Hole | | | |
| RD-86 | DOE | 80 | 13-3/8 | 0 - 20 | 8 | 0 - 20 | 0 - 20 | | 1830.51 | Bladder | 75 |
| | | | 5 | 20 - 80 | --- | --- | | Open Hole | | | |
| RD-96 | DOE | 90 | 13 | 0 - 20 | 8 | 0 - 20 | 0 - 20 | | 1805.14 | Bladder | 73 |
| | | | 4 | 20 - 90 | --- | --- | | Open Hole | | | |
| WS-04A | NASA | 502 | 13 | 0 - 300 | 10-1/4 | 0 - 288 | Unknown | 96 - 288 | 1749.77(A) | ES-VFD | 329 |
| | | | 10 | 300 - 502 | --- | --- | | Open Hole | | | |
| WS-09A | NASA | 541 | 30 | 0 - 34 | 14 | 0 - 34 | 0 - 20 | | 1647.61 | NA | NA |
| | | | 15 | 34 - 541 | 12-1/8 | 0 - 541 | | | | | |
| | | | | | 8-1/4 | 0 - 539 | | 20 - 539 | | | |
| ***PRIVATE OFF-SITE WELLS AND SPRINGS*** | | | | | | | | | | | |
| FDP-835 | Boeing | No well construction data. Sample location is an undeveloped spring. | | | | | | | | --- | --- |
| FDP-890 | Boeing | No well construction data. Sample location is an undeveloped spring. | | | | | | | | | |
| OS-02 | Boeing | 700 | Unknown | Unknown | 10 | 0 - 17 | 0 - 17 | | 1237.01 | --- | --- |
| | | | | | --- | --- | | Open Hole | | | |
| OS-03 | Boeing | 100 | Drilled with cable tools | | 8-1/4 | 0 - 59 | 0 - 30 | 30 - 60 | 1298.15 | --- | --- |
| | | | | | --- | --- | | Open Hole | | | |

See last page of table for notes and abbreviations.

**TABLE II**
SITE-WIDE GROUNDWATER MONITORING PROGRAM, WELL CONSTRUCTION DETAILS
SANTA SUSANA FIELD LABORATORY
VENTURA COUNTY, CALIFORNIA

| Well Identifier | Sponsor | Well Depth (ft bls) | Borehole | | Casing | | Sealed Interval (feet) | Perforated Interval (feet) | Measuring Point Elevation (ft MSL) | Low-Flow Pump Type | Low-Flow Pump Setting** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Diameter (inches) | Interval (feet) | Inside Diameter (inches) | Interval (feet) | | | | | |
| OS-04 | Boeing | Well Construction Data Unresolved or Not Available | | | | | | | 1334.00 | --- | --- |
| OS-05 | Boeing | Well Construction Data Unresolved or Not Available | | | | | | | | --- | --- |
| OS-09 | Boeing | Well Construction Data Unresolved or Not Available | | | | | | | | --- | --- |
| OS-09R | Boeing | 408 | 10 | 0 - 29 | 6 | 0 - 29 | 0 - 29 | | 1018.10 | Westbay | --- |
| | | | 4 | 29-408 | 1.5 | 0-406 | | (5) | | | |
| OS-13 (S) | NASA | Well Construction Data Unresolved or Not Available | | | | | | | | --- | --- |
| OS-16 | NASA | Well Construction Data Unresolved or Not Available | | | | | | | 1785.05 | --- | --- |
| OS-25 | NASA | 515 | 10 | 0 - 36 | 6-1/4 | 0 - 36 | 0 - 36 | | 2043.58 | --- | --- |
| | | | 6 | 36 - 515 | --- | --- | | Open Hole | | | |
| OS-26 | NASA | 515 | 10 | 0 - 40 | 6-1/4 | 0 - 40 | 0 - 40 | | 2080.58 | --- | --- |
| | | | 6 | 40 - 515 | --- | --- | | Open Hole | | | |

See last page of table for notes and abbreviations.

**TABLE II**
NOTES AND ABBREVIATIONS

1. Depth/intervals are measured in feet below land surface.
2. (---) = No data available or not applicable.
3. (S) = Spring.
4. ES-VFD = Electric submersible- variable frequency drive.
5. ft (btc) = Feet below top of casing.
6. (ft MSL) = Mean Sea Level.
7. (ft bls) = Feet below land surface.
8. NA = Not applicable. WS-09A will not be equipped with a low-flow pump as it is a proposed extraction well for Groundwater Interim Measures (GWIM).
9. * = Well is equipped with QED SpectraSample™ flow-equalization inlets at equally-spaced intervals, as indicated by the settings below in Feet Below Top of Casing (ft BTOC):

| RD-01 | RD-09 | RD-13 | RD-18 | RD-63 | RD-71 |
|---|---|---|---|---|---|
| 257 | TBD | 75 | 110 | 55 | 191 |
| 302 | TBD | 91 | 135 | 89 | 208 |
| 352 | TBD | 167 | 160 | 123 | 225 |
| 402 | TBD | 123 | 185 | 157 | 242 |
| 452 | TBD | 139 | 210 | 191 | 259 |
| 502 | TBD | 155 | 235 | 225 | 276 |

10. ** = Pump settings may be modified based on pump performance or water level.

11. (A) = Elevation represents surveyed measuring point elevation prior to low-flow equipment retrofit.

12. (1) = Pump setting pending field verification and vendor design.

13. (2) = Well is typically dry and will be sampled when water present using portable, non-dedicated sampling apparatus.

14. (3) = Well is equipped with a "drop inlet" below the pump setting.

| Well | Pump Setting (ft BTOC) |
|---|---|
| RD-05B | 138.3 |
| RD-05C | 127.6 |
| RD-39B | 365.0 |
| RD-43C | 172.9 |
| RD-46B | 150.9 |
| RD-58B | 180.3 |
| RD-58C | 194.7 |

**TABLE II**
NOTES AND ABBREVIATIONS

15. (4) = FLUTe installed in well.

| Well | Port | Spacer Interval (ft btc) |
|---|---|---|
| RD-07 | 1 | 50 - 60 |
| | 2 | 70 - 80 |
| | 3 | 90 - 100 |
| | 4 | 110 - 120 |
| | 5 | 130 - 140 |
| | 6 | 150 - 160 |
| | 7 | 170 - 180 |
| | 8 | 190 - 200 |
| | 9 | 210 - 220 |
| | 10 | 230 - 240 |
| | 11 | 250 - 260 |
| | 12 | 270 - 280 |
| | 13 | 290 - 299.55 |
| RD-33A | 1 | 211 - 221 |
| | 2 | 231 - 241 |
| | 3 | 251 - 261 |
| | 4 | 271 - 281 |
| | 5 | 291 - 301 |
| | 6 | 311 - 321 |
| RD-50 | 1 | 106 - 116 |
| | 2 | 126 - 136 |
| | 3 | 146 - 156 |
| | 4 | 166 - 176 |
| | 5 | 186 - 196 |

| Well | Port | Spacer Interval (ft btc) |
|---|---|---|
| RD-54A | 1 | 150.5 - 160.5 |
| | 2 | 170.5 - 180.5 |
| | 3 | 190.5 - 200.5 |
| | 4 | 210.5 - 220.5 |
| | 5 | 230.5 - 240.5 |
| | 6 | 250.5 - 260.5 |
| | 7 | 270.5 - 280.5 |
| RD-57 | 1 | 228 - 238 |
| | 2 | 248 - 258 |
| | 3 | 268 - 278 |
| | 4 | 288 - 298 |
| | 5 | 308 - 318 |
| | 6 | 328 - 338 |
| | 7 | 348 - 358 |
| | 8 | 368 - 378 |
| | 9 | 388 - 398 |
| | 10 | 408 - 418 |

**TABLE II**
NOTES AND ABBREVIATIONS

16. (5) = Westbay installed in well.

A "Zone" is the designation given to a section of the Westbay that includes a measuring port and a pumping port. A pumping port enables the zone to be purged.

A "QA" is a section of the Westbay that only has a measuring port. This interval can be sampled, but not purged.

| Well | Port | Zone Length (ft btc) |
|---|---|---|
| OS-09R | Zone 1 | 29-40 |
| | Zone 2 | 45-52 |
| | QA-1 | 57-62 |
| | Zone 3 | 65-88 |
| | QA-2 | 93-97 |
| | Zone 4 | 100-127 |
| | Zone 5 | 132-145 |
| | Zone 6 | 150-173 |
| | Zone 7 | 178-200 |
| | Zone 8 | 205-216 |
| | Zone 9 | 221-245 |
| | QA-3 | 248-252 |
| | Zone 10 | 255-275 |
| | Zone 11 | 280-290 |
| | Zone 12 | 295-305 |
| | Zone 13 | 310-335 |
| | Zone 14 | 340-355 |
| | Zone 15 | 360-375 |
| | Zone 16 | 380-406 |

**TABLE III**
SITE-WIDE GROUNDWATER MONITORING PROGRAM, MONITORING PARAMETERS
SANTA SUSANA FIELD LABORATORY
VENTURA COUNTY, CALIFORNIA

| GIA | Analyte | Method | Wells |
|---|---|---|---|
| 1 | VOCs | 8260B | OS-13, OS-16, OS-25, OS-26, RD-01, RD-10, RD-32, RD-35A, RD-35B, RD-37, RD-38B, RD-39A, RD-39B, RD-43A, RD-43B, RD-43C, RD-66, RD-71, RD-78, RS-20 |
| | 1,4-Dioxane | 8260SIM | RD-01, RD-10, RD-32, RD-35A, RD-35B, RD-37, RD-38B, RD-39A, RD-39B, RD-43A, RD-43B, RD-43C, RD-66, RD-71, RD-78, RS-20 |
| | 1,2,3-Trichloropropane | SRL 524M | RD-32, RD-35A, RD-35B, RD-37, RD-38B, RD-39A, RD-39B, RD-43A, RD-43B, RD-43C, RD-66, RD-71, RD-78, RS-20 |
| | NDMA | 1625M | RD-32, RD-35A, RD-35B, RD-37, RD-38B, RD-39A, RD-39B, RD-43A, RD-43B, RD-43C, RD-66, RD-71, RD-78, RS-20 |
| | Perchlorate | 314.0 | RD-01, RD-10, RD-32, RD-35A, RD-35B, RD-37, RD-38B, RD-39A, RD-39B, RD-43A, RD-43B, RD-43C, RD-66, RD-71, RD-78, RS-20 |
| 2 | VOCs | 8260B | RD-10 |
| | 1,4-Dioxane | 8260SIM | RD-10 |
| | Perchlorate | 314.0 | PZ-074, PZ-123, RD-10, RD-75, RD-76 |
| 3 | VOCs | 8260B | RD-02, RD-44 |
| | 1,4-Dioxane | 8260SIM | RD-02, RD-44 |
| | NDMA | 1625M | RD-02, RD-44 |
| | Hydrazine | DV-WC-0077 | RD-02, RD-44 |
| | Formaldehyde | 8315A | RD-02, RD-44 |
| 4 | VOCs | 8260B | ES-01, PZ-076, PZ-077, PZ-078, RD-03, RD-46B, RD-48A, RD-48B, RD-48C, RD-61, RD-62 |
| | 1,4-Dioxane | 8260SIM | ES-01, PZ-076, PZ-077, PZ-078, RD-03, RD-46B, RD-48A, RD-48B, RD-48C, RD-61, RD-62 |
| | 1,2,3-Trichloropropane | SRL 524M | ES-01, PZ-076, PZ-077, PZ-078, RD-46B, RD-48A, RD-48B, RD-48C, RD-61, RD-62 |
| | Chloride, Nitrate | 300.0 | ES-01, PZ-076, PZ-077, PZ-078, RD-03, RD-46B, RD-48A, RD-48B, RD-48C, RD-61, RD-62 |
| | Dioxins | 8290 | ES-01, PZ-076, PZ-077, PZ-078, RD-03, RD-46B, RD-48A, RD-48B, RD-48C, RD-61, RD-62 |
| 5 | VOCs | 8260B | PZ-095, RD-69, RD-81, WS-04A |
| | 1,4-Dioxane | 8260SIM | PZ-095, RD-69, RD-81, WS-04A |
| 6 | VOCs | 8260B | OS-09, OS-09R, RD-09, RD-51A, RD-51B, RD-51C, RD-70, RD-83 |
| | 1,4-Dioxane | 8260SIM | RD-09, RD-51A, RD-51B |
| 7 | VOCs | 8260B | RD-14, RD-56A, RD-56B, RD-60, RD-68A, RD-68B |
| | 1,2,3-Trichloropropane | SRL 524M | RD-14, RD-56A, RD-56B, RD-60, RD-68A, RD-68B |
| | Fluoride | 300.0 | RD-14, RD-56A, RD-56B, RD-60, RD-68A, RD-68B |
| | Radiochemistry | 900.0, 901.1, 905.0, 906.0, 908.0 | RD-14, RD-56A, RD-56B, RD-60 |
| 9 | VOCs | 8260B | RD-05A, RD-05B, RD-05C, RD-06, RD-40, RD-41B, RD-42, RD-58B, RD-58C, RD-67, WS-09A, FDP-835, FDP-890 |
| | 1,4-Dioxane | 8260SIM | RD-05A, RD-05B, RD-05C, RD-06, RD-40, RD-41B, RD-42, RD-58B, RD-58C, RD-67, WS-09A, FDP-835, FDP-890 |
| | NDMA | 1625M | RD-05A, RD-05B, RD-05C, RD-06, RD-40, RD-42, RD-58B, RD-58C, RD-67, WS-09A, FDP-835, FDP-890 |
| 12 | VOCs | 8260B | ES-14, ES-29 |
| | Chloride, Nitrate | 300.0 | ES-14, ES-29 |
| 13 | VOCs | 8260B | OS-02, OS-03, OS-04, OS-05, RD-18, RD-19, RD-34A, RD-34B, RD-34C, RD-59A, RD-59B, RD-59C, RD-63, RD-85, RD-86 |
| | 1,4-Dioxane | 8260SIM | RD-18, RD-34A, RD-34C, RD-63, RD-85 |
| | Fluoride | 300.0 | OS-02, OS-03, OS-04, OS-05, RD-18, RD-19, RD-34A, RD-34B, RD-34C, RD-59A, RD-59B, RD-59C, RD-63, RD-85, RD-86 |
| | Metals | 6010/6020 | OS-02, OS-03, OS-04, OS-05, RD-18, RD-19, RD-34A, RD-34B, RD-34C, RD-59A, RD-59B, RD-59C, RD-63, RD-85, RD-86 |
| | Sodium | 6010 | OS-02, OS-03, OS-04, OS-05, RD-18, RD-19, RD-34A, RD-34B, RD-34C, RD-59A, RD-59B, RD-59C, RD-63, RD-85, RD-86 |
| | Radiochemistry | 900.0, 901.1, 905.0, 906.0, 908.0 | OS-02, OS-03, OS-04, OS-05, RD-18, RD-19, RD-34A, RD-34B, RD-34C, RD-59A, RD-59B, RD-59C, RD-63, RD-85, RD-86 |
| 14 | VOCs | 8260B | OS-02, OS-03, OS-04, OS-05, RD-59A, RD-59B, RD-59C |
| | Fluoride | 300.0 | OS-02, OS-03, OS-04, OS-05 |
| | Radiochemistry | 900.0, 901.1, 905.0, 906.0, 908.0 | OS-02, OS-03, OS-04, OS-05, RD-59A, RD-59B, RD-59C |

**TABLE III**
SITE-WIDE GROUNDWATER MONITORING PROGRAM, MONITORING PARAMETERS
SANTA SUSANA FIELD LABORATORY
VENTURA COUNTY, CALIFORNIA

| GIA | Analyte | Method | Wells |
|---|---|---|---|
| 15 | VOCs | 8260B | PZ-108 |
| | Metals | 6010/6020 | PZ-108 |
| 16 | VOCs | 8260B | OS-02, OS-03, OS-04, OS-05, PZ-124, RD-07, RD-59A, RD-59B, RD-59C, RD-96 |
| | Fluoride | 300.0 | OS-02, OS-03, OS-04, OS-05 |
| | Radiochemistry | 900.0, 901.1, 905.0, 906.0, 908.0 | OS-02, OS-03, OS-04, OS-05, PZ-124, RD-07, RD-59A, RD-59B, RD-59C, RD-96 |
| 17 | VOCs | 8260B | OS-02, OS-03, OS-04, OS-05, PZ-097, RD-33A, RD-33B, RD-33C, RD-50, RD-54A, RD-57, RD-59A, RD-59B, RD-59C, RS-18 |
| | Fluoride | 300.0 | OS-02, OS-03, OS-04, OS-05 |
| | Perchlorate | 314.0 | PZ-097, RD-33A, RD-33B, RD-33C, RD-50, RD-54A, RD-57, RD-59A, RD-59B, RD-59C, RS-18 |
| | Metals | 6010/6020 | OS-02, OS-03, OS-04, OS-05, PZ-097, RD-33A, RD-33B, RD-33C, RD-50, RD-54A, RD-57, RD-59A, RD-59B, RD-59C, RS-18 |
| | Radiochemistry | 900.0, 901.1, 905.0, 906.0, 908.0 | OS-02, OS-03, OS-04, OS-05, PZ-097, RD-33A, RD-33B, RD-33C, RD-50, RD-54A, RD-57, RD-59A, RD-59B, RD-59C, RS-18 |
| 18 | VOCs | 8260B | RD-13, RD-20 |
| | Radiochemistry | 900.0, 901.1, 905.0, 906.0, 908.0 | RD-13, RD-20 |

NOTES AND ABBREVIATIONS:
GIA = Groundwater Impact Area
NDMA = N-Nitrosodimethylamine
VOCs = Volatile Organic Compounds

**TABLE IV**
SITE-WIDE GROUNDWATER MONITORING SCHEDULE, YEAR 1
SANTA SUSANA FIELD LABORATORY
VENTURA COUNTY, CALIFORNIA

| Well ID | Sponsor | GIA | Monitoring Parameters / Analytical Methods | | | |
|---|---|---|---|---|---|---|
| | | | First Quarter | Second Quarter | Third Quarter | Fourth Quarter |
| **NEAR-SURFACE GROUNDWATER PIEZOMETERS** | | | | | | |
| PZ-074 | B | 2 | Perchlorate / 314.0 | | Perchlorate / 314.0 | |
| PZ-076 | B | 4 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>1,2,3-TCP / SRL 524M<br>Chloride,Nitrate / 300.0<br>Dioxins / 8290 | | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>1,2,3-TCP / SRL 524M<br>Chloride,Nitrate / 300.0 | |
| PZ-077 | B | 4 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>1,2,3-TCP / SRL 524M<br>Chloride,Nitrate / 300.0<br>Dioxins / 8290 | | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>1,2,3-TCP / SRL 524M<br>Chloride,Nitrate / 300.0 | |
| PZ-078 | B | 4 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>1,2,3-TCP / SRL 524M<br>Chloride,Nitrate / 300.0<br>Dioxins / 8290 | | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>1,2,3-TCP / SRL 524M<br>Chloride,Nitrate / 300.0 | |
| PZ-095 | N | 5 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM | | VOCs / 8260B<br>1,4-Dioxane / 8260SIM | |
| PZ-097 | D | 17 | VOCs / 8260B<br>Perchlorate / 314.0<br>Radiochemistry<br>Metals | | VOCs / 8260B<br>Perchlorate / 314.0<br>Radiochemistry<br>Metals | |
| PZ-108 | D | 15 | VOCs / 8260B<br>Metals | | VOCs / 8260B<br>Metals | |
| PZ-123 | B | 2 | Perchlorate / 314.0 | | Perchlorate / 314.0 | |
| PZ-124 | D | 16 | VOCs / 8260B<br>Radiochemistry | | VOCs / 8260B<br>Radiochemistry | |
| **NEAR-SURFACE GROUNDWATER ES WELLS** | | | | | | |
| ES-01 | B | 4 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>1,2,3-TCP / SRL 524M<br>Chloride,Nitrate / 300.0<br>Dioxins / 8290 | | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>1,2,3-TCP / SRL 524M<br>Chloride,Nitrate / 300.0 | |
| ES-14 | B | 12 | VOCs / 8260B<br>Chloride,Nitrate / 300.0 | | VOCs / 8260B<br>Chloride,Nitrate / 300.0 | |
| ES-29 | B | 12 | VOCs / 8260B<br>Chloride,Nitrate / 300.0 | | VOCs / 8260B<br>Chloride,Nitrate / 300.0 | |
| **NEAR-SURFACE GROUNDWATER RS WELLS** | | | | | | |
| RS-18 | D | 17 | VOCs / 8260B<br>Perchlorate / 314.0<br>Radiochemistry<br>Metals | | VOCs / 8260B<br>Perchlorate / 314.0<br>Radiochemistry<br>Metals | |
| RS-20 | B | 1 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M<br>1,2,3-TCP / SRL 524M<br>Perchlorate / 314.0 | | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M<br>1,2,3-TCP / SRL 524M<br>Perchlorate / 314.0 | |
| **CHATSWORTH FORMATION RD WELLS** | | | | | | |
| RD-01 | B | 1 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>Perchlorate / 314.0 | | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>Perchlorate / 314.0 | |

See last page of table for notes and abbreviations.

| Well ID | Sponsor | GIA | Monitoring Parameters / Analytical Methods | | | |
|---|---|---|---|---|---|---|
| | | | First Quarter | Second Quarter | Third Quarter | Fourth Quarter |
| RD-02 | B | 3 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M<br>Hydrazine / DV-WC-0077<br>Formaldehyde / 8315A | | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M<br>Hydrazine / DV-WC-0077<br>Formaldehyde / 8315A | |
| RD-03 | B | 4 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>Chloride,Nitrate / 300.0<br>Dioxins / 8290 | | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>Chloride,Nitrate / 300.0 | |
| RD-05A | N | 9 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M | | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M | |
| RD-05B | N | 9 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M | | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M | |
| RD-05C | N | 9 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M | | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M | |
| RD-06 | B | 9 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M | | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M | |
| RD-07 | D | 16 | VOCs / 8260B<br>Radiochemistry | | VOCs / 8260B<br>Radiochemistry | |
| RD-09 | B | 6 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM | | VOCs / 8260B<br>1,4-Dioxane / 8260SIM | |
| RD-10 | N | 1,2 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>Perchlorate / 314.0 | | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>Perchlorate / 314.0 | |
| RD-13 | D | 18 | VOCs / 8260B<br>Radiochemistry | | VOCs / 8260B<br>Radiochemistry | |
| RD-14 | D | 7 | VOCs / 8260B<br>1,2,3-TCP / SRL 524M<br>Fluoride / 300.0<br>Radiochemistry | | VOCs / 8260B<br>1,2,3-TCP / SRL 524M<br>Fluoride / 300.0<br>Radiochemistry | |
| RD-18 | D | 13 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>Radiochemistry<br>Fluoride / 300.0<br>Metals<br>Sodium / 6010 | | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>Radiochemistry<br>Fluoride / 300.0<br>Metals<br>Sodium / 6010 | |
| RD-19 | D | 13 | VOCs / 8260B<br>Radiochemistry<br>Fluoride / 300.0<br>Metals<br>Sodium / 6010 | | VOCs / 8260B<br>Radiochemistry<br>Fluoride / 300.0<br>Metals<br>Sodium / 6010 | |
| RD-20 | D | 18 | VOCs / 8260B<br>Radiochemistry | | VOCs / 8260B<br>Radiochemistry | |
| RD-32 | N | 1 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M<br>1,2,3-TCP / SRL 524M<br>Perchlorate / 314.0 | | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M<br>1,2,3-TCP / SRL 524M<br>Perchlorate / 314.0 | |

See last page of table for notes and abbreviations.

**TABLE IV**
SITE-WIDE GROUNDWATER MONITORING SCHEDULE, YEAR 1
SANTA SUSANA FIELD LABORATORY
VENTURA COUNTY, CALIFORNIA

| Well ID | Sponsor | GIA | Monitoring Parameters / Analytical Methods | | | |
|---|---|---|---|---|---|---|
| | | | **First Quarter** | **Second Quarter** | **Third Quarter** | **Fourth Quarter** |
| RD-33A | D | 17 | VOCs / 8260B<br>Perchlorate / 314.0<br>Radiochemistry<br>Metals | | VOCs / 8260B<br>Perchlorate / 314.0<br>Radiochemistry<br>Metals | |
| RD-33B | D | 17 | VOCs / 8260B<br>Perchlorate / 314.0<br>Radiochemistry<br>Metals | | VOCs / 8260B<br>Perchlorate / 314.0<br>Radiochemistry<br>Metals | |
| RD-33C | D | 17 | VOCs / 8260B<br>Perchlorate / 314.0<br>Radiochemistry<br>Metals | | VOCs / 8260B<br>Perchlorate / 314.0<br>Radiochemistry<br>Metals | |
| RD-34A | D | 13 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>Radiochemistry<br>Fluoride / 300.0<br>Metals<br>Sodium / 6010 | | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>Radiochemistry<br>Fluoride / 300.0<br>Metals<br>Sodium / 6010 | |
| RD-34B | D | 13 | VOCs / 8260B<br>Radiochemistry<br>Fluoride / 300.0<br>Metals<br>Sodium / 6010 | | VOCs / 8260B<br>Radiochemistry<br>Fluoride / 300.0<br>Metals<br>Sodium / 6010 | |
| RD-34C | D | 13 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>Radiochemistry<br>Fluoride / 300.0<br>Metals<br>Sodium / 6010 | | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>Radiochemistry<br>Fluoride / 300.0<br>Metals<br>Sodium / 6010 | |
| RD-35A | N | 1 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M<br>1,2,3-TCP / SRL 524M<br>Perchlorate / 314.0 | | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M<br>1,2,3-TCP / SRL 524M<br>Perchlorate / 314.0 | |
| RD-35B | N | 1 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M<br>1,2,3-TCP / SRL 524M<br>Perchlorate / 314.0 | | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M<br>1,2,3-TCP / SRL 524M<br>Perchlorate / 314.0 | |
| RD-37 | B | 1 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M<br>1,2,3-TCP / SRL 524M<br>Perchlorate / 314.0 | | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M<br>1,2,3-TCP / SRL 524M<br>Perchlorate / 314.0 | |
| RD-38B | B | 1 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M<br>1,2,3-TCP / SRL 524M<br>Perchlorate / 314.0 | | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M<br>1,2,3-TCP / SRL 524M<br>Perchlorate / 314.0 | |

See last page of table for notes and abbreviations.

| Well ID | Sponsor | GIA | Monitoring Parameters / Analytical Methods | | | |
|---|---|---|---|---|---|---|
| | | | **First Quarter** | **Second Quarter** | **Third Quarter** | **Fourth Quarter** |
| RD-39A | B | 1 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M<br>1,2,3-TCP / SRL 524M<br>Perchlorate / 314.0 | | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M<br>1,2,3-TCP / SRL 524M<br>Perchlorate / 314.0 | |
| RD-39B | B | 1 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M<br>1,2,3-TCP / SRL 524M<br>Perchlorate / 314.0 | | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M<br>1,2,3-TCP / SRL 524M<br>Perchlorate / 314.0 | |
| RD-40 | N | 9 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M | | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M | |
| RD-41B | N | 9 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM | | VOCs / 8260B<br>1,4-Dioxane / 8260SIM | |
| RD-42 | N | 9 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M | | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M | |
| RD-43A | B | 1 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M<br>1,2,3-TCP / SRL 524M<br>Perchlorate / 314.0 | | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M<br>1,2,3-TCP / SRL 524M<br>Perchlorate / 314.0 | |
| RD-43B | B | 1 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M<br>1,2,3-TCP / SRL 524M<br>Perchlorate / 314.0 | | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M<br>1,2,3-TCP / SRL 524M<br>Perchlorate / 314.0 | |
| RD-43C | B | 1 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M<br>1,2,3-TCP / SRL 524M<br>Perchlorate / 314.0 | | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M<br>1,2,3-TCP / SRL 524M<br>Perchlorate / 314.0 | |
| RD-44 | N | 3 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M<br>Hydrazine / DV-WC-0077<br>Formaldehyde / 8315A | | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M<br>Hydrazine / DV-WC-0077<br>Formaldehyde / 8315A | |
| RD-46B | B | 4 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>1,2,3-TCP / SRL 524M<br>Chloride,Nitrate / 300.0<br>Dioxins / 8290 | | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>1,2,3-TCP / SRL 524M<br>Chloride,Nitrate / 300.0 | |
| RD-48A | B | 4 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>1,2,3-TCP / SRL 524M<br>Chloride,Nitrate / 300.0<br>Dioxins / 8290 | | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>1,2,3-TCP / SRL 524M<br>Chloride,Nitrate / 300.0 | |
| RD-48B | B | 4 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>1,2,3-TCP / SRL 524M<br>Chloride,Nitrate / 300.0<br>Dioxins / 8290 | | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>1,2,3-TCP / SRL 524M<br>Chloride,Nitrate / 300.0 | |

See last page of table for notes and abbreviations.

| Well ID | Sponsor | GIA | Monitoring Parameters / Analytical Methods | | | |
|---|---|---|---|---|---|---|
| | | | **First Quarter** | **Second Quarter** | **Third Quarter** | **Fourth Quarter** |
| RD-48C | B | 4 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>1,2,3-TCP / SRL 524M<br>Chloride,Nitrate / 300.0<br>Dioxins / 8290 | | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>1,2,3-TCP / SRL 524M<br>Chloride,Nitrate / 300.0 | |
| RD-50 | D | 17 | VOCs / 8260B<br>Perchlorate / 314.0<br>Perchlorate / 314.0<br>Perchlorate / 314.0 | | VOCs / 8260B<br>Perchlorate / 314.0<br>Radiochemistry<br>Metals | |
| RD-51A | B | 6 | Perchlorate / 314.0<br>Perchlorate / 314.0 | | VOCs / 8260B<br>1,4-Dioxane / 8260SIM | |
| RD-51B | B | 6 | Perchlorate / 314.0<br>Perchlorate / 314.0 | | VOCs / 8260B<br>1,4-Dioxane / 8260SIM | |
| RD-51C | B | 6 | Perchlorate / 314.0 | | VOCs / 8260B | |
| RD-54A | D | 17 | Perchlorate / 314.0<br>Perchlorate / 314.0<br>Radiochemistry<br>Metals | | VOCs / 8260B<br>Perchlorate / 314.0<br>Radiochemistry<br>Metals | |
| RD-56A | N | 7 | VOCs / 8260B<br>1,2,3-TCP / SRL 524M<br>Fluoride / 300.0<br>Radiochemistry | | VOCs / 8260B<br>1,2,3-TCP / SRL 524M<br>Fluoride / 300.0<br>Radiochemistry | |
| RD-56B | N | 7 | VOCs / 8260B<br>1,2,3-TCP / SRL 524M<br>Fluoride / 300.0<br>Radiochemistry | | VOCs / 8260B<br>1,2,3-TCP / SRL 524M<br>Fluoride / 300.0<br>Radiochemistry | |
| RD-57 | D | 17 | VOCs / 8260B<br>Perchlorate / 314.0<br>Radiochemistry<br>Metals | | VOCs / 8260B<br>Perchlorate / 314.0<br>Radiochemistry<br>Metals | |
| RD-58B | B | 9 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M | | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M | |
| RD-58C | B | 9 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M | | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M | |
| RD-59A | D | 13,14,16,17 | VOCs / 8260B<br>Perchlorate / 314.0<br>Radiochemistry<br>Metals<br>Fluoride / 300.0<br>Sodium / 6010 | | VOCs / 8260B<br>Perchlorate / 314.0<br>Radiochemistry<br>Metals<br>Fluoride / 300.0<br>Sodium / 6010 | |
| RD-59B | D | 13,14,16,17 | VOCs / 8260B<br>Perchlorate / 314.0<br>Radiochemistry<br>Metals<br>Fluoride / 300.0<br>Sodium / 6010 | | VOCs / 8260B<br>Perchlorate / 314.0<br>Radiochemistry<br>Metals<br>Fluoride / 300.0<br>Sodium / 6010 | |

| Well ID | Sponsor | GIA | Monitoring Parameters / Analytical Methods | | | |
|---|---|---|---|---|---|---|
| | | | First Quarter | Second Quarter | Third Quarter | Fourth Quarter |
| RD-59C | D | 13,14,16,17 | VOCs / 8260B<br>Perchlorate / 314.0<br>Radiochemistry<br>Metals<br>Fluoride / 300.0<br>Sodium / 6010 | | VOCs / 8260B<br>Perchlorate / 314.0<br>Radiochemistry<br>Metals<br>Fluoride / 300.0<br>Sodium / 6010 | |
| RD-60 | B | 7 | VOCs / 8260B<br>1,2,3-TCP / SRL 524M<br>Fluoride / 300.0<br>Radiochemistry | | VOCs / 8260B<br>1,2,3-TCP / SRL 524M<br>Fluoride / 300.0<br>Radiochemistry | |
| RD-61 | N | 4 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>1,2,3-TCP / SRL 524M<br>Chloride,Nitrate / 300.0<br>Dioxins / 8290 | | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>1,2,3-TCP / SRL 524M<br>Chloride,Nitrate / 300.0 | |
| RD-62 | N | 4 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>1,2,3-TCP / SRL 524M<br>Chloride,Nitrate / 300.0<br>Dioxins / 8290 | | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>1,2,3-TCP / SRL 524M<br>Chloride,Nitrate / 300.0 | |
| RD-63 | D | 13 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>Radiochemistry<br>Fluoride / 300.0<br>Metals<br>Sodium / 6010 | | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>Radiochemistry<br>Fluoride / 300.0<br>Metals<br>Sodium / 6010 | |
| RD-66 | N | 1 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M<br>1,2,3-TCP / SRL 524M<br>Perchlorate / 314.0 | | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M<br>1,2,3-TCP / SRL 524M<br>Perchlorate / 314.0 | |
| RD-67 | N | 9 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M | | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M | |
| RD-68A | N | 7 | VOCs / 8260B<br>1,2,3-TCP / SRL 524M<br>Fluoride / 300.0 | | VOCs / 8260B<br>1,2,3-TCP / SRL 524M<br>Fluoride / 300.0 | |
| RD-68B | N | 7 | VOCs / 8260B<br>1,2,3-TCP / SRL 524M<br>Fluoride / 300.0 | | VOCs / 8260B<br>1,2,3-TCP / SRL 524M<br>Fluoride / 300.0 | |
| RD-69 | N | 5 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM | | VOCs / 8260B<br>1,4-Dioxane / 8260SIM | |
| RD-70 | N | 6 | VOCs / 8260B | | VOCs / 8260B | |
| RD-71 | N | 1 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M<br>1,2,3-TCP / SRL 524M<br>Perchlorate / 314.0 | | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M<br>1,2,3-TCP / SRL 524M<br>Perchlorate / 314.0 | |
| RD-75 | B | 2 | Perchlorate / 314.0 | | Perchlorate / 314.0 | |
| RD-76 | B | 2 | Perchlorate / 314.0 | | Perchlorate / 314.0 | |

See last page of table for notes and abbreviations.

| Well ID | Sponsor | GIA | Monitoring Parameters / Analytical Methods | | | |
|---|---|---|---|---|---|---|
| | | | **First Quarter** | **Second Quarter** | **Third Quarter** | **Fourth Quarter** |
| RD-78 | B | 1 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M<br>1,2,3-TCP / SRL 524M<br>Perchlorate / 314.0 | | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M<br>1,2,3-TCP / SRL 524M<br>Perchlorate / 314.0 | |
| RD-81 | N | 5 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM | | VOCs / 8260B<br>1,4-Dioxane / 8260SIM | |
| RD-83 | N | 6 | VOCs / 8260B | | VOCs / 8260B | |
| RD-85 | D | 13 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>Radiochemistry<br>Fluoride / 300.0<br>Metals<br>Sodium / 6010 | | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>Radiochemistry<br>Fluoride / 300.0<br>Metals<br>Sodium / 6010 | |
| RD-86 | D | 13 | VOCs / 8260B<br>Radiochemistry<br>Fluoride / 300.0<br>Metals<br>Sodium / 6010 | | VOCs / 8260B<br>Radiochemistry<br>Fluoride / 300.0<br>Metals<br>Sodium / 6010 | |
| RD-96 | D | 16 | VOCs / 8260B<br>Radiochemistry | | VOCs / 8260B<br>Radiochemistry | |
| **CHATSWORTH FORMATION WS WELLS** | | | | | | |
| WS-04A | N | 5 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM | | VOCs / 8260B<br>1,4-Dioxane / 8260SIM | |
| WS-09A | N | 9 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M | | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M | |
| **SPRINGS** | | | | | | |
| FDP-835 | B | 9 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M | | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M | |
| FDP-890 | B | 9 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M | | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M | |
| **OFF-SITE (OS) WELLS AND SPRINGS** | | | | | | |
| OS-02 | B | 13,14,16,17 | VOCs / 8260B<br>Fluoride / 300.0<br>Radiochemistry<br>Metals<br>Sodium / 6010 | | | |
| OS-03 | B | 13,14,16,17 | VOCs / 8260B<br>Fluoride / 300.0<br>Radiochemistry<br>Metals<br>Sodium / 6010 | | | |
| OS-04 | B | 13,14,16,17 | VOCs / 8260B<br>Fluoride / 300.0<br>Radiochemistry<br>Metals<br>Sodium / 6010 | | | |

**TABLE IV**
SITE-WIDE GROUNDWATER MONITORING SCHEDULE, YEAR 1
SANTA SUSANA FIELD LABORATORY
VENTURA COUNTY, CALIFORNIA

| Well ID | Sponsor | GIA | Monitoring Parameters / Analytical Methods | | | |
|---|---|---|---|---|---|---|
| | | | First Quarter | Second Quarter | Third Quarter | Fourth Quarter |
| OS-05 | B | 13,14,16,17 | VOCs / 8260B<br>Fluoride / 300.0<br>Radiochemistry<br>Metals<br>Sodium / 6010 | | | |
| OS-09 | B | 6 | VOCs / 8260B | | | |
| OS-09R | B | 6 | VOCs / 8260B | | | |
| OS-13 | N | 1 | VOCs / 8260B | | | |
| OS-16 | N | 1 | VOCs / 8260B | | | |
| OS-25 | N | 1 | VOCs / 8260B | | | |
| OS-26 | N | 1 | VOCs / 8260B | | | |

See last page of table for notes and abbreviations.

**Site-Wide Groundwater Monitoring Parameters / Methods**

| Analytes | | EPA Methodology | |
|---|---|---|---|
| 1,2,3-TCP / SRL 524M | = | EPA method 524 for 1,2,3-trichloropropane | |
| 1,4-Dioxane / 8260SIM | = | Modified SW846 method 8260B for 1,4-dioxane | |
| Chloride,Nitrate / 300.0 | = | EPA method 300.0 | |
| Dioxins / 8290 | = | EPA method 8290 | |
| Fluoride / 300.0 | = | EPA method 300.0 | |
| Formaldehyde / 8315A | = | EPA method 8315A | |
| Hydrazine / DV-WC-0077 | = | SW-846 8315M, 8315A, 9056M, or DV-WC-0077 | |
| Metals | = | SW846 method 6010/6020 for metals | |
| | | (Sb, As, Ba, Be, Cd, Cr, Co, Cu, Pb, Ni, Se, Ag, Tl, Sn, V, Zn) | |
| NDMA / 1625M | = | Modified EPA method 1625 for N-nitrosodimethylamine (NDMA) | |
| Perchlorate / 314.0 | = | EPA methods 314.0, 331.0, or 332.0, or SW846 methods 6850, 6860, or 8321 | |
| Radiochemistry | = | Radionuclides | EPA Method |
| | | Gamma-emitting radionuclides | 901.1 |
| | | Gross Alpha and Gross Beta | 900.0 |
| | | Strontium-90 (Sr-90) | 905.0 |
| | | Tritium | 906.0 |
| | | Isotopic Uranium | 908.0 |
| Sodium / 6010 | = | SW846 method 6010 | |
| VOCs / 8260B | = | SW846 method 8260B for volatile organic compounds (most recent version). | |
| | | 1,1,1-trichloroethane | |
| | | 1,1,2-trichloro-1,2,2-trifluoroethane | |
| | | 1,1,2-trichloroethane | |
| | | 1,1-dichloroethane | |
| | | 1,1-dichloroethene | |
| | | 1,2-dichloroethane | |
| | | acetone | |
| | | benzene | |
| | | carbon tetrachloride | |
| | | chloroform | |
| | | cis-1,2-dichloroethene | |
| | | ethylbenzene | |
| | | methyl ethyl ketone | |
| | | methylene chloride | |
| | | tetrachloroethene (PCE) | |
| | | toluene | |
| | | trans-1,2-dichloroethene | |
| | | trichloroethene (TCE) | |
| | | trichlorofluoromethane | |
| | | vinyl chloride | |
| | | xylenes | |

Note: An equivalent or superior in-house laboratory procedure will be considered acceptable for EPA or SW846 methodology. Lab will use the most current promulgated version of each EPA or SW846 method.

**TABLE V**
SITE-WIDE GROUNDWATER MONITORING SCHEDULE, AFTER YEAR 1
SANTA SUSANA FIELD LABORATORY
VENTURA COUNTY, CALIFORNIA

| Well ID | Sponsor | GIA | Monitoring Parameters / Analytical Methods | | | |
|---|---|---|---|---|---|---|
| | | | First Quarter | Second Quarter | Third Quarter | Fourth Quarter |
| **NEAR-SURFACE GROUNDWATER PIEZOMETERS** | | | | | | |
| PZ-074 | B | 2 | Perchlorate / 314.0 | | | |
| PZ-076 | B | 4 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>1,2,3-TCP / SRL 524M<br>Chloride,Nitrate / 300.0<br>Dioxins / 8290 | | | |
| PZ-077 | B | 4 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>1,2,3-TCP / SRL 524M<br>Chloride,Nitrate / 300.0<br>Dioxins / 8290 | | | |
| PZ-078 | B | 4 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>1,2,3-TCP / SRL 524M<br>Chloride,Nitrate / 300.0<br>Dioxins / 8290 | | | |
| PZ-095 | N | 5 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM | | | |
| PZ-097 | D | 17 | VOCs / 8260B<br>Perchlorate / 314.0<br>Radiochemistry<br>Metals | | | |
| PZ-108 | D | 15 | VOCs / 8260B<br>Metals | | | |
| PZ-123 | B | 2 | Perchlorate / 314.0 | | | |
| PZ-124 | D | 16 | VOCs / 8260B<br>Radiochemistry | | | |
| **NEAR-SURFACE GROUNDWATER ES WELLS** | | | | | | |
| ES-01 | B | 4 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>1,2,3-TCP / SRL 524M<br>Chloride,Nitrate / 300.0<br>Dioxins / 8290 | | | |
| ES-14 | B | 12 | VOCs / 8260B<br>Chloride,Nitrate / 300.0 | | | |
| ES-29 | B | 12 | VOCs / 8260B<br>Chloride,Nitrate / 300.0 | | | |
| **NEAR-SURFACE GROUNDWATER RS WELLS** | | | | | | |
| RS-18 | D | 17 | VOCs / 8260B<br>Perchlorate / 314.0<br>Radiochemistry<br>Metals | | | |
| RS-20 | B | 1 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M<br>1,2,3-TCP / SRL 524M<br>Perchlorate / 314.0 | | | |
| **CHATSWORTH FORMATION RD WELLS** | | | | | | |
| RD-01 | B | 1 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>Perchlorate / 314.0 | | | |

See last page of table for notes and abbreviations.

| Well ID | Sponsor | GIA | Monitoring Parameters / Analytical Methods | | | |
|---|---|---|---|---|---|---|
| | | | First Quarter | Second Quarter | Third Quarter | Fourth Quarter |
| RD-02 | B | 3 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M<br>Hydrazine / DV-WC-0077<br>Formaldehyde / 8315A | | | |
| RD-03 | B | 4 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>Chloride,Nitrate / 300.0<br>Dioxins / 8290 | | | |
| RD-05A | N | 9 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M | | | |
| RD-05B | N | 9 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M | | | |
| RD-05C | N | 9 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M | | | |
| RD-06 | B | 9 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M | | | |
| RD-07 | D | 16 | VOCs / 8260B<br>Radiochemistry | | | |
| RD-09 | B | 6 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM | | | |
| RD-10 | N | 1,2 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>Perchlorate / 314.0 | | | |
| RD-13 | D | 18 | VOCs / 8260B<br>Radiochemistry | | | |
| RD-14 | D | 7 | VOCs / 8260B<br>1,2,3-TCP / SRL 524M<br>Fluoride / 300.0<br>Radiochemistry | | | |
| RD-18 | D | 13 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>Radiochemistry<br>Fluoride / 300.0<br>Metals<br>Sodium / 6010 | | | |
| RD-19 | D | 13 | VOCs / 8260B<br>Radiochemistry<br>Fluoride / 300.0<br>Metals<br>Sodium / 6010 | | | |
| RD-20 | D | 18 | VOCs / 8260B<br>Radiochemistry | | | |
| RD-32 | N | 1 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M<br>1,2,3-TCP / SRL 524M<br>Perchlorate / 314.0 | | | |

See last page of table for notes and abbreviations.

| Well ID | Sponsor | GIA | Monitoring Parameters / Analytical Methods | | | |
|---|---|---|---|---|---|---|
| | | | **First Quarter** | **Second Quarter** | **Third Quarter** | **Fourth Quarter** |
| RD-33A | D | 17 | VOCs / 8260B<br>Perchlorate / 314.0<br>Radiochemistry<br>Metals | | | |
| RD-33B | D | 17 | VOCs / 8260B<br>Perchlorate / 314.0<br>Radiochemistry<br>Metals | | | |
| RD-33C | D | 17 | VOCs / 8260B<br>Perchlorate / 314.0<br>Radiochemistry<br>Metals | | | |
| RD-34A | D | 13 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>Radiochemistry<br>Fluoride / 300.0<br>Metals<br>Sodium / 6010 | | | |
| RD-34B | D | 13 | VOCs / 8260B<br>Radiochemistry<br>Fluoride / 300.0<br>Metals<br>Sodium / 6010 | | | |
| RD-34C | D | 13 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>Radiochemistry<br>Fluoride / 300.0<br>Metals<br>Sodium / 6010 | | | |
| RD-35A | N | 1 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M<br>1,2,3-TCP / SRL 524M<br>Perchlorate / 314.0 | | | |
| RD-35B | N | 1 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M<br>1,2,3-TCP / SRL 524M<br>Perchlorate / 314.0 | | | |
| RD-37 | B | 1 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M<br>1,2,3-TCP / SRL 524M<br>Perchlorate / 314.0 | | | |
| RD-38B | B | 1 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M<br>1,2,3-TCP / SRL 524M<br>Perchlorate / 314.0 | | | |

| Well ID | Sponsor | GIA | Monitoring Parameters / Analytical Methods | | | |
|---|---|---|---|---|---|---|
| | | | **First Quarter** | **Second Quarter** | **Third Quarter** | **Fourth Quarter** |
| RD-39A | B | 1 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M<br>1,2,3-TCP / SRL 524M<br>Perchlorate / 314.0 | | | |
| RD-39B | B | 1 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M<br>1,2,3-TCP / SRL 524M<br>Perchlorate / 314.0 | | | |
| RD-40 | N | 9 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M | | | |
| RD-41B | N | 9 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM | | | |
| RD-42 | N | 9 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M | | | |
| RD-43A | B | 1 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M<br>1,2,3-TCP / SRL 524M<br>Perchlorate / 314.0 | | | |
| RD-43B | B | 1 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M<br>1,2,3-TCP / SRL 524M<br>Perchlorate / 314.0 | | | |
| RD-43C | B | 1 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M<br>1,2,3-TCP / SRL 524M<br>Perchlorate / 314.0 | | | |
| RD-44 | N | 3 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M<br>Hydrazine / DV-WC-0077<br>Formaldehyde / 8315A | | | |
| RD-46B | B | 4 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>1,2,3-TCP / SRL 524M<br>Chloride,Nitrate / 300.0<br>Dioxins / 8290 | | | |
| RD-48A | B | 4 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>1,2,3-TCP / SRL 524M<br>Chloride,Nitrate / 300.0<br>Dioxins / 8290 | | | |
| RD-48B | B | 4 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>1,2,3-TCP / SRL 524M<br>Chloride,Nitrate / 300.0<br>Dioxins / 8290 | | | |

See last page of table for notes and abbreviations.

| Well ID | Sponsor | GIA | Monitoring Parameters / Analytical Methods<br>First Quarter | Second Quarter | Third Quarter | Fourth Quarter |
|---|---|---|---|---|---|---|
| RD-48C | B | 4 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>1,2,3-TCP / SRL 524M<br>Chloride,Nitrate / 300.0<br>Dioxins / 8290 | | | |
| RD-50 | D | 17 | VOCs / 8260B<br>Perchlorate / 314.0<br>Perchlorate / 314.0<br>Perchlorate / 314.0 | | | |
| RD-51A | B | 6 | Perchlorate / 314.0<br>Perchlorate / 314.0 | | | |
| RD-51B | B | 6 | Perchlorate / 314.0<br>Perchlorate / 314.0 | | | |
| RD-51C | B | 6 | Perchlorate / 314.0 | | | |
| RD-54A | D | 17 | Perchlorate / 314.0<br>Perchlorate / 314.0<br>Radiochemistry<br>Metals | | | |
| RD-56A | N | 7 | VOCs / 8260B<br>1,2,3-TCP / SRL 524M<br>Fluoride / 300.0<br>Radiochemistry | | | |
| RD-56B | N | 7 | VOCs / 8260B<br>1,2,3-TCP / SRL 524M<br>Fluoride / 300.0<br>Radiochemistry | | | |
| RD-57 | D | 17 | VOCs / 8260B<br>Perchlorate / 314.0<br>Radiochemistry<br>Metals | | | |
| RD-58B | B | 9 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M | | | |
| RD-58C | B | 9 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M | | | |
| RD-59A | D | 13,14,16,17 | VOCs / 8260B<br>Perchlorate / 314.0<br>Radiochemistry<br>Metals<br>Fluoride / 300.0<br>Sodium / 6010 | | | |
| RD-59B | D | 13,14,16,17 | VOCs / 8260B<br>Perchlorate / 314.0<br>Radiochemistry<br>Metals<br>Fluoride / 300.0<br>Sodium / 6010 | | | |

See last page of table for notes and abbreviations.

| Well ID | Sponsor | GIA | Monitoring Parameters / Analytical Methods | | | |
|---|---|---|---|---|---|---|
| | | | **First Quarter** | **Second Quarter** | **Third Quarter** | **Fourth Quarter** |
| RD-59C | D | 13,14,16,17 | VOCs / 8260B<br>Perchlorate / 314.0<br>Radiochemistry<br>Metals<br>Fluoride / 300.0<br>Sodium / 6010 | | | |
| RD-60 | B | 7 | VOCs / 8260B<br>1,2,3-TCP / SRL 524M<br>Fluoride / 300.0<br>Radiochemistry | | | |
| RD-61 | N | 4 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>1,2,3-TCP / SRL 524M<br>Chloride,Nitrate / 300.0<br>Dioxins / 8290 | | | |
| RD-62 | N | 4 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>1,2,3-TCP / SRL 524M<br>Chloride,Nitrate / 300.0<br>Dioxins / 8290 | | | |
| RD-63 | D | 13 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>Radiochemistry<br>Fluoride / 300.0<br>Metals<br>Sodium / 6010 | | | |
| RD-66 | N | 1 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M<br>1,2,3-TCP / SRL 524M<br>Perchlorate / 314.0 | | | |
| RD-67 | N | 9 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M | | | |
| RD-68A | N | 7 | VOCs / 8260B<br>1,2,3-TCP / SRL 524M<br>Fluoride / 300.0 | | | |
| RD-68B | N | 7 | VOCs / 8260B<br>1,2,3-TCP / SRL 524M<br>Fluoride / 300.0 | | | |
| RD-69 | N | 5 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM | | | |
| RD-70 | N | 6 | VOCs / 8260B | | | |
| RD-71 | N | 1 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M<br>1,2,3-TCP / SRL 524M<br>Perchlorate / 314.0 | | | |
| RD-75 | B | 2 | Perchlorate / 314.0 | | | |
| RD-76 | B | 2 | Perchlorate / 314.0 | | | |

See last page of table for notes and abbreviations.

| **Well ID** | **Sponsor** | **GIA** | **Monitoring Parameters / Analytical Methods** | | | |
|---|---|---|---|---|---|---|
| | | | **First Quarter** | **Second Quarter** | **Third Quarter** | **Fourth Quarter** |
| RD-78 | B | 1 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M<br>1,2,3-TCP / SRL 524M<br>Perchlorate / 314.0 | | | |
| RD-81 | N | 5 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM | | | |
| RD-83 | N | 6 | VOCs / 8260B | | | |
| RD-85 | D | 13 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>Radiochemistry<br>Fluoride / 300.0<br>Metals<br>Sodium / 6010 | | | |
| RD-86 | D | 13 | VOCs / 8260B<br>Radiochemistry<br>Fluoride / 300.0<br>Metals<br>Sodium / 6010 | | | |
| RD-96 | D | 16 | VOCs / 8260B<br>Radiochemistry | | | |
| **CHATSWORTH FORMATION WS WELLS** | | | | | | |
| WS-04A | N | 5 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM | | | |
| WS-09A | N | 9 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M | | | |
| **SPRINGS** | | | | | | |
| FDP-835 | B | 9 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M | | | |
| FDP-890 | B | 9 | VOCs / 8260B<br>1,4-Dioxane / 8260SIM<br>NDMA / 1625M | | | |
| **OFF-SITE (OS) WELLS AND SPRINGS** | | | | | | |
| OS-02 | B | 13,14,16,17 | VOCs / 8260B<br>Fluoride / 300.0<br>Radiochemistry<br>Metals<br>Sodium / 6010 | | | |
| OS-03 | B | 13,14,16,17 | VOCs / 8260B<br>Fluoride / 300.0<br>Radiochemistry<br>Metals<br>Sodium / 6010 | | | |
| OS-04 | B | 13,14,16,17 | VOCs / 8260B<br>Fluoride / 300.0<br>Radiochemistry<br>Metals<br>Sodium / 6010 | | | |

See last page of table for notes and abbreviations.

**TABLE V**
SITE-WIDE GROUNDWATER MONITORING SCHEDULE, AFTER YEAR 1
SANTA SUSANA FIELD LABORATORY
VENTURA COUNTY, CALIFORNIA

| Well ID | Sponsor | GIA | Monitoring Parameters / Analytical Methods | | | |
|---|---|---|---|---|---|---|
| | | | First Quarter | Second Quarter | Third Quarter | Fourth Quarter |
| OS-05 | B | 13,14,16,17 | VOCs / 8260B<br>Fluoride / 300.0<br>Radiochemistry<br>Metals<br>Sodium / 6010 | | | |
| OS-09 | B | 6 | VOCs / 8260B | | | |
| OS-09R | B | 6 | VOCs / 8260B | | | |
| OS-13 | N | 1 | VOCs / 8260B | | | |
| OS-16 | N | 1 | VOCs / 8260B | | | |
| OS-25 | N | 1 | VOCs / 8260B | | | |
| OS-26 | N | 1 | VOCs / 8260B | | | |

See last page of table for notes and abbreviations.

**Site-Wide Groundwater Monitoring Parameters / Methods**

| Analytes | | EPA Methodology | |
|---|---|---|---|
| 1,2,3-TCP / SRL 524M | = | EPA method 524 for 1,2,3-trichloropropane | |
| 1,4-Dioxane / 8260SIM | = | Modified SW846 method 8260B for 1,4-dioxane | |
| Chloride,Nitrate / 300.0 | = | EPA method 300.0 | |
| Dioxins / 8290 | = | EPA method 8290 | |
| Fluoride / 300.0 | = | EPA method 300.0 | |
| Formaldehyde / 8315A | = | EPA method 8315A | |
| Hydrazine / DV-WC-0077 | = | SW-846 8315M, 8315A, 9056M, or DV-WC-0077 | |
| Metals | = | SW846 method 6010/6020 for metals | |
| | | (Sb, As, Ba, Be, Cd, Cr, Co, Cu, Pb, Ni, Se, Ag, Tl, Sn, V, Zn) | |
| NDMA / 1625M | = | Modified EPA method 1625 for N-nitrosodimethylamine (NDMA) | |
| Perchlorate / 314.0 | = | EPA methods 314.0, 331.0, or 332.0, or SW846 methods 6850, 6860, or 8321 | |
| Radiochemistry | = | Radionuclides | EPA Method |
| | | Gamma-emitting radionuclides | 901.1 |
| | | Gross Alpha and Gross Beta | 900.0 |
| | | Strontium-90 (Sr-90) | 905.0 |
| | | Tritium | 906.0 |
| | | Isotopic Uranium | 908.0 |
| Sodium / 6010 | = | SW846 method 6010 | |
| VOCs / 8260B | = | SW846 method 8260B for volatile organic compounds (most recent version). | |
| | | 1,1,1-trichloroethane | |
| | | 1,1,2-trichloro-1,2,2-trifluoroethane | |
| | | 1,1,2-trichloroethane | |
| | | 1,1-dichloroethane | |
| | | 1,1-dichloroethene | |
| | | 1,2-dichloroethane | |
| | | acetone | |
| | | benzene | |
| | | carbon tetrachloride | |
| | | chloroform | |
| | | cis-1,2-dichloroethene | |
| | | ethylbenzene | |
| | | methyl ethyl ketone | |
| | | methylene chloride | |
| | | tetrachloroethene (PCE) | |
| | | toluene | |
| | | trans-1,2-dichloroethene | |
| | | trichloroethene (TCE) | |
| | | trichlorofluoromethane | |
| | | vinyl chloride | |
| | | xylenes | |

Note: An equivalent or superior in-house laboratory procedure will be considered acceptable for EPA or SW846 methodology. Lab will use the most current promulgated version of each EPA or SW846 method.

Wells and analyses listed would be re-evaluated after the first year.

**TABLE VI**
WATER LEVEL MONITORING PROGRAM
WELL CONSTRUCTION DETAILS
SANTA SUSANA FIELD LABORATORY
VENTURA COUNTY, CALIFORNIA

| | | | Borehole | | Casing | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Well Identifier** | **Geological Unit** | **Effective Borehole Depth (ft BLS)** | **Diameter (inches)** | **Interval (ft BLS)** | **Inside Diameter (inches)** | **Interval (ft BLS)** | **Sealed Interval (ft BLS)** | **Perforated Interval (ft BLS)** | **Measuring Point Elevation (ft MSL)** | **Low-Flow Pump Type** | **Low-Flow Pump Setting[1] (ft BLS)** | **Sponsor** |
| ES-01 | Near Surface | 26 | 15 | 0 - 26 | 6 | (v)1.3 - 25.5 | 0 - 6 | 15.5 - 25.5 | 1782.20 | Bladder | 24 (2) | Boeing |
| ES-02 | Near Surface | 17.5 | 15 | 0 - 17.5 | 6 | (v)1.5 - 16.7 | 0 - 4.8 | 6.7 - 16.7 | 1814.60 | --- | --- | Boeing |
| ES-03 | Near Surface | 27 | 15 | 0 - 27 | 6 | (v)1.3 - 27 | 0 - 9.4 | 17 - 27 | 1783.39 | --- | --- | Boeing |
| ES-04 | Near Surface | 20 | 15 | 0 - 20 | 6 | (v)1.4 - 20 | 0 - 4 | 5.8 - 20 | 1817.24 | --- | --- | Boeing |
| ES-05 | Near Surface | 19 | 15 | 0 - 19 | 6 | (v)1.3 - 19 | 0 - 5.8 | 9 - 19 | 1818.13 | --- | --- | Boeing |
| ES-06 | Near Surface | 25 | 15 | 0 - 25 | 6 | 0 - 25 | 0 - 5.6 | 11.6 - 25 | 1825.41 | --- | --- | Boeing |
| ES-07 | Near Surface | 23.2 | 15 | 0 - 23.2 | 6 | 0 - 23.2 | 0 - 6.5 | 8.5 - 23.2 | 1826.53 | --- | --- | Boeing |
| ES-08 | Near Surface | 24.1 | 15 | 0 - 24.1 | 6 | 0.6 - 24.1 | 0 - 4.7 | 12.1 - 24.1 | 1826.60 | --- | --- | Boeing |
| ES-09 | Near Surface | 24.2 | 15 | 0 - 24.2 | 6 | 0 - 24.2 | 0 - 3.4 | 11.9 - 24.2 | 1827.80 | --- | --- | Boeing |
| ES-10 | Near Surface | 20 | 15 | 0 - 20 | 6 | 0 - 20 | 0 - 5 | 9.7 - 20 | 1829.46 | --- | --- | Boeing |
| ES-11 | Near Surface | 27 | 15 | 0 - 27 | 6 | 0 - 27 | 0 - 4.2 | 7.2 - 27 | 1835.07 | --- | --- | Boeing |
| ES-12 | Near Surface | 22.5 | 15 | 0 - 22.5 | 6 | 0 - 22.5 | 0 - 6.9 | 10.9 - 22.5 | 1838.19 | --- | --- | Boeing |
| ES-13 | Near Surface | 30 | 15 | 0 - 30 | 6 | (v)1.2 - 23.6 | 0 - 3.1 | 6 - 23.6 | 1782.58 | --- | --- | Boeing |
| ES-14 | Near Surface | 24.6 | 15 | 0 - 24.6 | 6 | 0 - 23.5 | 0 - 9.4 | 12.9 - 23.5 | 1728.69 | Bladder | 22 (2) | Boeing |
| ES-15 | Near Surface | 24 | 15 | 0 - 24 | 6 | 0 - 24 | 0 -10.8 | 13.5 - 24 | 1730.21 | --- | --- | Boeing |
| ES-16 | Near Surface | 24.8 | 15 | 0 - 24.8 | 6 | 0 - 24.8 | 0 - 4.3 | 8.1 - 24.8 | 1737.90 | --- | --- | Boeing |
| ES-17 | Near Surface | 28 | 15 | 0 - 28 | 6 | 0 - 28 | 0 - 7.9 | 10.4 - 28 | 1739.31(A) | Bladder | 28.2 | Boeing |
| ES-18 | Near Surface | 35 | 15 | 0 - 35 | 6 | 0 - 26.9 | 0 - 9.1 | 12.9 - 26.9 | 1770.25 | --- | --- | Boeing |
| ES-19 | Near Surface | 33 | 15 | 0 - 33 | 6 | 0 - 26.3 | 0 - 6.3 | 10.3 - 26.3 | 1769.44 | --- | --- | Boeing |
| ES-20 | Near Surface | 35 | 15 | 0 - 35 | 6 | 0 - 23 | 0 - 3.5 | 9.8 - 23 | 1770.58 | --- | --- | Boeing |
| ES-21 | Near Surface | 35 | 12 | 0 - 35 | 6 | 0 - 35 | 0 - 2.2 | 15.8 - 35 | 1769.62 | --- | --- | Boeing |
| ES-22 | Near Surface | 35.5 | 12 | 0 - 35.5 | 6 | 0 - 35.5 | 0 - 5.2 | 17.5 - 35.5 | 1770.93 | --- | --- | Boeing |
| ES-23 | Near Surface | 20 | 12 | 0 - 20 | 6 | 0 - 20 | 0 - 2.4 | 10.6 - 20 | 1760.73 | --- | --- | Boeing |
| ES-24 | Near Surface | 30 | 12 | 0 - 30 | 6 | 0 - 30 | 0 -11.7 | 18.3 - 30 | 1728.67 | --- | --- | Boeing |
| ES-25 | Near Surface | 35 | 12 | 0 - 35 | 6 | 0 - 35 | 0 - 9.2 | 19.5 - 35 | 1737.78 | --- | --- | Boeing |
| ES-26 | Near Surface | 35 | 12 | 0 - 35 | 6 | 0 - 34.5 | 0 - 8.7 | 17.5 - 34.5 | 1748.01(A) | Bladder | 34.5 | Boeing |
| ES-27 | Near Surface | 35 | 12 | 0 - 35 | 6 | 0 - 35 | 0 - 9.5 | 15.3 - 35 | 1740.67(A) | Bladder | 35.8 | Boeing |
| ES-28 | Near Surface | 21 | 12 | 0 - 21 | 6 | 0 - 21 | 0 - 1.7 | 8.9 - 21 | 1759.15 | --- | --- | Boeing |
| ES-29 | Near Surface | 28 | 12 | 0 - 28 | 6 | 0 - 28 | 0 - 8.4 | 11.6 - 28 | 1760.47 | Bladder | 21 (2) | Boeing |
| ES-30 | Near Surface | 25 | 12 | 0 - 25 | 6 | 0 - 25 | 0 - 5.5 | 10.1 - 25 | 1759.51 | --- | --- | Boeing |
| ES-31 | Near Surface | 25 | 12 | 0 - 25 | 6 | 0 - 25 | 0 - 9.7 | 11.6 - 25 | 1787.01 | --- | --- | DOE |
| ES-32 | Near Surface | 25 | 12 | 0 - 25 | 6 | 0 - 21.5 | 0 - 4.6 | 7.5 - 21.5 | 1740.65 | --- | --- | Boeing |

See last page of table for notes and abbreviations.

**TABLE VI**
WATER LEVEL MONITORING PROGRAM
WELL CONSTRUCTION DETAILS
SANTA SUSANA FIELD LABORATORY
VENTURA COUNTY, CALIFORNIA

| | | | Borehole | | Casing | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Well Identifier | Geological Unit | Effective Borehole Depth (ft BLS) | Diameter (inches) | Interval (ft BLS) | Inside Diameter (inches) | Interval (ft BLS) | Sealed Interval (ft BLS) | Perforated Interval (ft BLS) | Measuring Point Elevation (ft MSL) | Low-Flow Pump Type | Low-Flow Pump Setting[1] (ft BLS) | Sponsor |
| HAR-01 | Chatsworth Formation | 110 | 15 | 0 - 30 | 10-1/8 | 0 - 30 | 0 - 30 | | 1874.13(A) | Bladder | 86.4 | Boeing |
| | | | 8 | 30 - 110 | --- | --- | | Open Hole | | | | |
| HAR-02 | Near Surface | 30 | 8 | 0 - 30 | 4 | -1.1 - 30[c] | 0 - 6.2 | 15.4 - 30 | 1886.38 | Bladder[3] | --- | Boeing |
| HAR-03 | Near Surface | 30 | 8 | 0 - 30 | 4 | 0 - 30 | 0 - 6.2 | 14.7 - 30 | 1875.48(A) | Bladder | 29.3 | Boeing |
| HAR-04 | Near Surface | 29 | 8 | 0 - 29 | 4 | 0 - 29 | 0 - 6.4 | 12.1 - 29 | 1873.40(A) | Bladder | 26.4 | Boeing |
| HAR-05 | Chatsworth Formation | 180 | 15 | 0 - 30 | 10-1/8 | 0 - 30 | 0 - 30 | | 1812.65(A) | Bladder | 26.5-151.5* | NASA |
| | | | 8 | 30 - 180 | --- | --- | | Open Hole | | | | |
| HAR-06 | Chatsworth Formation | 160 | 15 | 0 - 30 | 10-1/8 | 0 - 30 | 0 - 30 | | 1815.03 | --- | --- | NASA |
| | | | 8 | 30 - 160 | --- | --- | | Open Hole | | | | |
| HAR-07 | Chatsworth Formation | 100 | 15 | 0 - 30 | 10-1/8 | 0 - 30 | 0 - 30 | | 1728.38(A) | Bladder | 87.8 | NASA |
| | | | 8 | 30 - 100 | --- | --- | | Open Hole | | | | |
| HAR-08 | Chatsworth Formation | 130 | 15 | 0 - 30 | 10-1/8 | 0 - 30 | 0 - 30 | | 1730.75(A) | Bladder | 90.6 | NASA |
| | | | 8 | 30 - 130 | --- | --- | | Open Hole | | | | |
| HAR-09 | Near Surface | 30.5 | 8 | 0 - 30.5 | 4 | 0 - 30.5 | 0 - 5.9 | 16.1 - 30.5 | 1820.62(A) | Bladder | 23.9 | NASA |
| HAR-11 | Near Surface | 31 | 8 | 0 - 31 | 4 | 0 - 31 | 0 - 5 | 11.2 - 31 | 1827.90(A) | Bladder | 30 | NASA |
| HAR-12 | Near Surface | 30.5 | 8 | 0 - 30.5 | 4 | 0 - 30.5 | 0 - 3.5 | 15.5 - 30.5 | 1796.73(A) | Bladder | 27.1 | NASA |
| HAR-13 | Near Surface | 31.6 | 8 | 0 - 31.6 | 4 | 0 - 31.6 | 0 - 5.5 | 17.4 - 31.6 | 1801.18(A) | Bladder | 31.5 | NASA |
| HAR-14 | Near Surface | 40 | 8 | 0 - 40 | 4 | 0 - 40 | 0 - 5.5 | 11.8 - 40 | 1797.02(A) | Bladder | 31.6 | NASA |
| HAR-15 | Near Surface | 40 | 8 | 0 - 40 | 4 | 0 - 40 | 0 - 5 | 10.2 - 40 | 1809.69(A) | Bladder | 36.1 | NASA |
| HAR-16 | Chatsworth Formation | 120 | 15 | 0 - 30 | 10-1/8 | 0 - 30 | 0 - 30 | | 1872.31(A) | Bladder | 88.6 | Boeing |
| | | | 8 | 30 - 120 | --- | --- | | Open Hole | | | | |
| HAR-17 | Chatsworth Formation | 100 | 15 | 0 - 30 | 10-1/8 | 0 - 30 | 0 - 30 | | 1711.59 | --- | --- | Boeing |
| | | | 8 | 30 - 100 | --- | --- | | Open Hole | | | | |
| HAR-18 | Chatsworth Formation | 80 | 15 | 0 - 30 | 10-1/8 | 0 - 30 | 0 - 30 | | 1749.41 | --- | --- | Boeing |
| | | | 8 | 30 - 80 | --- | --- | | Open Hole | | | | |
| HAR-19 | Chatsworth Formation | 220[a] | 15 | 0 - 30 | 10-1/8 | 0 - 30 | 0 - 30 | | 1833.42(A) | Bladder | 208 | NASA |
| | | | 8 | 30 - 220 | --- | --- | | Open Hole | | | | |
| HAR-20 | Chatsworth Formation | 230 | 15 | 0 - 30 | 10-1/8 | 0 - 30 | 0 - 30 | | 1830.47(A) | Bladder | 211 | NASA |
| | | | 8 | 30 - 230 | --- | --- | | Open Hole | | | | |
| HAR-21 | Chatsworth Formation | 130 | 15 | 0 - 30 | 10-1/8 | 0 - 30 | 0 - 30 | | 1821.30(A) | Bladder | 43-109* | NASA |
| | | | 8 | 30 - 130 | --- | --- | | Open Hole | | | | |
| HAR-22 | Chatsworth Formation | 90 | 15 | 0 - 30 | 10-1/8 | 0 - 30 | 0 - 30 | | 1816.41 | --- | --- | NASA |
| | | | 8 | 30 - 90 | --- | --- | | Open Hole | | | | |

See last page of table for notes and abbreviations.

**TABLE VI**
WATER LEVEL MONITORING PROGRAM
WELL CONSTRUCTION DETAILS
SANTA SUSANA FIELD LABORATORY
VENTURA COUNTY, CALIFORNIA

| | | | Borehole | | Casing | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Well Identifier** | **Geological Unit** | **Effective Borehole Depth (ft BLS)** | **Diameter (inches)** | **Interval (ft BLS)** | **Inside Diameter (inches)** | **Interval (ft BLS)** | **Sealed Interval (ft BLS)** | **Perforated Interval (ft BLS)** | **Measuring Point Elevation (ft MSL)** | **Low-Flow Pump Type** | **Low-Flow Pump Setting[1] (ft BLS)** | **Sponsor** |
| HAR-23 | Chatsworth Formation | 90 | 15 | 0 - 30 | 10-1/8 | 0 - 30 | 0 - 30 | | 1805.87(A) | Bladder | 63 | NASA |
| | | | 8 | 30 - 90 | --- | --- | | Open Hole | | | | |
| HAR-24 | Chatsworth Formation | 110 | 15 | 0 - 30 | 10-1/8 | 0 - 30 | 0 - 30 | | 1906.89 | --- | --- | Boeing |
| | | | 8 | 30 - 110 | --- | --- | | Open Hole | | | | |
| HAR-25 | Chatsworth Formation | 90 | 15 | 0 - 30 | 10-1/8 | 0 - 30 | 0 - 30 | | 1889.75(A) | Bladder | 84.9 | Boeing |
| | | | 8 | 30 - 90 | --- | --- | | Open Hole | | | | |
| HAR-26 | Chatsworth Formation | 90 | 15 | 0 - 30 | 10-1/8 | 0 - 30 | 0 - 30 | | 1763.23(A) | Bladder | 61.5 | Boeing |
| | | | 8 | 30 - 90 | --- | --- | | Open Hole | | | | |
| HAR-27 | Near Surface | 40 | 8 | 0 - 40 | 4 | 0 - 40 | 0 - 3 | 21 - 40 | 1719.39(A) | Bladder | 39.2 | NASA |
| HAR-28 | Near Surface | 40 | 8 | 0 - 40 | 4 | 0 - 40 | 0 - 6 | 20 - 40 | 1720.17(A) | Bladder | 38.3 | NASA |
| HAR-29 | Near Surface | 40.2 | 8 | 0 - 40.2 | 4 | 0 - 40.2 | 0 - 7 | 20 - 40.2 | 1724.13(A) | Bladder | 39 | NASA |
| HAR-30 | Near Surface | 35 | 8 | 0 - 35 | 4 | 0 - 35 | 0 - 6.5 | 14 - 35 | 1806.47(A) | Bladder | 31.4 | NASA |
| HAR-31 | Near Surface | 40 | 8 | 0 - 40 | 4 | 0 - 40 | 0 - 6 | 22 - 40 | 1812.45(A) | Bladder | 40 | NASA |
| HAR-32 | Near Surface | 40 | 8 | 0 - 40 | 4 | 0 - 40 | 0 - 6 | 21 - 40 | 1736.58(A) | Bladder | 38.0 | Boeing |
| HAR-33 | Near Surface | 35 | 8 | 0 - 35 | 4 | 0 - 35 | 0 - 6 | 18 - 35 | 1744.66(A) | Bladder | 34.3 | Boeing |
| HAR-34 | Near Surface | 23 | 8 | 0 - 23 | 4 | 0 - 23 | 0 - 3 | 9 - 23 | 1751.17 | --- | --- | Boeing |
| OS-02 | Chatsworth Formation | 700 | Unknown | Unknown | 10 | 0 - 17 | 0 - 17 | | 1237.01 | --- | --- | Boeing |
| | | | | | --- | --- | | Open Hole | | | | |
| OS-03 | Chatsworth Formation | 100 | Drilled with | | 8-1/4 | 0 - 59 | 0 - 30 | 30 - 60 | 1298.15 | --- | --- | Boeing |
| | | | cable tools | | --- | --- | | Open Hole | | | | |
| OS-04 | Chatsworth Formation | Well Construction Data Unresolved or Not Available | | | | | | | 1334.00 | | | Boeing |
| OS-05 | Chatsworth Formation | Well Construction Data Unresolved or Not Available | | | | | | | | | | Boeing |
| OS-09 | Chatsworth Formation | Well Construction Data Unresolved or Not Available | | | | | | | | | | Boeing |
| OS-09R | Chatsworth Formation | 408 | 10 | 0 - 29 | 6 | 0 - 29 | 0 - 29 | | 1018.10 | Westbay | --- | Boeing |
| | | | 4 | 29-408 | 1.5 | 0-406 | | (6) | | | | |
| OS-16 | Chatsworth Formation | Well Construction Data Unresolved or Not Available | | | | | | | 1785.05 | | | NASA |
| OS-24 | Chatsworth Formation | 10 | 0 - 40 | 6-1/4 | 0 - 40 | 0 - 40 | | 1947.30 | 1947.30 | --- | --- | NASA |
| | | 6 | 40 - 515 | --- | --- | | Open Hole | | | | | |
| OS-25 | Chatsworth Formation | 515 | 10 | 0 - 36 | 6-1/4 | 0 - 36 | 0 - 36 | | 2043.58 | --- | --- | NASA |
| | | | 6 | 36 - 515 | --- | --- | | Open Hole | | | | |
| OS-26 | Chatsworth Formation | 515 | 10 | 0 - 40 | 6-1/4 | 0 - 40 | 0 - 40 | | 2080.58 | --- | --- | NASA |
| | | | 6 | 40 - 515 | --- | --- | | Open Hole | | | | |
| PZ-035 | Near Surface | 22.3[a] | NA | 0-24 | 2 | 0-20 | 0-7 | 10-20 | 1712.96 | Bladder[3] | --- | Boeing |

See last page of table for notes and abbreviations.

**TABLE VI**
WATER LEVEL MONITORING PROGRAM
WELL CONSTRUCTION DETAILS
SANTA SUSANA FIELD LABORATORY
VENTURA COUNTY, CALIFORNIA

| | | | Borehole | | Casing | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Well Identifier** | **Geological Unit** | **Effective Borehole Depth (ft BLS)** | **Diameter (inches)** | **Interval (ft BLS)** | **Inside Diameter (inches)** | **Interval (ft BLS)** | **Sealed Interval (ft BLS)** | **Perforated Interval (ft BLS)** | **Measuring Point Elevation (ft MSL)** | **Low-Flow Pump Type** | **Low-Flow Pump Setting[1] (ft BLS)** | **Sponsor** |
| PZ-059 | Near Surface | 24 | NA | 0-24 | 2 | 0-22 | 0-8 | 12-22 | 1836.67 | Bladder[3] | --- | NASA |
| PZ-060 | Near Surface | 49 | NA | 0-49 | 2 | 0-48 | 38-48 | 38-48 | 1868.90 | Bladder[3] | --- | NASA |
| PZ-070 | Near Surface | 24 | NA | 0-23[a] | 2 | 0-23 | 13-23 | 13-23 | 1834.61 | Bladder[3] | --- | NASA |
| PZ-074 | Near Surface | 24 | 8 | 0-25 | 2 | 0-20 | 0-8.5 | 10-20 | 1772.73 | Bladder[3] | --- | Boeing |
| PZ-076 | Near Surface | 47 | 8 | 0-60 | 2 | 0-46 | 0-32 | 36-46 | 1767.09 | Bladder[3] | --- | Boeing |
| PZ-077 | Near Surface | 26 | 8 | 0-37 | 2 | 0-25 | 0-12 | 15-25 | 1753.42 | Bladder[3] | --- | Boeing |
| PZ-078 | Near Surface | 26 | 8 | 0-48 | 2 | 0-25 | 0-12 | 15-25 | 1755.77 | Bladder[3] | --- | Boeing |
| PZ-089 | Near Surface | 18[a] | NA | 0-20 | 2 | 0-16 | 0-4.5 | 6-16 | 1876.64 | Bladder[3] | --- | Boeing |
| PZ-095 | Near Surface | 26 | 8 | 0-37.5 | 2 | 0-24 | 0-11 | 14-24 | 1760.02 | Bladder[3] | --- | NASA |
| PZ-097 | Near Surface | 44.5 | 8 | 0-44.5 | 2 | 0-43 | 0-31 | 33-43 | 1761.87 | Bladder[3] | --- | DOE |
| PZ-108 | Near Surface | 28.5 | 8 | 0-30 | 2 | 0-26 | 0-13 | 16-26 | 1763.01 | Bladder[3] | --- | DOE |
| PZ-123 | Near Surface | 23.5 | 8 | 0-23.5 | 2 | 0-21.5 | 0-8.7 | 11.5-21.5 | 1610.81 | Bladder[3] | --- | Boeing |
| PZ-124 | Near Surface | 31 | 8 | 0-31 | 2 | 0-24.7 | 0-11.5 | 14.7-24.7 | 1764.11 | Bladder[3] | --- | DOE |
| RD-01 | Chatsworth Formation | 506 | 15 | 0 - 26 | 10-1/8 | 0 - 26 | 0 - 26 | | 1935.89 | Bladder | 257-502* | Boeing |
| | | | 8-5/8 | 26 - 506 | --- | --- | | Open Hole | | | | |
| RD-02 | Chatsworth Formation | 400 | 15 | 0 - 26 | 10-1/8 | 0 - 26 | 0 - 26 | | 1873.92 | ES-VFD | 286 | Boeing |
| | | | 8-5/8 | 26 - 400 | --- | --- | | Open Hole | | | | |
| RD-03 | Chatsworth Formation | 300 | 15 | 0 - 27 | 10-1/8 | 0 - 27 | 0 - 27 | | 1743.50(A) | ES-VFD | 165 | Boeing |
| | | | 8-5/8 | 27 - 300 | --- | --- | | Open Hole | | | | |
| RD-04 | Chatsworth Formation | 496 | 15 | 0 - 27 | 10-1/8 | 0 - 27 | 0 - 27 | | 1883.85 | --- | --- | Boeing |
| | | | 8-5/8 | 27 - 496 | --- | --- | | Open Hole | | | | |
| RD-05A | Chatsworth Formation | 158 | 12-1/4 | 0 - 29.5 | 8-1/4 | 0 - 29.5 | 0 - 29.5 | | 1704.66(A) | Bladder | 120.7 | NASA |
| | | | 6-1/4 | 29.5 - 158 | --- | --- | | Open Hole | | | | |
| RD-05B | Chatsworth Formation | 310 | 15 | 0 - 27 | 10-1/8 | 0 - 27 | 0 - 27 | | 1705.89(A) | Bladder | 283.5 (4) | NASA |
| | | | 9-7/8 | 27 - 310 | 5 | 0 - 310 | 0 - 248 | 257.6 - 310 | | | | |
| RD-05C | Chatsworth Formation | 480 | 17-1/2 | 0 - 29 | 12-1/8 | 0 - 28 | 0 - 29 | | 1705.25(A) | Bladder | 436 (4) | NASA |
| | | | 11-7/8 | 29 - 421 | 6-1/4 | 0 - 418 | 0 - 421 | | | | | |
| | | | 6-1/4 | 421 - 480 | --- | --- | | Open Hole | | | | |
| RD-06 | Chatsworth Formation | 260 | 15 | 0 - 27 | 10-1/8 | 0 - 27 | 0 - 27 | | 1617.21(A) | ES-VFD | 167 | Boeing |
| | | | 9-7/8 | 27 - 136 | 6-1/4 | 0 - 140 | | 70 - 140 | | | | |
| | | | 8-5/8 | 136 - 260 | --- | --- | | Open Hole | | | | |
| RD-07 | Chatsworth Formation | 300 | 15 | 0 - 25 | 10-1/8 | 0 - 25 | 0 - 25 | | 1812.82 | FLUTe | --- | DOE |
| | | | 8-5/8 | 25 - 300 | --- | --- | | Open Hole (5) | | | | |

See last page of table for notes and abbreviations.

**TABLE VI**
WATER LEVEL MONITORING PROGRAM
WELL CONSTRUCTION DETAILS
SANTA SUSANA FIELD LABORATORY
VENTURA COUNTY, CALIFORNIA

| Well Identifier | Geological Unit | Effective Borehole Depth (ft BLS) | Borehole | | Casing | | Sealed Interval (ft BLS) | Perforated Interval (ft BLS) | Measuring Point Elevation (ft MSL) | Low-Flow Pump Type | Low-Flow Pump Setting[1] (ft BLS) | Sponsor |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Diameter (inches) | Interval (ft BLS) | Inside Diameter (inches) | Interval (ft BLS) | | | | | | |
| RD-08 | Chatsworth Formation | 50 | 15 | 0 - 27 | 10-1/8 | 0 - 27 | 0 - 27 | | 1763.38(A) | Bladder | 41.4 | Boeing |
| | | | 8-5/8 | 27 - 50 | --- | --- | | Open Hole | | | | |
| RD-09 | Chatsworth Formation | 200 | 15 | 0 - 37 | 10-1/8 | 0 - 37 | 0 - 37 | | 1768.20 | Bladder | 40-195* (2) | Boeing |
| | | | 8-5/8 | 37 - 200 | --- | --- | | Open Hole | | | | |
| RD-10 | Chatsworth Formation | 400 | 15 | 0 - 30 | 10-1/8 | 0 - 30 | 0 - 30 | | 1904.43 | ES-VFD | 293 | NASA |
| | | | 8-3/8 | 30 - 400 | --- | --- | | Open Hole | | | | |
| RD-11 | Chatsworth Formation | 71 | 15 | 0 - 30 | 10-1/8 | 0 - 30 | 0 - 30 | | 1762.65(A) | Bladder | 60.2 | Boeing |
| | | | 8-3/8 | 30 - 71 | --- | --- | | Open Hole | | | | |
| RD-12 | Chatsworth Formation | 72 | 15 | 0 - 30 | 10-1/8 | 0 - 30 | 0 - 30 | | 1762.62(A) | Bladder | 51.6 | Boeing |
| | | | 8-3/8 | 30 - 72 | --- | --- | | Open Hole | | | | |
| RD-13 | Chatsworth Formation | 160 | 12 | 0 - 30 | 8-1/4 | 0 - 30 | 0 - 30 | | 1840.27 | Bladder | 75-155* | DOE |
| | | | 6-1/2 | 30 - 160 | --- | --- | | Open Hole | | | | |
| RD-14 | Chatsworth Formation | 125 | 12 | 0 - 30 | 8-1/4 | 0 - 30 | 0 - 30 | | 1824.29 | Bladder | 115 | DOE |
| | | | 6-1/2 | 30 - 125 | --- | --- | | Open Hole | | | | |
| RD-15 | Chatsworth Formation | 152 | 12 | 0 - 30 | 8-1/4 | 0 - 30 | 0 - 30 | | 1817.70 | --- | --- | DOE |
| | | | 6-1/2 | 30 - 152 | --- | --- | | Open Hole | | | | |
| RD-16 | Chatsworth Formation | 220 | 12 | 0 - 30 | 8-1/4 | 0 - 30 | 0 - 30 | | 1808.99 | --- | --- | DOE |
| | | | 6-1/2 | 30 - 220 | --- | --- | | Open Hole | | | | |
| RD-17 | Chatsworth Formation | 125 | 12 | 0 - 30 | 8-1/4 | 0 - 30 | 0 - 30 | | 1836.30 | --- | --- | DOE |
| | | | 6-1/2 | 30 - 125 | --- | --- | | Open Hole | | | | |
| RD-18 | Chatsworth Formation | 240 | 12 | 0 - 30 | 8-1/4 | 0 - 30 | 0 - 30 | | 1839.49 | Bladder | 110-235* | DOE |
| | | | 6-1/2 | 30 - 240 | --- | --- | | Open Hole | | | | |
| RD-19 | Chatsworth Formation | 135 | 12 | 0 - 30 | 8-1/4 | 0 - 30 | 0 - 30 | | 1853.13 | Bladder | 107 | DOE |
| | | | 6-1/2 | 30 - 135 | --- | --- | | Open Hole | | | | |
| RD-20 | Chatsworth Formation | 127 | 12 | 0 - 30 | 8-1/4 | 0 - 30 | 0 - 30 | | 1819.72 | Bladder | 87 (2) | DOE |
| | | | 6-1/2 | 30 - 127 | --- | --- | | Open Hole | | | | |
| RD-21 | Chatsworth Formation | 175 | 12 | 0 - 30 | 8-1/4 | 0 - 30 | 0 - 30 | | 1866.96 | FLUTe | --- | DOE |
| | | | 6-1/2 | 30 - 175 | --- | --- | | Open Hole (5) | | | | |
| RD-22 | Chatsworth Formation | 440 | 12 | 0 - 30 | 8-1/4 | 0 - 30 | 0 - 30 | | 1853.41 | FLUTe | --- | DOE |
| | | | 6-1/2 | 30 - 440 | --- | --- | | Open Hole (5) | | | | |
| RD-23 | Chatsworth Formation | 440 | 12 | 0 - 30 | 8-1/4 | 0 - 30 | 0 - 30 | | 1838.19 | FLUTe | --- | DOE |
| | | | 6-1/2 | 30 - 440 | --- | --- | | Open Hole (5) | | | | |

See last page of table for notes and abbreviations.

| Well Identifier | Geological Unit | Effective Borehole Depth (ft BLS) | Borehole Diameter (inches) | Borehole Interval (ft BLS) | Casing Inside Diameter (inches) | Casing Interval (ft BLS) | Sealed Interval (ft BLS) | Perforated Interval (ft BLS) | Measuring Point Elevation (ft MSL) | Low-Flow Pump Type | Low-Flow Pump Setting[1] (ft BLS) | Sponsor |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RD-24 | Chatsworth Formation | 150 | 12 | 0 - 30 | 8-1/4 | 0 - 30 | 0 - 30 | | 1809.93 | --- | --- | DOE |
| | | | 6-1/2 | 30 - 150 | --- | --- | | Open Hole | | | | |
| RD-26 | Chatsworth Formation | 160 | 12 | 0 - 30 | 8-1/4 | 0 - 30 | 0 - 30 | | 1880.39 | --- | --- | NASA |
| | | | 6-1/2 | 30 - 160 | --- | --- | | Open Hole | | | | |
| RD-27 | Chatsworth Formation | 150 | 12 | 0 - 30 | 8-1/4 | 0 - 30 | 0 - 30 | | 1841.67 | --- | --- | DOE |
| | | | 6-1/2 | 30 - 150 | --- | --- | | Open Hole | | | | |
| RD-29 | Chatsworth Formation | 100 | 12 | 0 - 30 | 8-1/4 | 0 - 30 | 0 - 30 | | 1806.29 | --- | --- | DOE |
| | | | 6-1/2 | 30 - 100 | --- | --- | | Open Hole | | | | |
| RD-30 | Chatsworth Formation | 75 | 12 | 0 - 30 | 8-1/4 | 0 - 30 | 0 - 30 | | 1768.69 | --- | --- | DOE |
| | | | 6-1/2 | 30 - 75 | --- | --- | | Open Hole | | | | |
| RD-31 | Chatsworth Formation | 542 | 12 | 0 - 30 | 8-1/4 | 0 - 30 | 0 - 30 | | 1944.55 | Westbay | --- | NASA |
| | | | 6-1/2 | 30 - 178 | --- | --- | | (6) | | | | |
| | | | 3.8 | 178 - 542 | --- | --- | | (6) | | | | |
| RD-32 | Chatsworth Formation | 150 | 17-1/2 | 0 - 19 | 12-1/8 | 0 - 19 | 0 - 19 | | 1808.47 | Bladder | 125 | NASA |
| | | | 11-7/8 | 19 - 99 | 6-1/4 | 0 - 99 | 0 - 99 | | | | | |
| | | | 5-7/8 | 99 - 150 | --- | --- | | Open Hole | | | | |
| RD-33A | Chatsworth Formation | 320 | 17-1/2 | 0 - 11 | 12-1/8 | 0 - 11 | 0 - 11 | | 1792.97 | FLUTe | --- | DOE |
| | | | 11 | 11 - 100 | 6-1/4 | 0 - 100 | 0 - 100 | | | | | |
| | | | 5-1/2 | 100 - 320 | --- | --- | | Open Hole (5) | | | | |
| RD-33B | Chatsworth Formation | 415 | 17-1/2 | 0 - 20 | 12-1/8 | 0 - 20 | 0 - 20 | | 1793.21 | Bladder | 387 | DOE |
| | | | 11 | 20 - 360 | 6-1/4 | 0 - 360 | 20 - 360 | | | | | |
| | | | 6-1/4 | 360 - 415 | --- | --- | | Open Hole | | | | |
| RD-33C | Chatsworth Formation | 520 | 17-1/2 | 0 - 10 | 12-1/8 | 0 - 10 | 0 - 10 | | 1793.54 | Bladder | 500 | DOE |
| | | | 11 | 10 - 480 | 6-1/4 | 0 - 480 | 0 - 480 | | | | | |
| | | | 6-1/4 | 480 - 520 | --- | --- | | Open Hole | | | | |
| RD-34A | Chatsworth Formation | 60 | 12-1/4 | 0 - 16 | 8-1/4 | 0 - 16 | 0 - 16 | | 1761.83 | Bladder | 58 | DOE |
| | | | 6-1/2 | 16 - 60 | --- | --- | | Open Hole | | | | |
| RD-34B | Chatsworth Formation | 240 | 17-1/2 | 0 - 30 | 12-1/8 | 0 - 30 | 0 - 30 | | 1762.51 | Bladder | 210 | DOE |
| | | | 11 | 30 - 180 | 6-1/4 | 0 - 180 | 0 - 180 | | | | | |
| | | | 6-1/4 | 180 - 240 | --- | --- | | Open Hole | | | | |
| RD-34C | Chatsworth Formation | 450 | 17-1/2 | 0 - 30 | 12-1/8 | 0 - 30 | 0 - 30 | | 1762.60 | Bladder | 415 | DOE |
| | | | 11 | 30 - 380 | 6-1/4 | 0 - 380 | 0 - 380 | | | | | |
| | | | 6-1/4 | 380 - 450 | --- | --- | | Open Hole | | | | |

See last page of table for notes and abbreviations.

| | | | Borehole | | Casing | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Well Identifier | Geological Unit | Effective Borehole Depth (ft BLS) | Diameter (inches) | Interval (ft BLS) | Inside Diameter (inches) | Interval (ft BLS) | Sealed Interval (ft BLS) | Perforated Interval (ft BLS) | Measuring Point Elevation (ft MSL) | Low-Flow Pump Type | Low-Flow Pump Setting[1] (ft BLS) | Sponsor |
| RD-35A | Chatsworth Formation | 110 | 12-1/4 | 0 - 19.5 | 8-1/4 | 0 - 19.5 | 0 - 19.5 | | 1908.62 | Bladder | 100 (2) | NASA |
| | | | 6-1/4 | 19.5 - 110 | 4 | 0 - 105.5 | 0 - 30 | 65 - 105.5 | | | | |
| RD-35B | Chatsworth Formation | 328 | 24 | 0 – 10 | 18 | 0 - 10 | 0 - 10 | | 1905.65 | Bladder | 293 (2) | NASA |
| | | | 17-1/2 | 10 – 162 | 12 | 0 - 158 | 0 - 162 | | | | | |
| | | | 9-7/8 | 162 – 328 | 4 | 0 - 324 | 0 - 292 | 303 - 324 | | | | |
| | | | 3 | 328 – 359 | --- | --- | 328 - 359 | | | | | |
| RD-36A | Chatsworth Formation | 95 | 17-1/2 | 0 – 20 | 12-1/8 | 0 - 20 | 0 - 20 | | 1913.09 | Bladder | 92.4 | Boeing |
| | | | 6-1/4 | 20 – 95 | --- | --- | | Open Hole | | | | |
| RD-36B | Chatsworth Formation | 170 | 17-1/2 | 0 – 20.5 | 12-1/8 | 0 - 20.5 | 0 - 20.5 | | 1915.26(A) | Bladder | 165 | Boeing |
| | | | 11-7/8 | 20.5 – 120 | 6-1/4 | 0 - 120 | 0 - 120 | | | | | |
| | | | 5-7/8 | 120 – 170 | --- | --- | | Open Hole | | | | |
| RD-36C | Chatsworth Formation | 466 | 26 | 0 – 20 | 20 | 0 - 20 | 0 - 20 | | 1913.82(A) | Bladder | 429 (4) | Boeing |
| | | | 15 | 20 – 198 | 10-1/8 | 0 - 197 | 0 - 198 | | | | | |
| | | | 5-7/8 | 198 – 466 | 4 | 0 - 455.5 | 0 - 381 | 405 - 455.5 | | | | |
| RD-36D | Chatsworth Formation | 605 | 24-1/2 | 0 – 10 | 18 | 0 - 10 | 0 - 10 | | 1920.08(A) | Bladder | 589.7 (4) | Boeing |
| | | | 15 | 10 – 554 | 10 | 0 - 550 | 0 - 550 | | | | | |
| | | | 9-7/8 | 554 – 608 | 4 | 0 - 605 | 0 - 560 | 575 - 605 | | | | |
| RD-37 | Chatsworth Formation | 400 | 17-1/2 | 0 – 38 | 12-1/8 | 0 - 38 | 0 - 38 | | 1870.01(A) | Bladder | 339 | Boeing |
| | | | 11-7/8 | 38 – 260 | 4 | 0 - 377 | | | | | | |
| | | | 7-7/8 | 260 – 400 | | | | 272 - 377 | | | | |
| RD-38A | Chatsworth Formation | 120 | 17-1/2 | 0 – 20 | 12-1/8 | 0 - 20 | 0 - 20 | | 1879.47(A) | Bladder | 117.9 | Boeing |
| | | | 6-1/2 | 20 – 120 | --- | --- | | Open Hole | | | | |
| RD-38B | Chatsworth Formation | 370 | 24 | 0 - 6 | 18 | 0 - 6 | 0 - 6 | | 1881.45(A) | ES-VFD | 346 | Boeing |
| | | | 17-1/2 | 6 - 170 | 12 | 0 - 161 | 0 - 170 | | | | | |
| | | | 11-7/8 | 170 - 279 | 6 | 0 - 277 | 0 - 279 | | | | | |
| | | | 5-1/2 | 279 - 370 | --- | --- | | Open Hole | | | | |
| RD-39A | Chatsworth Formation | 159 | 17-1/2 | 0 – 20 | 12-1/8 | 0 - 20 | 0 - 20 | | 1960.23(A) | Bladder | 157.8 | Boeing |
| | | | 6-1/2 | 20 – 159 | --- | --- | | Open Hole | | | | |
| RD-39B | Chatsworth Formation | 477 | 24 | 0 – 12 | 16 | 0 - 12 | 0 - 12 | | 1959.48(A) | Bladder | 456.2 (4) | Boeing |
| | | | 15 | 12 – 213 | 10 | 0 - 210 | 0 - 213 | | | | | |
| | | | 9-1/2 | 213 – 477 | 4 | 0 – 470 | 0 – 424 | 440 - 470 | | | | |
| | | | 6-1/2 | 477 – 500 | --- | --- | 477 – 500 | | | | | |

See last page of table for notes and abbreviations.

| | | | Borehole | | Casing | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Well Identifier** | **Geological Unit** | **Effective Borehole Depth (ft BLS)** | **Diameter (inches)** | **Interval (ft BLS)** | **Inside Diameter (inches)** | **Interval (ft BLS)** | **Sealed Interval (ft BLS)** | **Perforated Interval (ft BLS)** | **Measuring Point Elevation (ft MSL)** | **Low-Flow Pump Type** | **Low-Flow Pump Setting[1] (ft BLS)** | **Sponsor** |
| RD-40 | Chatsworth Formation | 300 | 12-1/4 | 0 - 19.5 | 8-1/4 | 0 - 19.5 | 0 - 19.5 | | 1972.02 | Bladder | 294 (2) | NASA |
| | | | 6-1/4 | 19.5 - 300 | --- | --- | | Open Hole | | | | |
| RD-41A | Chatsworth Formation | 120 | 12-1/4 | 0 - 19.5 | 8-1/4 | 0 - 19.5 | 0 - 19.5 | | 1774.48(A) | Bladder | 94.2 | NASA |
| | | | 6-1/4 | 19.5 - 120 | --- | --- | | Open Hole | | | | |
| RD-41B | Chatsworth Formation | 390 | 17-1/2 | 0 - 19.5 | 12-1/8 | 0 - 19.5 | 0 - 19.5 | | 1774.71 | Bladder | 365 (4) | NASA |
| | | | 11-7/8 | 19.5 - 340 | 6-1/4 | 0 - 336 | 0 - 340 | | | | | |
| | | | 5-7/8 | 340 - 390 | --- | --- | | Open Hole | | | | |
| RD-41C | Chatsworth Formation | 558 | 17-1/2 | 0 - 19.5 | 12-1/8 | 0 - 19.5 | 0 - 19.5 | | 1773.73 | --- | --- | NASA |
| | | | 11-1/4 | 19.5 - 492 | 6-1/4 | 0 - 491 | 0 - 492 | | | | | |
| | | | 6-1/4 | 492 - 558 | --- | --- | | Open Hole | | | | |
| RD-42 | Chatsworth Formation | 120 | 12-1/4 | 0 - 19.5 | 8-1/4 | 0 - 19.5 | 0 - 19.5 | | 1945.46 | Bladder | 88 (2) | NASA |
| | | | 6-1/4 | 19.5 - 120 | --- | --- | | Open Hole | | | | |
| RD-43A | Chatsworth Formation | 98 | 17-1/2 | 0 - 19.5 | 12-1/8 | 0 - 19.5 | 0 - 19.5 | | 1680.16(A) | Bladder | 70.7 | Boeing |
| | | | 6-1/2 | 19.5 - 98 | --- | --- | | Open Hole | | | | |
| RD-43B | Chatsworth Formation | 295 | 17-1/2 | 0 - 20 | 12-1/8 | 0 - 20 | 0 - 20 | | 1680.21(A) | ES-VFD | 270 | Boeing |
| | | | 11-7/8 | 20 - 240.5 | 6-1/4 | 0 – 240.5 | 0 – 30.5 | | | | | |
| | | | 6-1/2 | 240.5 – 295 | --- | --- | 115.5 – 240.5 | Open Hole | | | | |
| RD-43C | Chatsworth Formation | 439.5 | 17-1/2 | 0 - 20 | 12-1/8 | 0 - 20 | 0 - 20 | | 1679.31(A) | Bladder | 404 (4) | Boeing |
| | | | 11-7/8 | 20 - 370 | 6-1/4 | 0 - 370 | 5 - 140 | | | | | |
| | | | 6-1/2 | 370 - 439.5 | --- | --- | 183 - 219 | Open Hole | | | | |
| | | | | | | | 318 - 368 | | | | | |
| RD-44 | Chatsworth Formation | 485 | 17-1/2 | 0 - 20 | 12-1/8 | 0 - 20 | 0 - 20 | | 2035.92 | Bladder | 442 | NASA |
| | | | 6-1/4 | 20 - 485 | --- | --- | | Open Hole | | | | |
| RD-45A | Chatsworth Formation | 480 | 17-1/2 | 0 - 19.5 | 12-1/8 | 0 - 19.5 | 0 - 19.5 | | 1841.59(A) | Bladder | 270-445* | Boeing |
| | | | 6-1/2 | 19.5 - 480 | --- | --- | | Open Hole | | | | |
| RD-45B | Chatsworth Formation | 590 | 17-1/2 | 0 - 20 | 12-1/8 | 0 - 20 | 0 - 20 | | 1840.09(A) | ES-VFD | 566 | Boeing |
| | | | 11-7/8 | 20 - 538 | 6-1/4 | 0 - 538 | 0 - 127 | | | | | |
| | | | 6-1/2 | 538 - 590 | --- | --- | 471 - 538 | Open Hole | | | | |
| RD-45C | Chatsworth Formation | 798 | 24 | 0 - 20 | 16 | 0 - 19 | 0 - 20 | | 1835.74(A) | ES-VFD | 776 | Boeing |
| | | | 11-7/8 | 20 - 750 | 6-1/4 | 0 - 750 | 0 - 135 | | | | | |
| | | | 6-1/4 | 750 - 798 | --- | --- | 483 - 540 | | | | | |
| | | | | | | | 590 - 750 | Open Hole | | | | |

See last page of table for notes and abbreviations.

| | | | Borehole | | Casing | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Well Identifier** | **Geological Unit** | **Effective Borehole Depth (ft BLS)** | **Diameter (inches)** | **Interval (ft BLS)** | **Inside Diameter (inches)** | **Interval (ft BLS)** | **Sealed Interval (ft BLS)** | **Perforated Interval (ft BLS)** | **Measuring Point Elevation (ft MSL)** | **Low-Flow Pump Type** | **Low-Flow Pump Setting[1] (ft BLS)** | **Sponsor** |
| RD-46A | Chatsworth Formation | 140 | 12-1/4 | 0 - 29.5 | 8-1/4 | 0 - 29.5 | 0 - 29.5 | | 1806.13(A) | Bladder | 109.1 | Boeing |
| | | | 6-1/4 | 29.5 - 140 | --- | --- | | Open Hole | | | | |
| RD-46B | Chatsworth Formation | 328 | 24 | 0 - 20 | 18 | 0 - 20 | 0 - 20 | | 1807.19(A) | Bladder | 310.5 (4) | Boeing |
| | | | 17-1/2 | 20 - 193 | 12 | 0 - 190 | 0 - 193 | | | | | |
| | | | 9-7/8 | 193 - 328 | 4 | 0 - 325 | 0 - 281 | 293 - 325 | | | | |
| | | | 3 | 328 - 366 | --- | --- | 328 - 366 | | | | | |
| RD-47 | Chatsworth Formation | 710 | 17-1/2 | 0 - 19 | 12-1/8 | 0 - 19 | 0 - 19 | | 2045.72 | --- | --- | NASA |
| | | | 6-1/2 | 19.0 - 710 | --- | --- | | Open Hole | | | | |
| RD-48A | Chatsworth Formation | 110 | 12-1/4 | 0 - 20 | 8-1/4 | 0 - 20 | 0 - 20 | | 1736.54(A) | Bladder | 110.4 | Boeing |
| | | | 6-1/2 | 20 - 110 | --- | --- | | Open Hole | | | | |
| RD-48B | Chatsworth Formation | 248 | 17-1/2 | 0 - 29.5 | 12-1/8 | 0 - 29.5 | 0 - 29.5 | | 1735.40(A) | Bladder | 225 | Boeing |
| | | | 11-1/4 | 29.5 - 200 | 6-1/4 | 0 - 200 | 0 - 198.5 | | | | | |
| | | | 6-1/4 | 200 - 248 | --- | --- | | Open Hole | | | | |
| RD-48C | Chatsworth Formation | 438 | 17-1/2 | 0 - 30 | 12-1/8 | 0 - 30 | 0 - 30 | | 1734.95(A) | ES-VFD | 406 | Boeing |
| | | | 11-1/4 | 30 - 371 | 6-1/4 | 0 - 371 | 0 - 371 | | | | | |
| | | | 6-1/4 | 371 - 438 | --- | --- | | Open Hole | | | | |
| RD-49A | Chatsworth Formation | 50 | 12-3/4 | 0 - 18.5 | 8-1/4 | 0 - 18.5 | 0 - 18.5 | | 1867.25(A) | Bladder | 41 | NASA |
| | | | 6-1/4 | 18.5 - 50 | --- | --- | | Open Hole | | | | |
| RD-49B | Chatsworth Formation | 298 | 17-1/2 | 0 - 20 | 12-1/8 | 0 - 20 | 0 - 20 | | 1867.95(A) | ES-VFD | 276 | NASA |
| | | | 11-7/8 | 20 - 250 | 6-1/4 | 0 - 250 | 0 - 250 | | | | | |
| | | | 5-7/8 | 250 - 298 | --- | --- | | Open Hole | | | | |
| RD-49C | Chatsworth Formation | 558 | 17-1/2 | 0 - 19 | 12-1/8 | 0 - 19 | 0 - 19 | | 1869.45(A) | ES-VFD | 505 | NASA |
| | | | 11-7/8 | 19 - 500 | 6-1/4 | 0 - 491 | 0 - 491 | | | | | |
| | | | 6-1/4 | 500 - 558 | --- | --- | | Open Hole | | | | |
| RD-50 | Chatsworth Formation | 195 | 12-3/4 | 0 - 18.5 | 8-1/4 | 0 - 18.5 | 0 - 18.5 | | 1914.88 | FLUTe | --- | DOE |
| | | | 6-1/4 | 18.5 - 195 | --- | --- | | Open Hole (5) | | | | |
| RD-51A | Chatsworth Formation | 250 | 24 | 0 - 50 | 12-1/8 | 0 - 50 | 0 - 50 | | 1832.51(A) | Bladder | 249.5 | Boeing |
| | | | 11-3/4 | 50 - 160 | 6-1/4 | 0 - 160 | 0 - 160 | | | | | |
| | | | 5-1/2 | 160 - 250 | --- | --- | | Open Hole | | | | |
| RD-51B | Chatsworth Formation | 370 | 24 | 0 - 48 | 12-1/8 | 0 - 48 | 0 - 48 | | 1832.68(A) | ES-VFD | 337 | Boeing |
| | | | 11-3/4 | 48 - 300 | 6-1/4 | 0 - 300 | 0 - 300 | | | | | |
| | | | 5-1/2 | 300 - 370 | --- | --- | | Open Hole | | | | |

See last page of table for notes and abbreviations.

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| | | | Borehole | | Casing | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Well Identifier** | **Geological Unit** | **Effective Borehole Depth (ft BLS)** | **Diameter (inches)** | **Interval (ft BLS)** | **Inside Diameter (inches)** | **Interval (ft BLS)** | **Sealed Interval (ft BLS)** | **Perforated Interval (ft BLS)** | **Measuring Point Elevation (ft MSL)** | **Low-Flow Pump Type** | **Low-Flow Pump Setting[1] (ft BLS)** | **Sponsor** |
| RD-51C | Chatsworth Formation | 602 | 14 | 0 - 13.5 | 12-1/8 | 0 - 13.5 | 0 - 13.5 | | 1831.65(A) | ES-VFD | 547.5 | Boeing |
| | | | 11-3/4 | 13.5 - 510 | 6-1/4 | 0 - 510 | 0 - 510 | | | | | |
| | | | 5-1/2 | 510 - 602 | --- | --- | | Open Hole | | | | |
| RD-52A | Chatsworth Formation | 137 | 12-1/4 | 0 - 19.5 | 8-1/4 | 0 - 19.5 | 0 - 19.5 | | 1755.09(A) | Bladder | 130.3 | Boeing |
| | | | 6-1/2 | 19.5 - 137 | --- | --- | | Open Hole | | | | |
| RD-52B | Chatsworth Formation | 318 | 17-1/2 | 0 - 24 | 12-1/8 | 0 - 24 | 0 - 24 | | 1712.15 | ES-VFD | 266 | Boeing |
| | | | 11-1/4 | 24 - 200 | 6-1/4 | 0 - 200 | 0 - 199 | | | | | |
| | | | 5-7/8 | 200 - 318 | --- | --- | | Open Hole | | | | |
| RD-52C | Chatsworth Formation | 678 | 17-1/2 | 0 - 20 | 12-1/8 | 0 - 20 | 0 - 20 | | 1712.83(A) | Bladder | 649 (4) | Boeing |
| | | | 11-7/8 | 20 - 450 | | | 0 - 620 | | | | | |
| | | | 11-1/4 | 450 - 620 | 6-1/4 | 0 - 620 | | | | | | |
| | | | 6-1/4 | 620 - 678 | --- | --- | | Open Hole | | | | |
| RD-53** | Chatsworth Formation | 159 | 14 | 0 - 20 | 12-1/8 | 0 - 20 | 0 - 20 | | 1909.19(A) | Bladder | 158 | Boeing |
| | | | 12 | 20 - 77 | 6-1/4 | 0 - 77 | 0 - 77 | | | | | |
| | | | 5-1/2 | 77 - 159 | --- | --- | | Open Hole | | | | |
| RD-54A | Chatsworth Formation | 278 | 17-1/2 | 0 - 19 | 12-1/8 | 0 - 19 | 0 - 19 | | 1841.72 | --- | --- | DOE |
| | | | 11-1/4 | 19 - 119 | 6-1/4 | 0 - 119 | 0 - 119 | | | | | |
| | | | 5-7/8 | 119 - 278 | --- | --- | | Open Hole | | | | |
| RD-54B | Chatsworth Formation | 437 | 17-1/2 | 0 - 19 | 12-1/8 | 0 - 19 | 0 - 19 | | 1842.54 | --- | --- | DOE |
| | | | 11-1/4 | 19 - 379 | 6-1/4 | 0 - 379 | 0 - 379 | | | | | |
| | | | 5-7/8 | 379 - 437 | --- | --- | | Open Hole | | | | |
| RD-54C | Chatsworth Formation | 638 | 17-1/2 | 0 - 20 | 12-1/8 | 0 - 20 | 0 - 20 | | 1843.77 | --- | --- | DOE |
| | | | 11-1/4 | 20 - 558 | 6-1/4 | 0 - 557 | 0 - 557 | | | | | |
| | | | 6-1/4 | 558 - 638 | --- | --- | | Open Hole | | | | |
| RD-55A | Chatsworth Formation | 106 | 17-1/2 | 0 - 28 | 12-1/8 | 0 - 28 | 0 - 28 | | 1756.87(A) | Bladder | 71.3 | Boeing |
| | | | 6-1/4 | 28 - 106 | --- | --- | | Open Hole | | | | |
| RD-55B | Chatsworth Formation | 250 | 17-1/2 | 0 - 20 | 12-1/8 | 0 - 20 | 0 - 20 | | 1757.19(A) | Bladder | 226.3 (4) | Boeing |
| | | | 11 | 20 - 199.5 | 6-1/4 | 0 - 199.5 | 0 - 199.5 | | | | | |
| | | | 5-7/8 | 199.5 - 250 | --- | --- | | Open Hole | | | | |
| RD-56A | Chatsworth Formation | 397.5 | 17-1/2 | 0 - 20.5 | 12-1/8 | 0 - 20.5 | 0 - 20.5 | | 1758.62 | Bladder | 378 (2) | NASA |
| | | | 6-1/2 | 20.5 - 397.5 | --- | --- | | Open Hole | | | | |

See last page of table for notes and abbreviations.

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SANTA SUSANA FIELD LABORATORY
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| Well Identifier | Geological Unit | Effective Borehole Depth (ft BLS) | Borehole Diameter (inches) | Borehole Interval (ft BLS) | Casing Inside Diameter (inches) | Casing Interval (ft BLS) | Sealed Interval (ft BLS) | Perforated Interval (ft BLS) | Measuring Point Elevation (ft MSL) | Low-Flow Pump Type | Low-Flow Pump Setting[1] (ft BLS) | Sponsor |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RD-56B | Chatsworth Formation | 463 | 22 | 0 - 10 | 16 | 0 - 10 | 0 -10 | | 1761.83 | ES-VFD | 458 (2) | NASA |
| | | | 15 | 10 - 453 | 10 | 0 - 443 | 0 - 443 | | | | | |
| | | | 6-1/2 | 453 - 463 | --- | --- | | Open Hole | | | | |
| RD-57 | Chatsworth Formation | 419 | 17-1/2 | 0 - 19.5 | 12-1/8 | 0 - 19.5 | 0 - 19.5 | | 1774.15 | FLUTe | --- | DOE |
| | | | 6-1/2 | 19.5 - 419 | --- | --- | | Open Hole (5) | | | | |
| RD-58A | Chatsworth Formation | 126 | 12-1/4 | 0 - 19.5 | 8-1/4 | 0 - 19.5 | 0 - 19.5 | | 1756.11(A) | Bladder | 108 | Boeing |
| | | | 6-1/4 | 19.5 - 126 | --- | --- | | Open Hole | | | | |
| RD-58B | Chatsworth Formation | 268 | 17-1/2 | 0 - 20 | 12-1/8 | 0 - 20 | 0 - 20 | | 1761.34(A) | Bladder | 245.5 (4) | Boeing |
| | | | 11-7/8 | 20 - 220 | 6-1/4 | 0 - 220 | 0 - 220 | | | | | |
| | | | 6-1/2 | 220 - 268 | --- | --- | | Open Hole | | | | |
| RD-58C | Chatsworth Formation | 498 | 17-1/2 | 0 - 19 | 12-1/8 | 0 - 19 | 0 - 19 | | 1759.59(A) | Bladder | 475.5 (4) | Boeing |
| | | | 11-7/8 | 19 - 450 | 6-1/4 | 0 - 450 | 0 - 450 | | | | | |
| | | | 6-1/2 | 450 - 498 | --- | --- | | Open Hole | | | | |
| RD-59A | Chatsworth Formation | 58 | 17-1/2 | 0 - 21 | 12-1/8 | 0 - 21 | 0 - 21 | | 1340.50 | Bladder | 43 | DOE |
| | | | 6-1/2 | 21 - 58 | --- | --- | | Open Hole | | | | |
| RD-59B | Chatsworth Formation | 214 | 17-1/2 | 0 - 19.5 | 12-1/8 | 0 - 19.5 | 0 - 19.5 | | 1342.49 | Artesian | --- | DOE |
| | | | 6-1/2 | 19.5 - 214 | 2 | 0 - 209 | 0 - 161 | 178 - 209 | | | | |
| RD-59C | Chatsworth Formation | 398 | 17-1/2 | 0 - 19 | 12-1/8 | 0 - 19 | 0 - 19 | | 1345.41 | Artesian | --- | DOE |
| | | | 6-1/2 | 19 - 398 | 2 | 0 - 397 | 0 - 186 | | | | | |
| | | | | | | | 250 - 328 | 345.5 - 397 | | | | |
| RD-60 | Chatsworth Formation | 126 | 12-1/4 | 0 - 19.5 | 8-1/4 | 0 - 19.5 | 0 - 19.5 | | 1870.40 | Bladder | 108 (2) | Boeing |
| | | | 6-1/4 | 19.5 - 126 | --- | --- | | Open Hole | | | | |
| RD-61 | Chatsworth Formation | 129 | 17-1/2 | 0 - 19 | 12-1/8 | 0 - 19 | 0 - 19 | | 1845.87 | Bladder | 127 | NASA |
| | | | 6-1/4 | 19 - 129 | --- | --- | | Open Hole | | | | |
| RD-62 | Chatsworth Formation | 238 | 17-1/2 | 0 - 20.7 | 12-1/8 | 0 - 20.7 | 0 - 19.5 | | 1837.20 | Bladder | 222 | NASA |
| | | | 6-1/2 | 20.7 - 238 | --- | --- | | Open Hole | | | | |
| RD-63 | Chatsworth Formation | 230 | 12-3/4 | 0 - 20 | 8-1/4 | 0 - 20 | 0 - 20 | | 1764.85 | Bladder | 55-225* | DOE |
| | | | 6-1/2 | 20 - 230 | --- | --- | | Open Hole | | | | |
| RD-64 | Chatsworth Formation | 398 | 12-1/4 | 0 - 19 | 8-1/4 | 0 - 19 | 0 - 19 | | 1857.04 | FLUTe | --- | DOE |
| | | | 6-1/2 | 19 - 398 | --- | --- | | Open Hole (5) | | | | |
| RD-65 | Chatsworth Formation | 397 | 12-3/4 | 0 - 19 | 8-1/4 | 0 - 19 | 0 - 19 | | 1819.14 | FLUTe | --- | DOE |
| | | | 6-1/2 | 19 - 397 | --- | --- | | Open Hole (5) | | | | |

See last page of table for notes and abbreviations.

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| Well Identifier | Geological Unit | Effective Borehole Depth (ft BLS) | Borehole Diameter (inches) | Borehole Interval (ft BLS) | Casing Inside Diameter (inches) | Casing Interval (ft BLS) | Sealed Interval (ft BLS) | Perforated Interval (ft BLS) | Measuring Point Elevation (ft MSL) | Low-Flow Pump Type | Low-Flow Pump Setting[1] (ft BLS) | Sponsor |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RD-66 | Chatsworth Formation | 225 | 22 | 0 - 19 | 12 | 0 - 19 | 0 - 19 | | 1730.79 | Bladder | 197 | NASA |
| | | | 6-1/2 | 19 - 225 | --- | --- | | Open Hole | | | | |
| RD-67 | Chatsworth Formation | 102 | 17-1/2 | 0 - 20 | 12 | 0 - 20 | 0 - 20 | | 1901.71 | Bladder | 79 | NASA |
| | | | 6-1/2 | 20 - 102 | --- | --- | | Open Hole | | | | |
| RD-68A | Chatsworth Formation | 90 | 17-1/2 | 0 - 19 | 12 | 0 - 19 | 0 - 19 | | 1307.64 | Artesian | --- | NASA |
| | | | 6-1/4 | 19 - 90 | --- | --- | | Open Hole | | | | |
| RD-68B | Chatsworth Formation | 272 | --- | 0 - 52 | 12 | 0 - 52 | 0 - 224 | 240 - 270 | 1312.44 | Artesian | --- | NASA |
| | | | 11-7/8 | 52 - 272 | 4 | 0 - 270 | | | | | | |
| RD-69 | Chatsworth Formation | 103 | 17-1/2 | 0 - 19 | 12 | 0 - 19 | 0 - 19 | | 1831.28 | Bladder | 76 | NASA |
| | | | 6-1/4 | 19 - 103 | --- | --- | | Open Hole | | | | |
| RD-70 | Chatsworth Formation | 278 | 17-1/2 | 0 - 19 | 12 | 0 - 19 | 0 - 19 | | 1732.26 | ES-VFD | 214 | NASA |
| | | | 6-1/2 | 19 - 278 | --- | --- | | Open Hole | | | | |
| RD-71 | Chatsworth Formation | 281 | 17-1/2 | 0 - 20 | 12 | 0 - 20 | 0 - 20 | | 1740.02 | Bladder | 191-276* | NASA |
| | | | 6-1/2 | 20 - 281 | --- | --- | | Open Hole | | | | |
| RD-72 | Chatsworth Formation | 182 | 24 | 0 - 27 | 12 | 0 - 27 | 0 - 27 | | 1907.25 | FLUTe | --- | NASA |
| | | | 6-1/2 | 27 - 182 | --- | --- | | Open Hole (5) | | | | |
| RD-73 | Chatsworth Formation | 141 | 12 | 0 - 20 | 10 | 0 - 20 | 0 - 20 | | 1901.60 | --- | --- | Boeing |
| | | | 6 | 20 - 141 | --- | --- | | Open Hole | | | | |
| RD-74 | Chatsworth Formation | 101 | 17-1/2 | 0 - 30 | 12 | 0 - 30 | 0 - 30 | | 1810.90 | --- | --- | DOE |
| | | | 6-1/2 | 30 - 101 | --- | --- | | Open Hole | | | | |
| RD-75 | Chatsworth Formation | 425 | 12-3/4 | 0 - 30 | 8 | 0 - 30 | 0 - 30 | | 1613.30 | ES-VFD | 407 | Boeing |
| | | | 4-4/5 | 30 - 425 | --- | --- | | Open Hole | | | | |
| RD-76 | Chatsworth Formation | 153 | 12-3/4 | 0 - 30 | 8 | 0 - 30 | 0 - 30 | | 1772.27 | Bladder | 143 | Boeing |
| | | | 6 | 30 - 153 | 4 | 0 - 153 | --- | 133 - 153 | | | | |
| | | | 5-1/2 | 153-185 | --- | --- | Fill 153-185 | | | | | |
| RD-77 | Chatsworth Formation | 170 | 12-3/4 | 0 - 46 | 8 | 0 - 46 | 0 - 46 | | 1918.48(A) | Bladder | 138 | Boeing |
| | | | 4-4/5 | 46 - 170 | --- | --- | | Open Hole | | | | |
| RD-78 | Chatsworth Formation | 333 | 12-3/4 | 0 - 40 | 8 | 0 - 40 | 0 - 40 | | 1819.84 | Bladder | 288 | Boeing |
| | | | 5-1/2 | 40 - 333 | --- | --- | | Open Hole | | | | |
| RD-80 | Chatsworth Formation | 224 | 12-3/4 | 0 - 19 | 8 | 0 - 19 | 0 - 19 | | 1740.18 | --- | --- | Boeing |
| | | | 4-4/5 | 19 - 224 | --- | --- | | Open Hole | | | | |
| RD-81 | Chatsworth Formation | 205 | 12-3/4 | 0 - 20 | 8 | 0 - 20 | 0 - 20 | | 1705.77 | Bladder | 170 (2) | NASA |
| | | | 6 | 20 - 205 | --- | --- | | Open Hole | | | | |

See last page of table for notes and abbreviations.

| | | | Borehole | | Casing | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Well Identifier** | **Geological Unit** | **Effective Borehole Depth (ft BLS)** | **Diameter (inches)** | **Interval (ft BLS)** | **Inside Diameter (inches)** | **Interval (ft BLS)** | **Sealed Interval (ft BLS)** | **Perforated Interval (ft BLS)** | **Measuring Point Elevation (ft MSL)** | **Low-Flow Pump Type** | **Low-Flow Pump Setting[1] (ft BLS)** | **Sponsor** |
| RD-82 | Chatsworth Formation | 197 | 12-3/4 | 0 - 20 | 8 | 0 - 20 | 0 - 20 | | 1676.73 | --- | --- | NASA |
| | | | 6 | 20 - 197 | --- | --- | | Open Hole | | | | |
| RD-83 | Chatsworth Formation | 143 | 12-3/4 | 0 - 20 | 8 | 0 - 20 | 0 - 20 | | 1661.18 | Bladder | 104 | NASA |
| | | | 6 | 20 - 143 | --- | --- | | Open Hole | | | | |
| RD-84 | Chatsworth Formation | 171 | 10 | 0 - 40 | 5 | 0 - 40 | 0 - 40 | | 1907.83 | --- | --- | Boeing |
| | | | 4 | 40 - 171 | --- | --- | | Open Hole | | | | |
| RD-85 | Chatsworth Formation | 90 | 13-3/8 | 0 - 20 | 8 | 0 - 20 | 0 - 20 | | 1849.09 | Bladder | 75 | DOE |
| | | | 5 | 20 - 90 | --- | --- | | Open Hole | | | | |
| RD-86 | Chatsworth Formation | 80 | 13-3/8 | 0 - 20 | 8 | 0 - 20 | 0 - 20 | | 1830.51 | Bladder | 75 | DOE |
| | | | 5 | 20 - 80 | --- | --- | | Open Hole | | | | |
| RD-87 | Chatsworth Formation | 60 | 13-3/8 | 0 - 20 | 8 | 0 - 20 | 0 - 20 | | 1789.09 | Bladder | 54 (2) | DOE |
| | | | 5 | 20 - 60 | --- | --- | | Open Hole | | | | |
| RD-88 | Chatsworth Formation | 30 | 13-3/8 | 0 - 20 | 8 | 0 - 20 | 0 - 20 | | 1774.62 | Bladder | 45 (2) | DOE |
| | | | 5 | 20 - 30 | --- | --- | | Open Hole | | | | |
| RD-89 | Chatsworth Formation | 50 | 13 | 0 - 30 | 8 | 0 - 30 | 0 - 30 | | 1814.18 | --- | --- | DOE |
| | | | 3.8 | 30 - 50 | --- | --- | | Open Hole | | | | |
| RD-90 | Chatsworth Formation | 125 | 12-3/4 | 0 - 20 | 8 | 0 - 20 | 0 - 20 | | 1784.75 | Bladder | 81 (2) | DOE |
| | | | 6 | 20 - 125 | --- | --- | | Open Hole | | | | |
| RD-91 | Chatsworth Formation | 140 | 12-3/4 | 0 - 20 | 8 | 0 - 20 | 0 - 20 | | 1818.04 | --- | --- | DOE |
| | | | 6 | 20 - 140 | --- | --- | | Open Hole | | | | |
| RD-92 | Chatsworth Formation | 105 | 12-3/4 | 0 - 20 | 8 | 0 - 20 | 0 - 20 | | 1833.74 | --- | --- | DOE |
| | | | 6 | 20 - 105 | --- | --- | | Open Hole | | | | |
| RD-93 | Chatsworth Formation | 60 | 13 | 0 - 20 | 8 | 0 - 20 | 0 - 20 | | 1810.48 | --- | --- | DOE |
| | | | 3.8 | 20 - 60 | --- | --- | | Open Hole | | | | |
| RD-94 | Chatsworth Formation | 35 | 13 | 0 - 20.5 | 8 | 0 - 20.5 | 0 - 20.5 | | 1744.38 | --- | --- | DOE |
| | | | 3.8 | 20.5 - 35 | --- | --- | | Open Hole | | | | |
| RD-95 | Chatsworth Formation | 80 | 13 | 0 - 50 | 8 | 0 - 50 | 0 - 50 | | 1811.36 | --- | --- | DOE |
| | | | 3.8 | 50 - 80 | --- | --- | | Open Hole | | | | |
| RD-96 | Chatsworth Formation | 90 | 13 | 0 - 20 | 8 | 0 - 20 | 0 - 20 | | 1805.14 | Bladder | 73 | DOE |
| | | | 4 | 20 - 90 | --- | --- | | Open Hole | | | | |
| RD-97 | Chatsworth Formation | 74.5 | 13 | 0 - 20 | 8 | 0 - 20 | 0 - 20 | | 1792.22 | --- | --- | DOE |
| | | | 4 | 20 - 74.5 | --- | --- | | Open Hole | | | | |

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| Well Identifier | Geological Unit | Effective Borehole Depth (ft BLS) | Borehole Diameter (inches) | Borehole Interval (ft BLS) | Casing Inside Diameter (inches) | Casing Interval (ft BLS) | Sealed Interval (ft BLS) | Perforated Interval (ft BLS) | Measuring Point Elevation (ft MSL) | Low-Flow Pump Type | Low-Flow Pump Setting[1] (ft BLS) | Sponsor |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RD-98 | Chatsworth Formation | 65 | 13-3/8 | 0 - 20 | 8-1/8 | 0 - 20 | 0 - 20 | | 1808.73 | --- | --- | DOE |
| | | | 5-1/2 | 20 - 65 | --- | --- | --- | Open hole | | | | |
| RD-104 | Chatsworth Formation | 60.5 | 22 | 0 -5 | 8-5/8 | 0 - 5 | 0 - 5 | | 1826.49 | Bladder[3] | --- | NASA |
| | | | 13-1/8 | 5 - 30 | 8-5/8 | 5 - 29 | 5 - 29 | | | | | |
| | | | 5-1/2 | 30 - 60.5 | --- | --- | --- | Open hole | | | | |
| RS-01 | Near Surface | 24.5 | 16 | 0 - 24.5 | 4 | 0 - 24.5 | 0 - 12.5 | 14.5 - 24.5 | 1879.68 | --- | --- | Boeing |
| RS-02 | Near Surface | 26 | 16 | 0 - 26 | 4 | 0 - 26 | 0 - 15 | 16 - 26 | 1901.08 | --- | --- | NASA |
| RS-03 | Near Surface | 21 | 16 | 0 - 21 | 4 | 0 - 21 | 0 - 10 | 11 - 21 | 1834.22 | --- | --- | Boeing |
| RS-04 | Near Surface | 30 | 16 | 0 - 30 | 4 | 0 - 30 | 0 - 18 | 20 - 30 | 1826.56 | --- | --- | NASA |
| RS-05 | Near Surface | 20 | 16 | 0 - 20 | 4 | 0 - 20 | 0 - 7.5 | 10 - 20 | 1783.73 | --- | --- | NASA |
| RS-06 | Near Surface | 18 | 16 | 0 - 18 | 4 | 0 - 18 | 0 - 7 | 8 - 18 | 1757.43 | --- | --- | Boeing |
| RS-07 | Near Surface | 7.5 | 16 | 0 - 7.5 | 4 | 0 - 7.5 | 0 - 1.6 | 2.5 - 7.5 | 1732.27 | Bladder[3] | --- | Boeing |
| RS-08 | Near Surface | 12.5 | 16 | 0 - 12.5 | 4 | 0 - 12.5 | 0 - 5 | 7 - 12.5 | 1821.57(A) | Bladder | 11 | NASA |
| RS-09 | Near Surface | 26.2 | 16 | 0 - 26.2 | 4 | 0 - 26.2 | 0 - 14.2 | 16 - 26.2 | 1735.52 | --- | --- | Boeing |
| RS-10 | Near Surface | 17 | 16 | 0 - 17 | 4 | 0 - 17 | 0 - 6 | 7.3 - 17 | 1762.08 | Bladder[3] | --- | NASA |
| RS-11 | Near Surface | 17.5 | 16 | 0 - 17.5 | 4 | 0 - 17.5 | 0 - 9 | 10 - 17.5 | 1790.39 | --- | --- | DOE |
| RS-12 | Near Surface | 15.3 | 16 | 0 - 15.3 | 4 | 0 - 15.3 | 0 - 4 | 5 - 15.3 | 1727.48 | --- | --- | Boeing |
| RS-13 | Near Surface | 22.8 | 16 | 0 - 22.8 | 4 | 0 - 22.8 | 0 - 15 | 17 - 22.8 | 1645.13 | Bladder[3] | --- | Boeing |
| RS-14 | Near Surface | 16 | 16 | 0 - 16 | 4 | 0 - 16 | 0 - 5 | 6 - 16 | 1734.78 | Bladder[3] | --- | Boeing |
| RS-15 | Near Surface | 12 | 16 | 0 - 12 | 4 | 0 - 12 | 0 - 4.5 | 5 - 12 | 1764.86 | --- | --- | NASA |
| RS-16 | Near Surface | 20.5 | 16 | 0 - 20.5 | 4 | 0 - 20.5 | 0 - 14.5 | 16.5 - 20.5 | 1811.05 | --- | --- | DOE |
| RS-17 | Near Surface | 16 | 16 | 0 - 16 | 4 | 0 - 16 | 0 - 4 | 6.4 - 16 | 1766.52 | --- | --- | Boeing |
| RS-18 | Near Surface | 13 | 16 | 0 - 13 | 4 | 0 - 13 | 0 - 6 | 7.5 - 13 | 1802.86 | Bladder[3] | --- | DOE |
| RS-19 | Near Surface | 15 | 16 | 0 - 15 | 4 | 0 - 15 | 0 - 4.8 | 4.8 - 15 | 1812.42 | --- | --- | NASA |
| RS-20 | Near Surface | 20.5 | 16 | 0 - 20.5 | 4 | 0 - 20.5 | 0 - 8.5 | 10.5 - 20.5 | 1823.77 | Bladder[3] | --- | Boeing |
| RS-21 | Near Surface | 29 | 16 | 0 - 29 | 4 | 0 - 24.6 | 0 - 3.5 | 14.5 - 24.6 | 1767.36 | --- | --- | Boeing |
| RS-22 | Near Surface | 31 | 16 | 0 - 31 | 4 | 0 - 31 | 0 - 4 | 21 - 31 | 1771.23 | --- | --- | Boeing |
| RS-23 | Near Surface | 13 | 12 | 0 - 13 | 4 | 0 - 13 | 0 - 6.8 | 8 - 13 | 1887.25 | --- | --- | DOE |
| RS-24 | Near Surface | 8.5 | 12 | 0 - 8.5 | 4 | 0 - 8.5 | 0 - 3 | 4 - 8.5 | 1809.24 | --- | --- | DOE |
| RS-25 | Near Surface | 13.5 | Trenched | 0 - 13.5 | 4 | 0 - 13.5 | 0 - 2 | 8.5 - 13.5 | 1862.71 | --- | --- | DOE |
| RS-27 | Near Surface | 9 | 8 | 0 - 9 | 4 | 0 - 9 | 0 - 3 | 5 - 9 | 1804.78 | --- | --- | DOE |
| RS-28 | Near Surface | 19 | 8 | 0 - 19 | 4 | 0 - 19 | 0 - 9 | 14 - 19 | 1768.59 | --- | --- | DOE |
| RS-29 | Near Surface | 38 | 9-7/8 | 0 - 38 | 4 | 0 - 37.5 | 0 - 17 | 27 - 37.5 | 1833.09 | --- | --- | Boeing |

See last page of table for notes and abbreviations.

| | | | Borehole | | Casing | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Well Identifier** | **Geological Unit** | **Effective Borehole Depth (ft BLS)** | **Diameter (inches)** | **Interval (ft BLS)** | **Inside Diameter (inches)** | **Interval (ft BLS)** | **Sealed Interval (ft BLS)** | **Perforated Interval (ft BLS)** | **Measuring Point Elevation (ft MSL)** | **Low-Flow Pump Type** | **Low-Flow Pump Setting[1] (ft BLS)** | **Sponsor** |
| RS-30 | Near Surface | 23 | 12 | 0 - 23 | 4 | 0 - 21 | 0 - 9 | 10.5 - 21 | 1909.01 | --- | --- | Boeing |
| RS-31 | Near Surface | 18 | 12 | 0 - 18 | 4 | 0 - 17.5 | 0 - 6 | 7 - 17.5 | 1909.03 | --- | --- | Boeing |
| RS-32 | Near Surface | 18 | 12 | 0 - 18 | 4 | 0 - 17 | 0 - 6 | 6.5 - 17 | 1908.99 | --- | --- | Boeing |
| RS-33 | Near Surface | 35 | 8-1/2 | 0 - 35 | 4 | 0 - 35 | 0 - 14.5 | 14.5 - 34.5 | 1728.89 | Bladder | 35.9 | Boeing |
| RS-34 | Near Surface | 35 | 8-1/2 | 0 - 35 | 4 | 0 - 35 | 0 - 14.5 | 14.5 - 34.5 | 1808.87 | Bladder | 35.2 | NASA |
| RS-35 | Near Surface | 28 | 8-1/2 | 0 - 28 | 4 | 0 - 28 | 0 - 17.5 | 17.5 - 27.5 | 1900.07 | Bladder[3] | --- | Boeing |
| RS-54 | Near Surface | 38 | 11-1/4 | 0 - 7 | 6-1/4 | 0 – 7 | 0 - 7 | | 1846.66 | --- | --- | DOE |
| | | | 5-7/8 | 7 - 38 | --- | --- | | Open Hole | | | | |
| SH-01 | Near Surface | 10 | 16 | 0 - 10 | 4 | 0 - 10 | 0 - 5 | 5.5 - 10 | 1772.84 | --- | --- | Boeing |
| SH-02 | Near Surface | 10.6 | 16 | 0 - 10.6 | 4 | 0 - 10.6 | 0 - 5 | 6 - 10.6 | 1762.76 | Bladder[3] | --- | Boeing |
| SH-03 | Near Surface | 9.5 | 16 | 0 - 9.5 | 4 | 0 - 9.5 | 0 - 4.6 | 5 - 9.5 | 1762.53 | Bladder[3] | --- | Boeing |
| SH-04 | Near Surface | 17 | 16 | 0 - 17 | 4 | 0 - 13 | 0 - 8 | 9 - 13 | 1765.08 | Bladder[3] | --- | Boeing |
| SH-05 | Near Surface | 10.5 | 16 | 0 - 10.5 | 4 | 0 - 10.5 | 0 - 5.6 | 6 - 10.5 | 1762.97 | --- | --- | Boeing |
| SH-06 | Near Surface | 11.5 | 16 | 0 - 11.5 | 4 | 0 - 11.5 | 0 - 6.2 | 7 - 11.5 | 1776.99 | --- | --- | Boeing |
| SH-07 | Near Surface | 13.5 | 16 | 0 - 13.5 | 4 | 0 - 13.5 | 0 - 8.5 | 9.5 - 13.5 | 1775.11 | Bladder[3] | --- | Boeing |
| SH-08 | Near Surface | 12 | 16 | 0 - 12 | 4 | 0 - 11.4 | 0 - 5.2 | 5.9 - 11.4 | 1763.25 | --- | --- | Boeing |
| SH-09 | Near Surface | 9 | 16 | 0 - 9 | 4 | 0 - 9 | 0 - 3.5 | 4 - 9 | 1761.19 | Bladder[3] | --- | Boeing |
| SH-10 | Near Surface | 8 | 16 | 0 - 8 | 4 | 0 - 7.5 | 0 - 2 | 3 - 7.5 | 1757.69 | --- | --- | Boeing |
| SH-11 | Near Surface | 17.5 | 16 | 0 - 17.5 | 4 | 0 - 17.5 | 0 - 11 | 13 - 17.5 | 1756.00 | Bladder[3] | --- | Boeing |
| WS-04A | Chatsworth Formation | 502 | 13 | 0 - 300 | 10-1/4 | 0 - 288 | Unknown | 96 - 288 | 1749.77(A) | ES-VFD | 329 | NASA |
| | | | 10 | 300 - 502 | --- | --- | | Open Hole | | | | |
| WS-05 | Chatsworth Formation | 2304 | >12-1/4 | 0 - 40 | 12 | 0 - 40 | 0 - 55 | | 1830.20 | --- | --- | Boeing |
| | | | 12-1/4 | 40 - 2304 | --- | --- | | Open Hole | | | | |
| WS-06 | Chatsworth Formation | 1440 | 30 | 0 - 6 | 12-1/8 | 0 - 450 | 0 - 6 | 306 - 450 | 1932.72 | --- | --- | Boeing |
| | | | 13 | 6 - 450 | --- | --- | | | | | | |
| | | | 8-1/4 | 450 - 1440 | | | | Open Hole | | | | |
| WS-07 | Chatsworth Formation | 700 | 15 | 0 - 400 | 12-1/8 | 0 - 400 | Unknown | 216 - 400 | 1826.19 | --- | --- | DOE |
| | | | 10 | 400 - 700 | --- | --- | | Open Hole | | | | |
| WS-08 | Chatsworth Formation | 700 | 15 | 0 - 400 | 12-1/8 | 0 - 400 | Unknown | 192 - 400 | 1794.39 | --- | --- | Boeing |
| | | | 10 | 400 - 700 | --- | --- | | Open Hole | | | | |
| WS-09 | Chatsworth Formation | 1800 | 30 | 0 - 17 | 12-1/8 | 0 - 17 | 0 - 14 | | 1883.99 | --- | --- | Boeing |
| | | | 15 | 17 - 690 | --- | --- | | | | | | |
| | | | 10 | 690 - 1800 | --- | --- | | Open Hole | | | | |

See last page of table for notes and abbreviations.

**TABLE VI**
WATER LEVEL MONITORING PROGRAM
WELL CONSTRUCTION DETAILS
SANTA SUSANA FIELD LABORATORY
VENTURA COUNTY, CALIFORNIA

| | | | Borehole | | Casing | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Well Identifier** | **Geological Unit** | **Effective Borehole Depth (ft BLS)** | **Diameter (inches)** | **Interval (ft BLS)** | **Inside Diameter (inches)** | **Interval (ft BLS)** | **Sealed Interval (ft BLS)** | **Perforated Interval (ft BLS)** | **Measuring Point Elevation (ft MSL)** | **Low-Flow Pump Type** | **Low-Flow Pump Setting[1] (ft BLS)** | **Sponsor** |
| WS-09A | Chatsworth Formation | 541 | 30 | 0 - 34 | 14 | 0 - 34 | 0 - 20 | | 1647.61 | NA*** | NA*** | NASA |
| | | | 15 | 34 - 541 | 12-1/8 | 0 - 541 | | | | | | |
| | | | | | 8-1/4 | 0 - 539 | | 20 - 539 | | | | |
| WS-09B | Chatsworth Formation | 220 | 16 | 0 - 220 | --- | --- | Unknown | Open Hole | 1796.89 | --- | --- | Boeing |
| WS-11 | Chatsworth Formation | 677 | 13 | 0 - 400 | 12-1/8 | 0 - 400 | Unknown | 200 - 400 | 1748.70 | --- | --- | Boeing |
| | | | 9 | 400 - 677 | 8-1/4 | 365.5 - 615 | | 365 - 615 | | | | |
| | | | | | | | | Open Hole | | | | |
| WS-12 | Chatsworth Formation | 1768 | 15 | 0 - 408 | 14 | 0 - 375 | Unknown | | 1705.98 | --- | --- | Boeing |
| | | | 12 | 408 - 1768 | --- | --- | | Open Hole | | | | |
| WS-13 | Chatsworth Formation | 940 | >13 | 0 - 750 | 12-1/8 | 0 - 750 | 0 - 15 | 22 - 750 | 1658.62 | --- | --- | Boeing |
| | | | 11-1/2 | 750 - 940 | --- | --- | | Open Hole | | | | |
| WS-14 | Chatsworth Formation | 1272 | >16 | 0 - 40 | 16 | 0 - 40 | Unknown | | 1878.23 | --- | --- | Boeing |
| | | | 12-3/4 | 40 - 1272 | --- | --- | | Open Hole | | | | |
| WS-SP | Chatsworth Formation | 203 | Unknown | 0 - 203 | 6 | 0 - 203 | Unknown | Unknown | 1766.76 | --- | --- | NASA |

| Additional Monitoring Points for Water Levels | | |
|---|---|---|
| **Identifier** | **Geological Unit** | **Sponsor** |
| ECL-FD | Near Surface | Boeing |
| ECL-Sump | Near Surface | Boeing |

See last page of table for notes and abbreviations.

1. (---) = No casing installed over the borehole interval specified; open hole.

2. ES-VFD = Electric submersible- variable frequency drive.

3. ft BLS = Feet below land surface.

4. ft MSL = Feet above mean sea level.

5. NA = No data available or not applicable.

6. OS = Off-site.

7. (a) = The difference between the effective borehole depth and the drilled depth of the borehole was filled with sloughed native material and/or bentonite.

8. (c) = Below grade completion.

9. (v) = Top of well below land surface, installed inside zero-grade vault.

10. * = Well is equipped with QED SpectraSample™ flow-equalization inlets at equally-spaced intervals, as indicated by the settings below in Feet Below Top of Casing (ft BTOC):

| HAR-05 | HAR-21 | RD-01 | RD-09 | RD-13 | RD-18 | RD-45A | RD-63 | RD-71 |
|---|---|---|---|---|---|---|---|---|
| 26.5 | 43 | 257 | TBD | 75 | 110 | 270 | 55 | 191 |
| 51.5 | 59.5 | 302 | TBD | 91 | 135 | 305 | 89 | 208 |
| 76.5 | 76 | 352 | TBD | 167 | 160 | 340 | 123 | 225 |
| 101.5 | 92.5 | 402 | TBD | 123 | 185 | 375 | 157 | 242 |
| 126.5 | 109 | 452 | TBD | 139 | 210 | 410 | 191 | 259 |
| 151.5 | NA | 502 | TBD | 155 | 235 | 445 | 225 | 276 |

11. ** = Well RD-53 contains an inoperable submersible pump at the bottom of the well at approximately 159 feet bls that could not be retrieved.

12. *** = WS-09A will not be equipped with a low-flow pump as it is a proposed extraction well for Groundwater Interim Measures (GWIM).

13. (A) = Elevation represents surveyed measuring point elevation prior to low-flow equipment retrofit.

14. (1) = Depth of pump intake may be modified based on water levels or pump performance.

15. (2) = Pump setting pending field verification and vendor design.

16. (3) = Well is typically dry and will be sampled when water present using portable, non-dedicated sampling apparatus.

17. (4) = Well is equipped with a "drop inlet" below the pump setting.

| Well | Pump Setting (ft BTOC) |
|---|---|
| RD-05B | 138.3 |
| RD-05C | 127.6 |
| RD-36C | 277.2 |
| RD-36D | 431.4 |
| RD-39B | 365 |
| RD-41B | 162 |
| RD-43C | 172.9 |
| RD-46B | 150.9 |
| RD-52C | 200 |
| RD-55B | 131.4 |
| RD-58B | 180.3 |
| RD-58C | 194.7 |

18. (5) = FLUTe installed in well.

| Well | Port | Spacer Interval (ft btc) |
|---|---|---|
| RD-07 | No datalogger installed | |
| RD-21 | 1 | 85 - 95 |
| | 2 | 105 - 115 |
| | 3 | 125 - 135 |
| | 4 | 145 - 155 |
| | 5 | 165 - 175 |
| RD-22 | 1 | 310 - 320 |
| | 2 | 330 - 340 |
| | 3 | 350 - 360 |
| | 4 | 370 - 380 |
| | 5 | 390 - 400 |
| | 6 | 410 - 420 |
| | 7 | 430 - 440 |
| RD-23 | 1 | 231 - 241 |
| | 2 | 251 - 261 |
| | 3 | 271 - 281 |
| | 4 | 291 - 301 |
| | 5 | 311 - 321 |
| | 6 | 331 - 341 |
| | 7 | 351 - 361 |
| | 8 | 371 - 381 |
| | 9 | 391 - 396.5 |
| RD-33A | 1 | 211 - 221 |
| | 2 | 231 - 241 |
| | 3 | 251 - 261 |
| | 4 | 271 - 281 |
| | 5 | 291 - 301 |
| | 6 | 311 - 321 |

| Well | Port | Spacer Interval (ft btc) |
|---|---|---|
| RD-50 | 1 | 106 - 116 |
| | 2 | 126 - 136 |
| | 3 | 146 - 156 |
| | 4 | 166 - 176 |
| | 5 | 186 - 196 |
| RD-54A | 1 | 150.5 - 160.5 |
| | 2 | 170.5 - 180.5 |
| | 3 | 190.5 - 200.5 |
| | 4 | 210.5 - 220.5 |
| | 5 | 230.5 - 240.5 |
| | 6 | 250.5 - 260.5 |
| | 7 | 270.5 - 280.5 |
| RD-57 | 1 | 228 - 238 |
| | 2 | 248 - 258 |
| | 3 | 268 - 278 |
| | 4 | 288 - 298 |
| | 5 | 308 - 318 |
| | 6 | 328 - 338 |
| | 7 | 348 - 358 |
| | 8 | 368 - 378 |
| | 9 | 388 - 398 |
| | 10 | 408 - 418 |

| Well | Port | Spacer Interval |
|---|---|---|
| RD-64 | 1 | 170.5 - 180.5 |
| | 2 | 190.5 - 200.5 |
| | 3 | 210.5 - 220.5 |
| | 4 | 230.5 - 240.5 |
| | 5 | 250.5 - 260.5 |
| | 6 | 270.5 - 280.5 |
| | 7 | 290.5 - 300.5 |
| | 8 | 310.5 - 320.5 |
| | 9 | 330.5 - 340.5 |
| | 10 | 350.5 - 360.5 |
| | 11 | 370.5 - 380.5 |
| | 12 | 390.5 - 400.5 |
| RD-65 | 1 | 167 - 177 |
| | 2 | 187 - 197 |
| | 3 | 207 - 217 |
| | 4 | 227 - 237 |
| | 5 | 247 - 257 |
| | 6 | 267 - 277 |
| | 7 | 287 - 297 |
| | 8 | 307 - 317 |
| | 9 | 327 - 337 |
| | 10 | 347 - 357 |
| | 11 | 367 - 377 |
| | 12 | 387 - 397 |
| RD-72 | 1 | 45 - 55 |
| | 2 | 65 - 75 |
| | 3 | 85 - 95 |
| | 4 | 105 - 115 |
| | 5 | 125 - 135 |
| | 6 | 145 - 155 |
| | 7 | 165 - 175 |
| | 8 | 185 - 195 |

19. (6) = Westbay installed in well.

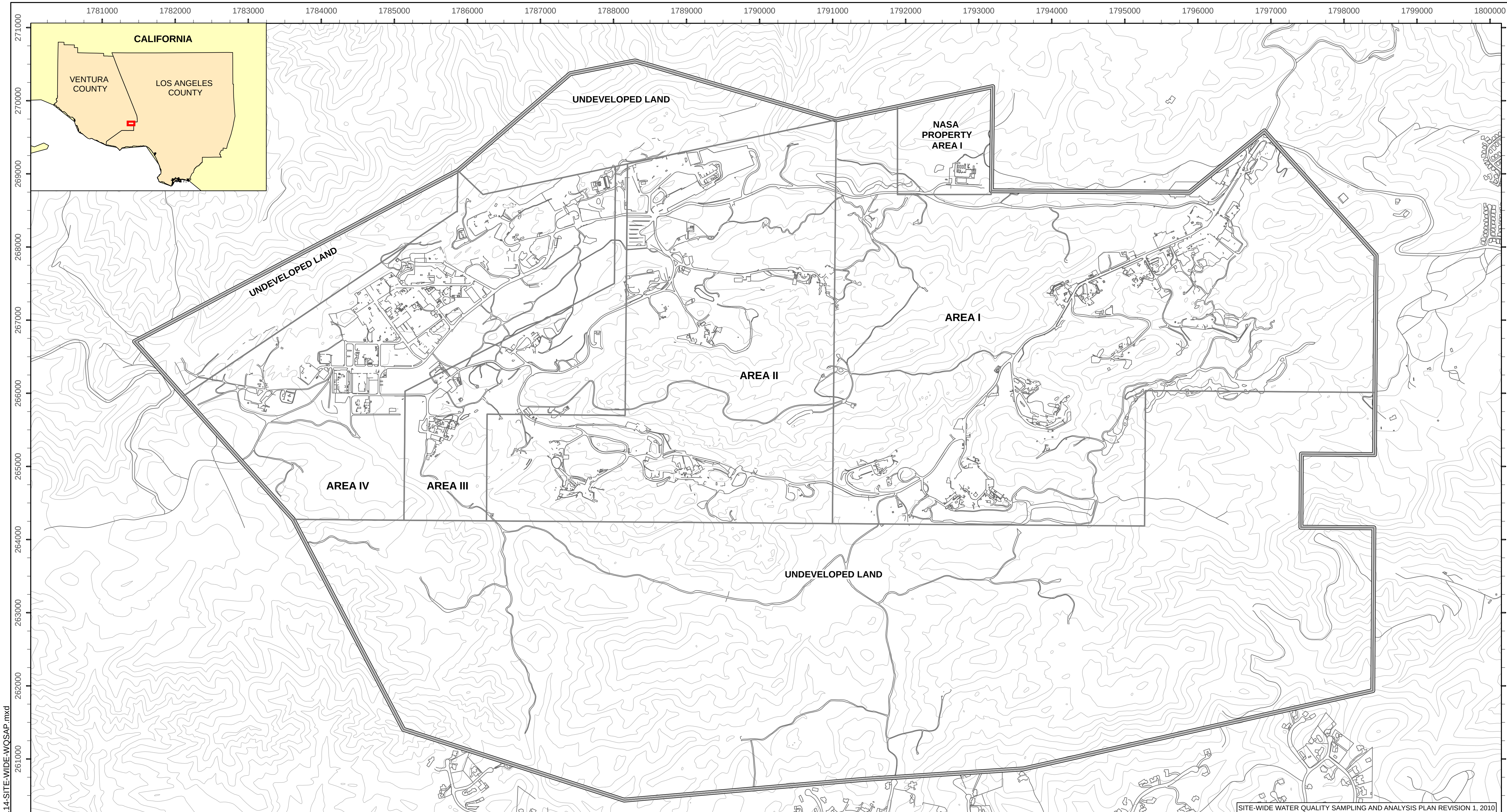
A "Zone" is the designation given to a section of the Westbay that includes a measuring port and a pumping port. A pumping port enables the zone to be purged.

A "QA" is a section of the Westbay that only has a measuring port. This interval can be sampled, but not purged.

| Well | Port | Zone Length (ft btc) |
|---|---|---|
| OS-09R | Zone 01 | 29-40 |
| | Zone 02 | 45-52 |
| | QA-1 | 57-62 |
| | Zone 03 | 65-88 |
| | QA-2 | 93-97 |
| | Zone 04 | 100-127 |
| | Zone 05 | 132-145 |
| | Zone 06 | 150-173 |
| | Zone 07 | 178-200 |
| | Zone 08 | 205-216 |
| | Zone 09 | 221-245 |
| | QA-3 | 248-252 |
| | Zone 10 | 255-275 |
| | Zone 11 | 280-290 |
| | Zone 12 | 295-305 |
| | Zone 13 | 310-335 |
| | Zone 14 | 340-355 |
| | Zone 15 | 360-375 |
| | Zone 16 | 380-406 |

| Well | Port | Zone Length (ft btc) |
|---|---|---|
| RD-31 | QA-01 | 30-182 |
| | Zone 01 | 186 - 201 |
| | Zone 02 | 204 - 219 |
| | QA-02 | 222 - 229 |
| | Zone 03 | 232 - 243 |
| | QA-03 | 246 - 249 |
| | Zone 04 | 252 - 265 |
| | QA-04 | 268 - 272 |
| | QA-05 | 275 - 279 |
| | Zone 05 | 282 - 290 |
| | QA-06 | 293 - 295 |
| | QA-07 | 298 - 305 |
| | QA-08 | 308 - 310 |
| | QA-09 | 313 - 320 |
| | Zone 06 | 323 - 336 |
| | QA-10 | 339 - 351 |
| | QA-11 | 354 - 358 |
| | QA-12 | 361 - 370 |
| | Zone 07 | 373 - 387 |

| Well | Port | Zone Length (ft btc) |
|---|---|---|
| RD-31 | QA-13 | 390 - 393 |
| | Zone 08 | 396 - 405 |
| | QA-14 | 408 - 419 |
| | QA-15 | 422 - 429 |
| | QA-16 | 432 - 441 |
| | Zone 09 | 444 - 456 |
| | QA-17 | 459 - 463 |
| | Zone 10 | 466 - 476 |
| | QA-18 | 479 - 482 |
| | QA-19 | 486 - 491 |
| | QA-20 | 494 - 497 |
| | Zone 11 | 500 - 507 |
| | QA-21 | 510 - 516 |
| | QA-22 | 519 - 521 |
| | Zone 12 | 524 - 533 |




SITE-WIDE WATER QUALITY SAMPLING AND ANALYSIS PLAN REVISION 1, 2010

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## LEGEND

SITE AREA BOUNDARY

SSFL PROPERTY BOUNDARY

Map Coordinates: CA State Plane, NAD 27, Zone V, US Survey FT

N W E S

0 2000 4000

SCALE IN FEET

HALEY & ALDRICH

THE BOEING COMPANY
SANTA SUSANA FIELD LABORATORY
VENTURA COUNTY, CALIFORNIA

FACILITY LOCATION MAP

SCALE: AS SHOWN
DECEMBER 2010

FIGURE 1


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## LEGEND

- SPRING
- CHATSWORTH FORMATION MONITOR WELL
- CHATSWORTH FORMATION EXTRACTION WELL
- PROPERTY BOUNDARY LINE
- FAULT, SHEAR ZONE, AND/OR DEFORMATION BAND

| | |
|---|---|
| 1600 | APPROXIMATE CONTOUR OF EQUAL WATER LEVEL ELEVATION, IN FEET ABOVE MEAN SEA LEVEL. CONTOUR INTERVAL 50 FEET. |
| 1623.10 | WATER LEVEL ELEVATION, IN FEET ABOVE MEAN SEA LEVEL. |
| 1658.64 | WATER LEVEL ELEVATION, IN FEET ABOVE MEAN SEA LEVEL. WATER LEVEL NOT USED TO GENERATE CONTOUR LINES. |
| UTM | UNABLE TO MEASURE |
| NM | NOT MEASURED |

LEGEND FOR GEOLOGY: REFER TO FIGURE 5, GEOLOGIC MAP, IN "REPORT ON ANNUAL GROUNDWATER MONITORING, 2008, SANTA SUSANA FIELD LABORATORY, VENTURA COUNTY, CALIFORNIA" DATED 27 FEBRUARY 2009.

| | |
|---|---|
| KUCC | GEOLOGIC UNIT |
| | MARKER BED |
| KLCS | GEOLOGIC UNIT |

GEOLOGY PROVIDED BY MWH. "GEOLOGIC CHARACTERIZATION OF THE CENTRAL SANTA SUSANA FIELD LABORATORY, VENTURA COUNTY, CA", 2007.

WATER LEVEL ELEVATIONS ARE PROVIDED FOR ILLUSTRATIVE PURPOSES ONLY AND ARE NOT INTENDED TO INFER GROUNDWATER FLOW CONDITIONS. THE LATERAL DIRECTION OF GROUNDWATER MOVEMENT CANNOT BE ASCERTAINED FROM THE CONTOUR LINES BECAUSE OF STRATIGRAPHIC AND STRUCTURAL PROPERTIES OF THE BEDROCK.

CONTOURS ARE BASED ON MEASURED WATER LEVELS IN CONVENTIONAL WELLS. ACTUAL WATER LEVELS IN THE SUBSURFACE WILL VARY FROM THOSE SHOWN.

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SITE-WIDE WATER QUALITY SAMPLING AND ANALYSIS PLAN, REVISION 1, 2010

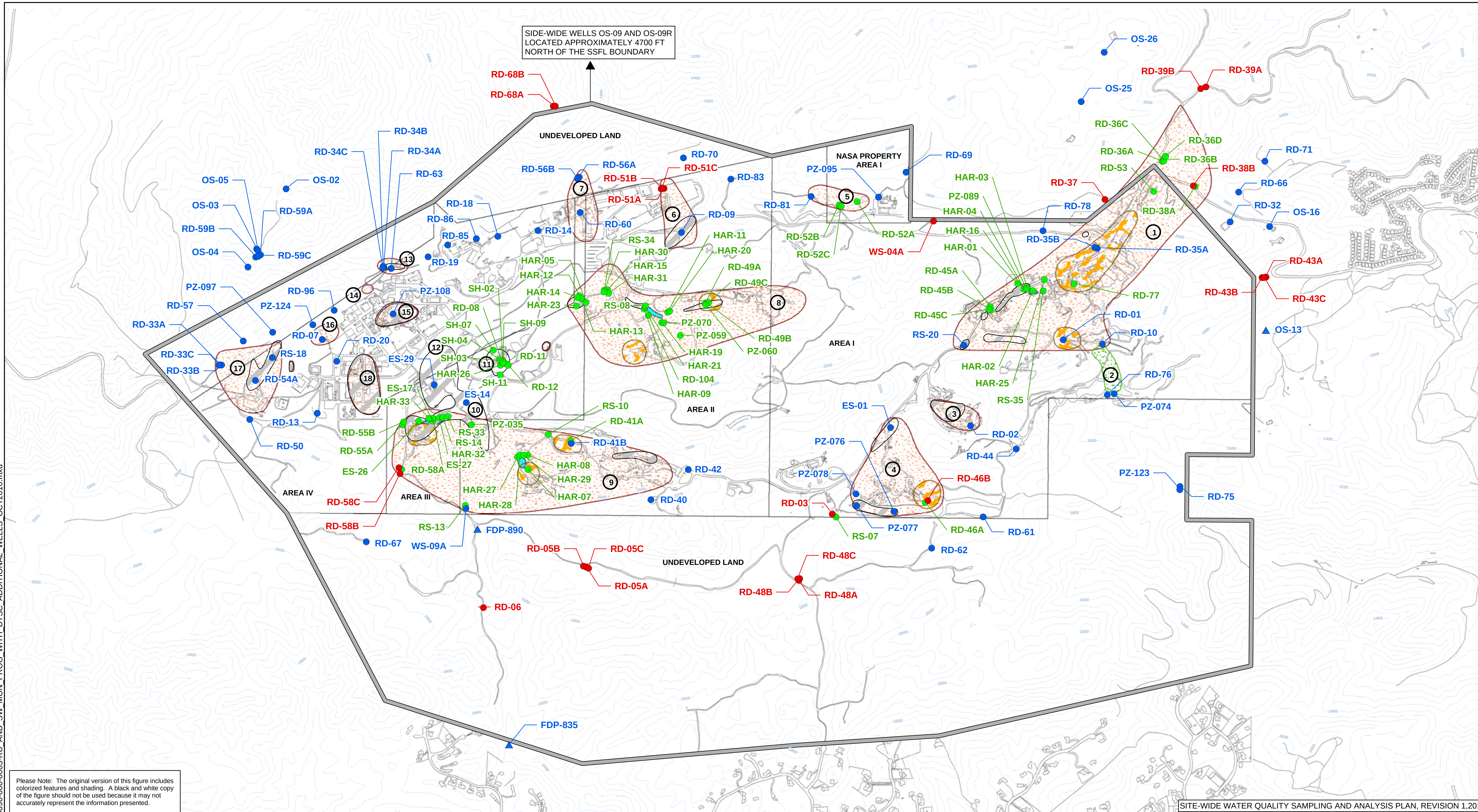
HALEY & ALDRICH

THE BOEING COMPANY
SANTA SUSANA FIELD LABORATORY
VENTURA COUNTY, CALIFORNIA

## CHATSWORTH FORMATION WATER LEVEL ELEVATION CONTOUR MAP - APRIL 2009

SCALE: AS SHOWN
DECEMBER 2010

FIGURE 2




Please Note: The original version of this figure includes colorized features and shading. A black and white copy of the figure should not be used because it may not accurately represent the information presented.

SITE-WIDE WATER QUALITY SAMPLING AND ANALYSIS PLAN, REVISION 1,2010

## LEGEND

- SITE-WIDE AND REGULATED UNIT MONITORING NETWORK WELL
- SITE-WIDE MONITORING NETWORK WELL
- REGULATED UNIT MONITORING PROGRAM WELL
- SITE-WIDE MONITORING NETWORK SPRING
- PROPERTY BOUNDARY
- REGULATED UNIT
- TCE GREATER THAN 5 ug/L IN NEAR SURFACE GROUNDWATER
- TCE GREATER THAN 5 ug/L IN CHATSWORTH FORMATION GROUNDWATER
- TCE GREATER THAN 1,000 ug/L IN CHATSWORTH FORMATION GROUNDWATER
- PERCHLORATE
- 5 GROUNDWATER IMPACT AREA

NOTES:
- ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE
- SW GROUNDWATER MONITORING PROGRAM SPRINGS AND SEEPS ARE NOT INDICATED.
- **SPA** = STORABLE PROPELLANT AREA
- **ABSP** = ALFA BRAVO SKIM POND
- **ECL** = ENGINEERING CHEMISTRY LAB
- **STL IV** = SYSTEMS TEST LABORATORY IV
- **APTF** = ADVANCED PROPULSION TEST FACILITY

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SCALE IN FEET

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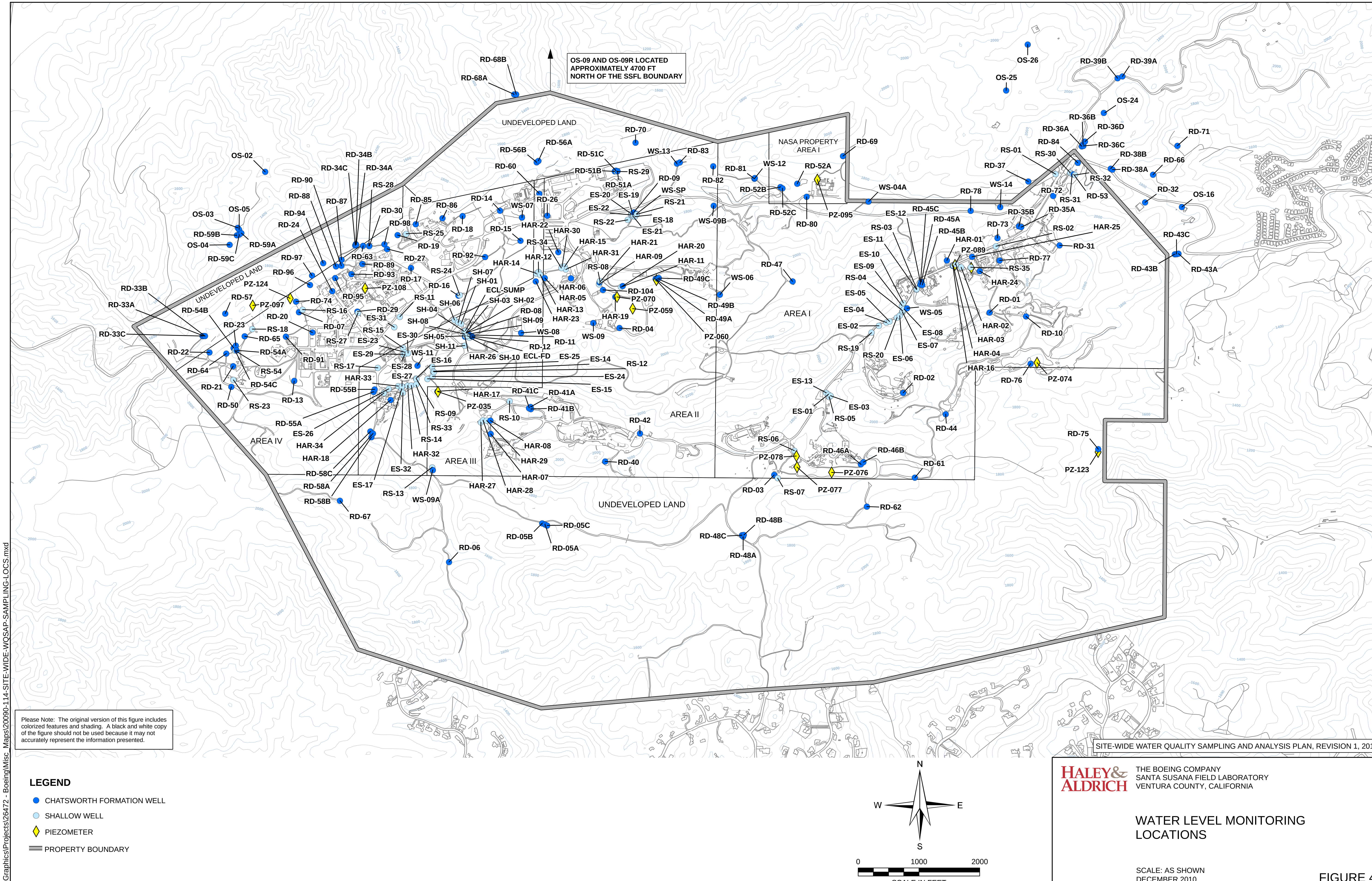
THE BOEING COMPANY
SANTA SUSANA FIELD LABORATORY
VENTURA COUNTY, CALIFORNIA

MONITOR WELL NETWORK, SITE-WIDE GROUNDWATER MONITORING PROGRAM

SCALE: AS SHOWN
DECEMBER 2010

FIGURE 3

G:\Graphics\Projects\26472\Misc_Maps\20090-000-0003-RU_AND_SW_MON_PROG_WITH_DTSC_ADDITIONAL_WELLS_OCT2010.mxd




Please Note: The original version of this figure includes colorized features and shading. A black and white copy of the figure should not be used because it may not accurately represent the information presented.

SITE-WIDE WATER QUALITY SAMPLING AND ANALYSIS PLAN, REVISION 1, 2010

**LEGEND**

- CHATSWORTH FORMATION WELL
- SHALLOW WELL
- PIEZOMETER
- PROPERTY BOUNDARY

HALEY & ALDRICH

THE BOEING COMPANY
SANTA SUSANA FIELD LABORATORY
VENTURA COUNTY, CALIFORNIA

## WATER LEVEL MONITORING LOCATIONS

SCALE: AS SHOWN
DECEMBER 2010

FIGURE 4

G:\Graphics\Projects\26472 - Boeing\Misc_Maps\20090-114-SITE-WIDE-WQSAP-SAMPLING-LOCS.mxd

# APPENDIX A

# GROUNDWATER MONITORING FIELD SAMPLING PLAN

**GROUNDWATER MONITORING
FIELD SAMPLING PLAN
SANTA SUSANA FIELD LABORATORY
VENTURA COUNTY, CALIFORNIA
REVISION 1**

**by**

**Haley & Aldrich, Inc.
Tucson, Arizona**

**for**

**The Boeing Company,
National Aeronautics and Space Administration (NASA), and
United States Department of Energy (DOE)
Ventura County, California**

**File No. 20090-456/556/656/M503
December 2010**

**TABLE OF CONTENTS**

## LIST OF TABLES



## LIST OF SECTIONS

# 1. INTRODUCTION

Three Water Quality Sampling and Analysis Plans (WQSAPs) provide guidance for the Santa Susana Field Laboratory (SSFL) to conduct groundwater monitoring and maintain the groundwater monitoring network at the site. One WQSAP is applicable to the Areas I and III Regulated Unit Groundwater Monitoring Program, one is applicable to the Area II Regulated Unit Groundwater Monitoring Program, and one is applicable to the Site-Wide Groundwater Monitoring Program.

This Field Sampling Plan (FSP) presents methodologies for sampling and analyses of groundwater conducted pursuant to the monitoring programs described in the WQSAPs.

## 2. PURPOSE AND SCOPE

The purpose of this field sampling plan (FSP) is to provide methodologies for groundwater sampling activities at SSFL.

The purpose of the groundwater monitoring programs is to:

- Monitor for temporal changes in constituents of concern and/or general water quality at SSFL,
- Determine if the spatial distribution of affected groundwater is stable or migrating, and
- Evaluate whether affected groundwater poses an unacceptable risk to human health or the environment or contributes to degradation of water resources.

The methodologies outlined in this FSP have been prepared to support the data quality objectives outlined in the Quality Assurance Project Plan (QAPP). Analytical constituents and analytical methods are identified in the QAPP.

# 3. SAMPLING TEAM ORGANIZATION

Sampling team members will be organized and their individual responsibilities designated. Individuals will be assigned to manage the tasks associated with the field sampling activities. Individuals may perform one or more of the tasks and be assigned multiple responsibilities.

Before each sampling event, each member of the sampling team will verify that they have read and understood the current versions of the WQSAPs. Two weeks prior to the initiation of each sampling event, the California Department of Toxic Substances Control (DTSC) will be notified of the upcoming sampling event. The notification will include a proposed sampling schedule.

The sampling team members are described below.

## 3.1 Task Manager

The Task Manager is responsible for coordinating field sampling activities with ongoing Facility operations.

The Task Manager's responsibilities will include:

1. Overall coordination of the tasks required for the sampling event and distribution of information to the sampling team;

2. Preparing laboratory task orders and coordinating with the laboratory;

3. Coordinating the identification of sampling locations;

4. Organizing field data;

5. Directing and coordinating the field samplers;

6. Ensuring applicable quality assurance and quality control (QA/QC) procedures are implemented; and

7. Ensuring implementation of applicable health and safety procedures.

## 3.2 On-Site Health and Safety Coordinator

An on-site Health and Safety Coordinator will be designated prior to implementation of sampling activities. The Health and Safety Coordinator is responsible for implementing the provisions of the Health and Safety Plan (HASP) for sampling activities (Appendix C of the WQSAPs). The on-site Health and Safety Coordinator may be one of the sampling personnel.

## 3.3 Field Coordinator

The Field Coordinator will be responsible for the overall coordination and effective use of field personnel on-site and for maintaining a record of field activities.

The Field Coordinator will be responsible for field quality control including:

1. Issuance and tracking of measurement and test equipment;

2. Proper sample labeling, handling, storage, shipping, and chain-of-custody procedures; and

3. Control and timely collection of field records during field investigation activities.

Field coordinators will be identified on a task-specific basis as appropriate for field activities.

### 3.4 Samplers

Samplers are required to be familiar with the requirements of this FSP for those activities associated with the field effort they are about to perform. In addition, the samplers will be responsible for familiarizing themselves with the Health and Safety Plan. Each sampler will be required to sign a document stating that he or she has read and understands the Health and Safety Plan (Appendix C of the WQSAPs).

Samplers will assist the Task Manager and Field Coordinator in the activities required for a sampling event. A sampler has the following responsibilities:

- Mobilizing sampling equipment
- Organizing sampling materials
- Ensuring equipment is in working order
- Collecting samples
- Taking field measurements
- Decontaminating sampling equipment
- Labeling and packaging samples
- Completing chain-of-custody records
- Completing field records
- Maintaining field records
- Control and final disposition of purge or decontamination fluids generated during the sampling activities

# 4. FIELD SAMPLING PROCEDURES

The purpose of this section is to present procedures required for groundwater sampling. This section includes general procedures and guidelines for:

- Pre-sampling preparation
- Calibration and use of field instruments
- Well maintenance
- Sampling methodology
- Sample preservation and shipment (post sampling)
- Sample numbering
- Field documentation and chain-of-custody control
- Decontamination procedures
- Waste containment

Procedures for sampling activities are provided as Standard Operating Procedures (SOPs) in Section 1 of this document. SOPs are presented describing the following activities:

- Measurement of groundwater levels
- Groundwater purging and sampling
- Sample management
- Equipment decontamination

## 4.1 Preparation for Sampling

Activities to be completed by project personnel in preparation for sampling are described below. These activities will be performed before initiating sampling activities to achieve efficient use of field time and ensure that sampling objectives are met.

### 4.1.1 Review of Existing Information

Prior to conducting sampling, personnel will review background information on the site and groundwater to be sampled. This information may include existing sampling data, previous project work plans, and the Health and Safety Plan. Review of this information will assist the sampling personnel in becoming familiar with the location, general condition, and expected range of field test data for the site as a whole and for individual sample locations. Personnel may also need to review the use of the necessary sampling equipment, and health and safety equipment for sampling activities.

### 4.1.2 Organizing Equipment and Materials

It is the responsibility of samplers to ensure that the sampling equipment, health and safety equipment, materials, and appropriate sample bottles are available on-site. SOPs list equipment and materials needed for sampling. The Health and Safety Plan identifies required health and safety equipment.

A California-certified analytical laboratory will provide the appropriate sample bottles. Sample preservatives will be added to the sample containers by the laboratory, as needed, prior to delivery to the samplers. The types of bottles and preservatives provided will vary depending on the parameters to be analyzed. The QAPP lists the preservatives, bottle types and maximum holding times for the indicated analytical methods.

Field activity records, sample labels, and chain-of-custody records will be used to document the sampling events and track the custody of the samples from collection through shipment to the laboratory for analysis.

#### 4.1.3 Calibration and Use of Field Instruments

A list of field instruments (make and model) used during groundwater sampling activities will be maintained. This equipment includes, but is not limited to, water sounders and meters to measure temperature, electrical conductivity (EC), pH, dissolved oxygen (DO), and turbidity. If there are modifications to the equipment list, those will be provided to DTSC. If the equipment is modified during a sampling event, the modifications will be noted in the quarterly monitoring report.

Prior to sampling, field personnel will clean, calibrate, and check equipment for possible malfunction. Calibration procedures provided by the manufacturer will be followed. A field instrument record will be maintained to document equipment calibrations (Table A-II). Calibration records will be completed at the same time the calibrations are performed.

Calibration of the field instruments will be performed in a manner consistent with the manufacturer's recommendations, prior to initial use in the field. Additional calibration may be required if signs of instrument malfunction or questionable readings are observed.

Water-level measuring equipment will be calibrated with a steel survey tape prior to field activities or on a quarterly basis.

Calibration solution expiration dates will be checked prior to calibration of the equipment and replaced with fresh material if expired.

#### 4.1.4 Well Maintenance

A list of equipment (make and model) used during groundwater sampling activities will be maintained. This equipment includes, but is not limited to, dedicated and portable pumps and associated peripherals. Modifications to the equipment list will be provided to DTSC prior to the sampling event. If the equipment is modified during a sampling event, the modifications will be noted in the quarterly monitoring report.

The physical conditions of monitor wells will be documented on the water-level measurement form (Table A-I). During each monitoring event, the exterior of wells will be visually inspected. The operation of dedicated pumping equipment will be observed.

*A. Exterior Maintenance*

The following exterior well features will be inspected:

- well identification signs

- well pad and surface seals
- standing water in well vault
- well security, including protective cover, vault and lock
- general appearance
- overgrown vegetation or soil erosion which could limit access to current or future sampling activities

The condition of the concrete well pad, protective cover, vault, lock and the surface seal will be inspected during each monitoring event. If components are in disrepair, inadequate, or damaged, the condition will be recorded (Table A-I) and recommendations for maintenance will be made.

*B. Down-hole Maintenance*

The operation of dedicated sampling equipment installed in a well will be observed and recorded during purging activities performed for each sampling event. If the dedicated pump and equipment are not operating, the condition will be recorded and recommendations for maintenance will be made.

When down hole maintenance requiring removal of the pumping equipment is performed at a well, the total depth of the well will be measured and recorded. This value will be compared to the recorded depth of construction. Corrective maintenance will be proposed at wells where the total depth has decreased by more than ten percent of the length of the saturated open bore or screened interval. Upon approval, corrective maintenance will be scheduled before the next planned sampling. The corrective maintenance may include bailing and/or airlift swabbing and surging, as appropriate. The re-development will be performed to remove the fill from the bottom of the well and to aid in restoring original well performance. One month will be allowed to pass between well re-development and subsequent sampling.

Records of well maintenance (Table A-V), repairs, and re-development will be maintained and submitted with the annual report.

### 4.2 Sampling Methodology

Three basic items that need to be clearly documented as part of the sampling protocol are: (1) water-level measurements; (2) purge rate, time, volume, and field parameter measurements; and (3) sample collection.

#### 4.2.1 Water-Level Measurements

Groundwater levels are scheduled to be measured prior to the quarterly sampling event, regardless of whether or not the well is to be sampled. The water level will be collected from a known elevation measuring point on the well casing.

Water-level measurement procedures are included in the Manual Water-Level Measurement SOP.

### 4.2.2 Well Purging

Generally, groundwater sampling will be conducted based on U.S. Environmental Protection Agency guidelines described in *Low-Flow (Minimal Drawdown) Ground-water Sampling Procedures,* dated April 1996, and additional guidance provided by DTSC in memoranda entitled *"Post Closure Permits"*, dated 25 March 2008 and *"Santa Susana Field Laboratory Site-Wide Water Quality Sampling and Analysis Plan, dated December 14, 2007"*, dated 07 October 2008.

Lower yield wells (generally those with a specific capacity less than 1 gallon per minute per foot of water-level decline) will be purged and sampled using bladder pumps. Higher yield wells (generally those with a specific capacity greater than 1 gallon per minute per foot of water-level decline) will be purged and sampled using variable frequency drive (VFD) electric submersible pumps.

Wells equipped with bladder pumps or VFD submersible pumps will be purged and sampled using procedures described in the Low-Flow Purge SOP (Section 1.2) and the Groundwater Sampling SOP (Section 1.3). When low-flow purging, a minimum volume of groundwater equal to the volume of the sample purging equipment (pumps, piping, tubing and flow cell) will be initially purged. The total volume of groundwater purged from a well prior to sample collection will be determined by parameter stabilization, as described in the Groundwater Sampling and Low-Flow Purge SOPs.

Exceptions to low-flow sampling protocols include some wells equipped with Westbay Sampling Systems or FLUTe Multilevel Sampling Systems, artesian wells, off-site private wells, groundwater extraction wells, or other wells not equipped with low-flow pump apparatus.

Wells in the Regulated Unit and Site-Wide monitoring programs that are indicated by past monitoring to be typically dry will be sampled when water is present using portable, non-dedicated bladder pumps and dedicated tubing installed in the well. Portable pumps will be decontaminated prior to installation and used according to the procedures described in the Equipment Decontamination SOP (Section 1.7).

Some wells may be equipped with multi-level sampling systems, such as the FLUTe or Westbay sampling systems. Procedures for sampling these wells are described in the FLUTe Multilevel Sampling System and Westbay Multilevel Sampling System SOPs.
Flowing artesian wells and wells connected to a groundwater extraction and treatment system are assumed to be fully purged, and samples may be collected at the discharge point. At artesian wells equipped with valves, a pressure reading shall be obtained prior to opening the valve to begin purging activities. Artesian wells equipped with valves will be purged until parameters stabilize, or for one hour, before collecting a sample.

Wells connected to an extraction system are equipped with high and low water-level controls; as a result, groundwater discharge may not be continuous. Some extraction wells may have to be turned off and water levels allowed to recover over night before sampling. After recovery of an adequate water column for sampling, the well can turned on and samples collected from the groundwater discharge sampling point. A volume of water equal to the volume of the discharge piping should be purged before sampling.

Off-site, private wells will be purged using the installed pump equipment until parameters stabilize, or for one hour (if the owner permits), before collecting a sample.

Occasionally it may be necessary to collect groundwater samples from monitor wells not included in the Regulated Unit or Site-Wide programs. These wells may be equipped with non-variable-speed electric submersible pumps that are not consistent with low-flow purging as described in the Low-Flow Purge SOP (Section 1.2). Wells equipped with non-variable-speed pumps will be purged according to follow procedures:

- Make sure equipment necessary for operation of the submersible pump is in place, including an appropriate waste containment vessel.
- If using a portable generator to power the well, ensure that the generator is downwind of the well.
- Connect discharge piping at the wellhead; usually a riser pipe that threads into the top of the column pipe with an elbow or tee above the top of the well vault. Downstream from the tee is the typical location of the flow meter used to measure flow rate and total volume evacuated, and a flow-control valve to control the flow rate. Between the tee and the flow meter and gate valve should be installed to divert flow through a flow cell for parameter measurements and a sample port for collection of samples.
- A garden hose or similar should be used to convey water from the discharge piping to the appropriate waste containment vessel.
- Before starting the pump, have a water-level measuring device in the well and lowered to the water level, so that drawdown measurements can be made upon start-up.
- When piping and electrical connections are properly completed, the generator is turned on or the power is switched on, starting the pump.
- The water level in the well is measured immediately after the pump starts to determine if drawdown is occurring in the well. If there is measurable drawdown upon starting the pump, the discharge should be decreased using the flow-control valve until the water level becomes stable, if possible.
- After a sufficient volume of water has been pumped to purge the discharge piping once, parameter measurements shall commence. Parameter measurements should be recorded at fixed time intervals, which are based on the volume of the discharge piping and the flow rate of the pump, until parameter stabilization occurs according to criteria described in the Low-Flow Purge SOP (Section 1.2) or after one hour of purging.
- If the water level declines to below the pump intake, cease pumping and allow at least 24 hours for recovery before retrieving a sample.

### 4.2.3 Groundwater Parameter Measurements and Sample Collection

Water-quality parameters will be measured in the field at each monitoring well during purging activities to evaluate when groundwater quality has stabilized and sample collection can proceed (Table A-III). Procedures for measurement of water quality parameters and sample collection are presented in the Groundwater Sampling and Low-Flow Purge SOPs.

At extraction system and flowing artesian wells, one set of parameters shall be obtained and recorded at the time of sample collection.

At artesian wells equipped with valves, after opening the valve, at least four sets of parameters shall be obtained before groundwater samples are collected. After parameter stabilization or one hour, which ever is less, samples can be collected from the groundwater discharge point.

Sample bottles are supplied by the laboratory. Bottles for analyses requiring preservation will be pre-preserved in the laboratory. The WQSAPs provide information regarding the analyses to be conducted. The QAPP includes sample preservation and handling protocols for each bottle or analysis type.

## 4.3 Field Documentation and Sample Management

Documentation of field activities is a requirement of the groundwater monitoring program. This documentation provides a record of the sequence of events and procedures conducted during field activities.

### 4.3.1 Field Documentation

Records will be maintained for sampling activities. This record provides documentation of water-level and field parameter measurements, documentation of the time and volume of groundwater purged, and documentation of the sample collection including time sampled and by whom. The record will also include other comments that will aid in the ability to reconstruct sampling activities without reliance on memory. Deviations from the sampling plan will be recorded, including justification and circumstances. In the case of an error, the incorrect information will be crossed out, and the correct information will then be entered, initialed, and dated.

Field documentation also includes:

- Monitor well condition (Table A-I) and maintenance record (Table A-V)
- Field instrument calibration (Table A-II)
- Water-level measurement and sampling activities (Tables A-I and A-III)
- Chain-of-Custody record (Table A-IV)

The Field Coordinator or designee will be responsible for organizing the appropriate records for the sampling team(s).

Copies of field documents will be stored at SSFL.

### 4.3.2 Sample Storage, Transport, and Chain-of-Custody

Following sample collection and labeling, samples will be packaged for transport to the analytical laboratory.

Following collection, samples will be stored in coolers with ice, and, if necessary, temporarily stored in refrigerators at the site until transport to the laboratory. Samples stored in the refrigerator will be transferred to coolers with ice prior to shipping to the laboratory. Dry ice or cool packs should not be used. The refrigerators will be dedicated solely to the storage of groundwater samples. The refrigerators will be clearly labeled on the exterior to indicate use for sample storage only. The storage facility will remain secured when sampling personnel are not present.

Groundwater samples from wells suspected to contain elevated concentrations of volatile organic compounds (based on review of past analytical results) will be kept separate from other samples. Elevated volatile organic compound concentrations have been designated as concentrations equal to or exceeding 3,000 micrograms per liter. These samples will be kept in a separate cooler or refrigerator. One refrigerator or cooler will be designated for storage of only groundwater samples collected from sources suspected to contain elevated volatile organic compounds. The coolers and refrigerator will be clearly labeled as being for "Hot" samples only. Well sampling records for these wells and chain of custody records, listing samples from these wells, will include the following or similar warning:
"***Keep bottles separate from other samples due to high TCE concentrations***"

When possible, samples will be shipped to the laboratory within 48 hours of collection. Samples requiring analysis by methods with short holding times, such as nitrate or formaldehyde, will be shipped to the laboratory as soon as possible after collection. Sampling personnel should review the sampling schedule prior to the field event and note samples to be collected which pose special holding time issues. Personnel should plan accordingly, in advance, to ensure that the lab receives these samples in a prompt manner. When shipping samples, it is good practice to avoid shipping samples on Friday for Saturday delivery. Doing so poses a risk that the samples will not be received on Saturday and, therefore, may be outside the allowed temperature range upon receipt by the lab.

Procedures for sample labeling, handling, shipping and documentation are described in the Sample Management SOP.

### 4.4 Sampling Equipment Decontamination Procedures

In the event that reusable sampling equipment is used during field activities, such equipment will be decontaminated after each sample is collected to minimize the potential for cross-contamination between samples. Refer to the Equipment Decontamination SOP for information on decontamination procedures. Decontamination water will be collected and disposed of in accordance with procedures provided in the following section and the HASP.

### 4.5 Waste Containment and Disposal

Liquid wastes, including purged groundwater and decontamination fluids, generated during groundwater sampling and decontamination activities will be containerized and transported to a Boeing-designated on-site location. Transfer of groundwater from the containers to the permitted groundwater treatment systems for treatment or shipment off-site to approved disposal facilities will be performed by Boeing-assigned personnel. Labeling and documentation of containers will be determined at the time of use. Labels, labeling and containers utilized at SSFL will be pre-approved by Boeing, to ensure consistency with SSFL standards.

Personal protective equipment (PPE), rags, brushes, plastic sheeting, and other disposable items which have contacted groundwater will be contained in a labeled drum provided by the Boeing–contracted waste-handler and picked up by the Boeing–contracted waste-handler for proper disposal after each field program is completed.

### 4.5.1 Waste Container Cataloging

The Field Coordinator will be responsible to ensure that containers generated by the sampling team are properly labeled. Each container label will contain the following information:

- Client (generator) identification (name and address)
- Date generated
- Container contents (example: purge water from monitor wells RD-05A, RD-36B, and RD-36C; decontamination water from monitor wells HAR-16 and RD-49A; etc.)
- Estimated drum volume or capacity
- Physical state of material (solid or liquid)

The Field Coordinator will be responsible for ensuring that the Boeing-contracted waste-handler is aware of the containers generated the field event and their associated expiration dates.

## 5. ANALYTICAL PROCEDURES

Laboratory analyses shall be accomplished by a California-certified testing laboratory using USEPA, ASTM, Standard Methods, SW-846, and California Department of Public Health protocols, and required QA/QC procedures in effect at the time of analyses.

The Quality Assurance Project Plan (QAPP) provides information on the analytical requirements for groundwater monitoring (Appendix B of the WQSAPs). Refer to this document for information regarding prescribed analyses.

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# TABLE A-I: EXAMPLE WATER-LEVEL MEASUREMENT FORM

**Water Level Record - Boeing-SSFL Groundwater Monitoring - Quarter / Year** **Boeing - SSFL**

Recorded By: ______________________________

| Well ID | Sounder ID | Date | Time | M.P. Elevation | Previous Depth to Water | Well Depth (ft) | Well Depth Measured (ft) | Depth To Water from M.P. (ft) | Description of M.P. | PID Air Monitoring at Well Head: Bckgrnd | PID Air Monitoring at Well Head: Vault | PID Air Monitoring at Well Head: Access |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | |

Comments: ______________________________

Problems with: ☐ Well signs ☐ Pad/seal ☐ Water in vault ☐ Lock ☐ Vault ☐ Overgrown veg ☐ Soil erosion ☐ Non-used equip at well ☐ Other: ______________

# TABLE A-II: EXAMPLE CALIBRATION FORM

HALEY & ALDRICH

## SSFL CALIBRATION LOG

### MYRON L pH and CONDUCTIVITY METERS

| Calibration fluid | Expiration Date |
|---|---|
| 4.0 pH Buffer Solution | |
| 7.0 pH Buffer Solution | |
| 10.0 pH Buffer Solution | |
| 3000 umho TDS/Conductivity Standard | |
| 7000 umho TDS/Conductivity Standard | |

| Date Calibrated | Meter Serial No. | pH Buffer Solution | | | TDS/Conductivity Standard (micromhos) | | Comments | Signature |
|---|---|---|---|---|---|---|---|---|
| | | 4.0 | 7.0 | 10.0 | 3000 | 7000 | | |
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# TABLE A-II: EXAMPLE CALIBRATION FORM

## TURBIDITY METERS

| Calibration fluid | Expiration Date |
|---|---|
| 0.1 NTU Standard | NA |
| 1 NTU Standard | NA |
| 10 NTU Standard | NA |

| Date Calibrated | Meter Serial No. | Turbidity Standard (NTU) | | | Comments | Signature |
|---|---|---|---|---|---|---|
| | | 0.1 | 1 | 10 | | |
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# TABLE A-II: EXAMPLE CALIBRATION FORM

## WATER LEVEL SOUNDERS

| Date Calibrated | Sounder Serial No. | HA WL Assigned Letter (ABCD…) | Sounder Length Compared to 100-foot Steel Tape (feet) | DTW correction factor (feet; positive for short sounders; negative for long sounders) | Signature |
|---|---|---|---|---|---|
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## PID METER

| Calibration Gas | Expiration Date |
|---|---|
| Isobutylene 100 ppb | |

| Date Calibrated | Meter Serial No. | Calibration Value (HNu) | Calibration Standard Expiration Date | Signature |
|---|---|---|---|---|
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HALEY & ALDRICH

# TABLE A-III: EXAMPLE SAMPLING FORM

**Well ID:**
**PROJECT:**
**SPONSOR:**

**H & A FILE NO:**
**PROJECT MGR:**

**Sampler** ________________
**Sample Date** ____________
**Sample Time** ____________

**SAMPLING DATA:**
Refill ________________
Discharge ____________
PSI ________________

Well Depth: ft.
Well Depth Measured: ft.
Screen Top Depth: ft.
Screen Bottom Depth: ft.

Sounder ID ______________________
Initial Depth To Water ______________
Depth of Pump Intake ______________
DTW After Pump Installed ___________

Purge Water Disposal ________________
Purging Device ______________________
Tubing Present in Well: ☐ Yes ☐ No
Tubing Type ________________________

| Elapsed Time (24 hour) | Depth To Water From Casing (ft) | Pump Setting (ml/min) or (gal/min) | Purge Rate (ml/min) or (gal/min) | Cumulative Purge Vol (liters) or (gal) | Temperature ($^oF$) or ($^oC$) | pH | Conductivity (us/cm) | Dissolved Oxygen (mg/L) | Turbidity (NTU) | ORP/eH (mv) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | |
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| *Group* | *Method* | *Lab* | *Containers* | *Filtered?* | *Preservatives* | *Sample Type* | *Comments* |
|---|---|---|---|---|---|---|---|

**Haley & Aldrich, Inc.**
600 S. Meyer Avenue #100
Tucson, AZ 85701-2554

# TABLE A-IV: EXAMPLE CHAIN OF CUSTODY RECORD

Phone: 520.289.8600
Fax: 520.882.8178

**Project Name:** Boeing - SSFL
**Sponsor:**
**Samplers:**

**Laboratory:**
**Contact:**
**Phone:**
**Address:**

**COC Number:**
☑ **Level IV Required**
☑ **GeoTracker EDF Required**

**Delivery Date:**
**Turnaround Time: Standard** ☑ **Rush** ☐
**Project Manager:**

**H&A Project No:**

**Sampling Event:**

| Sample No. | Sample Date | Sample Time | Sampler | Composite or Grab | Soil or Water | Analysis Required | | | | | | | | | | | | | | | | | | | | No. of Containers | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | | | | | | | | | | | | |

| Signature | Firm | Date | Time |
|---|---|---|---|
| Relinquished | | | |
| Received: | | | |
| Relinquished | | | |
| Received: | | | |
| Relinquished | | | |
| Received: | | | |

**Container / Preservative**

| | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | | | | | VOA Vial |
| | | | | | | | | | | | | | | | | | | | | Amber Glass |
| | | | | | | | | | | | | | | | | | | | | Clear Glass |
| | | | | | | | | | | | | | | | | | | | | Plastic |
| | | | | | | | | | | | | | | | | | | | | Preservative |
| | | | | | | | | | | | | | | | | | | | | Filtered |
| 500 ml | 250 ml | 500 ml | 40 ml | 1 liter | 40 ml | | | | | | | | | | | | | | | Volume |

Preservatives
A = NaOH C = H2SO4 E = Methanol
B = HNO3 D = HCL F = Sodium Thiosulfate

**Sampling Comments**

#Name?

Evidence samples were tampered with. YES NO
If yes, please explain in section below.

HALEY & ALDRICH
600 S. Meyer Ave. #100
Tucson, Arizona 85701
Tel: 520.289.8600



# TABLE A-V: EXAMPLE WELL MAINTENANCE FORM

## WELL MAINTENANCE RECORD

WELL ID: ____________ FILE NUMBER: ____________
RECORDED BY: ____________ DATE: ____________
LOCATION: ____________ TIME: ____________

### Well Information

DEPTH TO WATER (ft): ____________ SCREENED/OPEN INTERVAL (ft): ____________ COMPLETION: ____________
TOTAL WELL DEPTH (ft): ____________ CASING DIAMETER (in): ____________ CASING TYPE: ____________
DEPTH TO INTAKE (ft): ____________ STICK-UP/RISER (ft): ____________
CURRENT PUMP MAKE / MODEL AND SETTING: ____________

### DESCRIBE MAINTENANCE ACTIVITIES

____________
____________
____________
____________

**If repairing or replacing pump, piping or tubing, complete the following:**

| | DATE CODE | MODEL/SERIAL# | VOLTS/PHASE |
|---|---|---|---|
| PUMP MFGR. | | | |
| MOTOR MFGR. | | | |

DIAMETER OF PUMP (in) ____________
PUMP HORSE POWER: ____________
SUBCONTRACTOR: ____________

**COLUMN PIPE / BLADDER TUBING:**

| TYPE | DIAMETER (in) | JOINT LENGTH (ft) | NUMBER OF JOINTS | TOTAL AMOUNT PIPE / TUBING (ft) |
|---|---|---|---|---|
| | | | | |
| | | | | |

**SOUNDING TUBE:**

| TYPE | DIAMETER (in) | JOINT LENGTH (ft) | NUMBER OF JOINTS | TOTAL AMOUNT PIPE / TUBING (ft) |
|---|---|---|---|---|
| | | | | |
| | | | | |

NOTES:

# APPENDIX A
# SECTION 1

## STANDARD OPERATING PROCEDURES

# APPENDIX A
# SECTION 1.1

# MANUAL WATER-LEVEL MEASUREMENT
# STANDARD OPERATING PROCEDURE

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## 1. INTRODUCTION

This procedure describes the measurement of water levels in groundwater monitoring and extraction wells, piezometers, and boreholes using an electric water-level indicator. This procedure does not cover automated measurement of water levels with a transducer/datalogger. Measurements for the potential presence and thickness of light non-aqueous phase liquid (LNAPL) or dense non-aqueous phase liquid (DNAPL) in monitor wells may be performed during water level measurement activities.

Water levels will be acquired using a methodology selected to provide accurate and precise data. This data may then be used to calculate groundwater elevations, determine hydraulic gradients and construct groundwater elevation contour maps. Accuracy and precision in obtaining the measurements are critical to the usability of the data.

## 2. BACKGROUND

Water-level measurements should be made from a fixed reference point marked on the well. The fixed reference mark will be located on the top of the well casing or on the top of the water-level access point into the well, depending on the completion of the well at the surface. Following well installation, a survey mark is placed on the top of the well casing as a reference point for groundwater-level measurements. If a survey mark is not present, the reference point is typically established and marked on the north side of the well casing.

If possible, avoid using steel protective casings or flush-mounted road boxes as a measurement reference point due to the greater potential for damage. Field personnel shall be made aware of the measurement reference point being used in order to ensure the collection of comparable data. The well reference point elevation is surveyed to the nearest 0.01 foot for later use in calculating groundwater elevation.

Before measurements are made, water levels in monitor wells and piezometers should be allowed to stabilize for a minimum of 24 hours after well construction and development. In low-yield situations, recovery of water levels to equilibrium may take longer. Measurements will be made to an accuracy of 0.01 foot. Water-level measuring equipment will be decontaminated prior to measurement activities at each well.

To help to provide reliable data, water levels should be collected within the shortest time practical. However, certain situations may produce rapidly changing groundwater levels that require taking measurements as close in time as possible. Large changes in water levels within wells may be indicative of such conditions. Rapid groundwater level changes may occur due to:

- Barometric pressure changes
- Tidal fluctuations
- Navigation controls on rivers
- Rainfall events
- Groundwater pumping

The time of data collection at each station should be accurately recorded. Personnel collecting water-level data shall record if the above conditions are known or suspected to be occurring during the groundwater-level collection period.

In conjunction with groundwater-level measurements, surface water elevations (e.g., ponds, lakes, rivers, and lagoons) may be monitored as well.

## 3. EQUIPMENT

An electric water-level indicator consists of a battery-operated, non-stretch, electric water-level probe with permanent markings. Measurements for LNAPL or DNAPL will be made with an oil/water interface probe. Water level indicators and interface probes will be operated and maintained pursuant to the manufacturers' instructions.

The calibrated cable will be checked against a surveyor's steel tape prior to field activities or on a quarterly basis. The difference between the electric water-level indicator calibrated cable and the surveyor's steel tape (the Calibration Correction Factor) will be used to calculate the water-level elevation as indicated in Section 5 of this SOP.

A new cable will be installed if the water-level indicator cable becomes difficult to read.

Other field equipment may include:

- Air monitoring instrumentation (photo ionization detector (PID) or flame ionization detector (FID))
- Steel survey tape for calibration
- Pocket tape
- Paper towels and trash bags
- Decontamination supplies, if applicable to the project
- Water-Level Measurement Form (Table A-I)

# 4. PREPARATION/PROCEDURE

## 4.1 Preparation

1. Review the Health and Safety Plan (Appendix C of the Water Quality Sampling and Analysis Plans) to determine project health and safety requirements. Determine and obtain the equipment and supplies needed. Obtain previous water-level monitoring data, if available.

2. Obtain site access, and necessary well keys or well wrenches.

3. Decontaminate or pre-clean equipment, and ensure that it is in working order and calibrated. Calibration of water sounders will be performed prior to each quarterly monitoring event.

4. Identify water-level monitoring locations on site plan prior to going into the field.

## 4.2 Procedures

Procedures for determining water levels are as follows:

1. Remove exterior lock and steel protective cover. Bail down or remove precipitation or surface water that may have accumulated in the well vault or the annulus between the steel protective cover and the casing, to prevent the water from draining into the well when opened.

2. Monitor the headspace of the well within the well vault or locking cover with a photoionization detector (PID) or flame ionization detector (FID) to determine the presence of volatile organic compound vapors, and record the reading in parts per million (ppm). If necessary, initiate personal protective measures indicated by the Health and Safety Plan (Appendix C of the Water Quality Sampling and Analysis Plans).

3. Remove interior lock and cap or plug. Record the well ID, time of day (military format) and other pertinent information.

4. Turn on the electric water-level indicator and adjust the sensitivity, if necessary. Care should be taken to prevent contact of the water-level indicator with the ground prior to insertion in the well. Lower the water-level measuring device into the well until the audible or visual signals indicate that the probe has contacted the water surface.

5. Measure and record the depth to water from the marked reference point and also record a description of the reference point used for the measurement (e.g., top of four-inch PVC casing). Dates should be recorded in the following format MM/DD/YY. Times should be based on a 24-hour military type format for the given time zone (Pacific Standard Time [PST] or Pacific Daylight Time [PDT]). For example, 8:45 a.m. should be recorded as 0845. The time 2:45 p.m. should be recorded as 1445.

6. If groundwater contact is not indicated by the audio signal, visual signal or meter, compare the total depth probed with the Well Depth indicated on the Water-Level Measurement Form (Table A-I). If the probed depth is at least equal to the Well Depth, the well is dry and this and the probed depth shall be recorded on the Water-Level Measurement Form in the comments. If the probed depth is less than

the Well Depth, remove the water-level indicator from the well and test it for proper operation by submersing the probe in water to confirm that it is functioning. If proper operation is determined, repeat the measurement. If the water-level measuring devise continues to indicate the well is "dry" at a probed depth less than the well total depth, the condition will be recorded and recommendations for evaluating maintenance or repair will be made.

7. Record the distance from the water surface (as determined by the audio signal, visual signal or meter) to the reference measuring point.

8. Two water-level readings should be collected and the results compared. If results do not agree to within 0.01 foot, additional measurements will be taken until two readings within 0.01 foot are obtained. Consistent failure of readings to agree could suggest an anomalous condition with the well or equipment is precluding a correct measurement. Such an occurrence will be noted in the Water-Level Measurement Form and the proper operation of the electric water-level indicator shall be determined prior to measuring additional water levels with that equipment.

9. Remove the down hole measurement equipment; replace well caps, plugs, locks, and protective steel cover.

10. Record physical changes, such as evidence of tampering with the well or cover, vandalism, erosion or cracks in protective concrete pad.

Procedures for determining LNAPL presence and thickness are as follows:

1. Access the well according to steps 1 through 3, above.

2. Turn on the interface probe. Care should be taken to prevent contact of the interface probe with the ground prior to insertion in the well. Lower the interface probe into the well until the audible or visual signals indicate that the probe has contacted LNAPL or the water surface.

3. If the audible or visual signal indicates contact with LNAPL, two readings should be collected and the results compared. If results do not agree to within 0.01 foot, additional measurements will be taken until two readings within 0.01 foot are obtained. Record the depth from the marked reference point to floating LNAPL, if present, in the comments section of the Water Level Measurement Form (Table A-1).

4. Lower the interface probe until the audible or visual signal indicates contact with water. Two readings should be collected and the results compared. If results do not agree to within 0.01 foot, additional measurements will be taken until two readings within 0.01 foot are obtained. Consistent failure of readings to agree during this or the previous step could suggest an anomalous condition with the well or equipment is precluding a correct measurement. Such an occurrence will be noted in the Water-Level Measurement Form and the proper operation of the interface probe shall be determined prior to making additional measurements with that equipment.

5. Record the distance from the marked reference point to the water surface. Also record a description of the reference point used for the measurement (e.g., top of four-inch PVC casing). Dates should be recorded in the following format MM/DD/YY. Times should be based on a 24-hour military type

format for the given time zone (Pacific Standard Time [PST] or Pacific Daylight Time [PDT]). For example, 8:45 a.m. should be recorded as 0845. The time 2:45 p.m. should be recorded as 1445.

6. If contact with LNAPL or groundwater is not indicated by the audio signal, visual signal or meter, compare the total depth probed with the Well Depth indicated on the Water-Level Measurement Form (Table A-I). If the probed depth is at least equal to the Well Depth, the well is dry and this and the probed depth shall be recorded on the Water-Level Measurement Form in the comments. If the probed depth is less than the Well Depth, remove the water-level indicator from the well and test it for proper operation by submersing the probe in water to confirm that it is functioning. If proper operation is determined, repeat the measurement. If the water-level measuring device continues to indicate the well is “dry” at a probed depth less than the well total depth, the condition will be recorded and recommendations for evaluating maintenance or repair will be made.

7. Remove the down-hole measurement equipment. Based on any residual liquid on the interface probe, an attempt will be made to describe the characteristic(s) of the residual product (if any) which may distinguish the material (such as odor, color, and viscosity with respect to water). Descriptions of residual product, if present, will be recorded in the comments section of the Water Level Measurement Form (Table A-1).

8. Replace well caps, plugs, locks, and protective steel cover.

9. Record physical changes, such as evidence of tampering with the well or cover, vandalism, erosion or cracks in protective concrete pad.

## 5. CALCULATIONS

To calculate groundwater elevation above mean sea level when using a water-level indicator, use the following equation:

$$E_W = E - D + C$$

Where:

$E_W$ = Elevation of water above mean sea level (feet) or local datum
$E$ = Elevation above sea level or local datum at point of measurement (feet)
$D$ = Depth to water (feet)
$C$ = Calibration correction factor (feet)

Apparent LNAPL thickness will be calculated by subtracting the measured depth to LNAPL from the depth to groundwater.

$$T_{LNAPL} = D_{water} - D_{LNAPL}$$

Where:

$T_{LNAPL}$ = Thickness of LNAPL (feet)
$D_{water}$ = Depth to water (feet)
$D_{LNAPL}$ = Depth to LNAPL (feet

Apparent DNAPL thickness will be calculated by subtracting the measured depth to DNAPL from the depth of the well.

$$T_{DNAPL} = D_{well} - D_{DNAPL}$$

Where:

$T_{DNAPL}$ = Thickness of DNAPL (feet)
$D_{well}$ = Depth of well (feet)
$D_{DNAPL}$ = Depth to DNAPL (feet

**APPENDIX A**
**SECTION 1.2**

**LOW-FLOW PURGE**
**STANDARD OPERATING PROCEDURE**

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# 1. SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure (SOP) is to set guidelines for the purging of monitor wells using the low-flow method. Generally, purging of wells will be conducted based on U.S. Environmental Protection Agency guidelines described in *Low-Flow (Minimal Drawdown) Ground-water Sampling Procedures,* dated April 1996, and additional guidance provided by DTSC in the memoranda entitled *"Post Closure Permits"*, dated 25 March 2008 and *"Santa Susana Field Laboratory Site-Wide Water Quality Sampling and Analysis Plan, dated December 14, 2007"*, dated 07 October 2008.

The low-flow purge method entails pumping a well at a flow rate approximately equal to the recharge rate of the aquifer, which may be near or slightly greater than the capacity of the well. The flow rate should not result in significant drawdown within the well. Minimal drawdown should inhibit vertical mixing within the well and result in drawing water directly from the aquifer media. The water level will be monitored regularly during the purging process to determine that the well is not being purged at a rate that induces drawdown in excess of the thresholds described in this SOP.

Exceptions to low-flow sampling protocols may include monitor wells not included in the Regulated Unit or Site-Wide programs, wells equipped with Westbay sampling systems or FLUTe Multilevel Sampling Systems, artesian wells, off-site private wells and groundwater extraction wells. These standard operating procedures may be varied or changed as required, dependent on site conditions, and equipment limitations.

## 2. INTERFERENCES AND POTENTIAL PROBLEMS

1. Placing the low-flow purge pump at the vertical midpoint of the water column in a well may be difficult for wells that experience large water level fluctuations.

2. Drawdown may be induced in low-yield wells at even the lowest flow rates produced by purge pumps. This may result in wells being purged to dryness.

3. Parameters may not stabilize within a reasonable time period. If parameters do not stabilize within one hour of the commencement of low-flow purging, even if flow rates have been minimized, samples will be collected and a notation will be made on the sampling form. DTSC will be notified within 30 days after the completion of field activities of instances where groundwater samples were collected but the stabilization criteria were not met within one hour. After evaluating well data and witnessing purging activities, DTSC may concur in writing that the subject well(s) cannot meet the stabilization requirements within a reasonable time period and modify stabilization requirements specific to that well(s). Such notification will amend purging requirements, as indicated, for that well(s). If DTSC concludes that modifications to the purging rates and duration will facilitate parameter stabilization, modifications to the purge rate and/or duration of purge for that well will be implemented as indicated by DTSC. Modifications to the WQSAP will be submitted to DTSC as an addendum.

## 3. EQUIPMENT

Prior to going to the field, instrumentation shall be assembled, calibrated in a manner consistent with manufacturers recommendations (if applicable), and tested. Listed below are types of equipment, instruments, and supplies necessary for well purging:

- Pump controllers (Variable Frequency Drive and Bladder Pump controllers) for low-flow sampling pumps
- Compressed gas cylinder or oil-less compressor for bladder-pump operation
- Generator for Variable Frequency Drive style low-flow pump operation
- Air-hoses, couplers and adaptors, as needed
- Tools necessary for set-up and field maintenance of pumping equipment
- Fuel for generator or compressor
- Flow cell for measurement of groundwater parameters
- Discharge tubing, hose or piping
- Calibrated vessel or flow meter to measure water volume purged
- Labeled vessels (e.g., drums or tanks) for containing purge water
- Water-level measurement equipment
- Calculator
- Keys to well box locks
- Measuring tape
- Cellular phone or radio to communicate with project managers and other field staff
- Watch with a stopwatch function
- Personal Protective Equipment (PPE), including nitrile gloves and safety glasses
- Paper towels and trash bags
- Decontamination supplies
- Field sampling and instrument calibration records
- Material safety data sheets (MSDS)
- Water Quality Sampling and Analysis Plans
- Instrument calibration forms
- Sample collection, labeling and documentation supplies.

## 4. REAGENTS

No chemical reagents are used in this procedure; however, decontamination solutions and calibration solutions may be necessary for the equipment used.

# 5. PROCEDURES

## 5.1 Preparation

1. Review past purging information for equipment types, well size, purge depth, purge rates, purge volumes, pump inlet interval set point, etc.

2. Determine the low-flow purge pumps to be used, and the number and type of samples needed.

3. Obtain the equipment and supplies needed to operate the pumps, to contain and transport purge water, and to collect, handle, and transport the samples.

4. Decontaminate or pre-clean non-dedicated equipment, and ensure that it is in working order.

## 5.2 Procedures

Procedures for low-flow purging are described below.

### 5.2.1 Setting Up Low-Flow Purge Equipment

1. Clean non-dedicated sampling equipment in accordance with the Equipment Decontamination SOP.

2. Unlock the well vault. If the presence of volatile organic vapors was indicated in a well during water-level monitoring activities, remove the well cap and allow the well to vent for approximately 2 minutes prior to purging and sampling.

3. Measure the water level following the Manual Water-Level Measurement SOP.

4. If the well is dry or the measured difference in depth between the depth to water and the well depth is less than three feet, the well contains insufficient water for sampling. Remove the water-level indicator and secure the well pursuant to Section 5.2.3.

5. If using a portable pump, retrieve dedicated tubing, connect to the pump apparatus according to the manufacturer's instructions, and install the non-dedicated pump intake at a depth halfway between the depth to water and the bottom of the saturated screened or open interval of the well.

6. Install the appropriate power supply and controls for the specific type, manufacturer, size, and model of the pump.

7. Install the in-line parameter monitoring equipment flow cell. Prior to performing purging, make sure the parameter monitoring equipment is calibrated at the beginning of each day.

8. Set up an in-line flow meter or a calibrated container to monitor volume purged.

9. Initiate operation of the low-flow purge pump.

### 5.2.2 Low-Flow Purge Set-up Using Electric Submersible Pumps

Dedicated electric submersible Variable Frequency Drive (VFD) pumps are installed in some wells. Pumps are installed on steel or PVC column pipe, which conveys water from the pump to the surface. Power is supplied by a portable generator or fixed electrical source. The procedure for setting up the sampling apparatus on a well equipped with a dedicated VFD pump is the same as described above with the following additional procedures and considerations:

- If using a portable generator to power the well, ensure that the generator is downwind of the well.
- Connect discharge piping at the wellhead; usually a riser pipe that threads into the top of the column pipe with an elbow or tee above the top of the well vault. Downstream from the tee is the typical location of the flowmeter used to measure flow rate and total volume evacuated. Between the tee and the flowmeter and gate valve should be connections to divert flow through a flow cell for parameter measurements and a sample port for collection of samples.
- A garden hose or similar should be used to convey water from the discharge piping to the appropriate waste containment vessel.
- To operate the submersible pump, the electrical lead from the motor is plugged into the pump control box. The pump control box controls the flow rate at which the well will be pumping. The control box is then plugged into the generator or fixed power source. DO NOT plug in the control box until the generator has been started and allowed to warm up. The control boxes are very sensitive to power fluctuations and could be damaged if the generator creates power surges or dips.
- When the equipment is properly connected and the generator is warmed up, the power to the control box may be switched on, starting the pump.

### 5.2.3 Purging

The goal of low-flow purge methodology is to pump water from the well at a rate that is, to the extent practicable, equal to the rate of recharge to the well. This is accomplished by implementing the following methodology:

1. The water level in the well is measured immediately after the pump starts to determine if drawdown is occurring in the well.
2. If there is drawdown greater than 0.3 foot upon start-up of the well, the discharge from the pump should be decreased using the pump control box until the water level becomes stable.
3. If no drawdown is observed, the pumping rate should be increased until drawdown is observed. The pumping rate should then be reduced to the level at which the water level is stable.
4. If the pump cannot withdraw water at a rate which induces noticeable drawdown, the maximum pump capacity should be utilized.

5. After a sufficient volume of water has been pumped to purge the discharge piping or tubing once, parameter measurements shall commence. Parameter measurements shall be recorded at fixed time intervals, until parameter stabilization occurs, as specified below.

6. Measure and record the depth to water at intervals not greater than five minutes. Dates should be recorded in the format MM/DD/YY. Times should be based on a 24-hour military type format for the given time zone (Pacific Standard Time [PST] or Pacific Daylight Time [PDT]). For example, 8:45 a.m. should be recorded as 0845. The time 2:45 p.m. should be recorded as 1445.

7. Adjust the pump flow rate as necessary so that excessive drawdown, greater than 0.3 feet, does not occur in the well screen or open hole interval of the well.

8. Monitor the following groundwater parameters at intervals not greater than five minutes: pH, conductivity, ORP, turbidity, dissolved oxygen (DO) and temperature. Record the measurements until stabilized.

   Stabilization has been achieved when three successive readings are within:

   – +/- 0.1 for pH,
   – +/- 3% for conductivity,
   – +/-10 mV for ORP,
   – +/-10% for turbidity, and
   – +/-10% for DO.

   Temperature should be monitored even though it is not considered for stabilization.

9. If parameters do not stabilize within one well volume or one hour of the commencement of purging, even if flow rates have been minimized, samples will be collected and a notation will be made on the sampling form.

10. Water samples cannot pass through the in-line parameter flow cell. If there is no sample port "upstream" of the flow cell, remove the flow cell and associated plumbing before sampling.

11. Collect the required groundwater samples. When sampling, make sure the sampler maintains the same flow rate sustained during the purging process. Label and store the samples on ice in an ice chest.

12. Turn off pump and remove the non-dedicated equipment, pump power supply and controls, if necessary.

13. Secure well cap and lock the well box.

14. Decontaminate non-dedicated equipment.

15. Remove equipment, supplies, and wastes from the well site. At all times during purging, sampling, and clean-up, care must be taken to prevent accidental spillage of purged groundwater.

16. Complete field record as necessary and in accordance with FSP.

## 6. PERSONNEL QUALIFICATIONS

Field samplers are required to take the 40-hour health and safety training course and refresher courses as required by 29 CFR 1910.120 prior to engaging in field collection activities. In addition, field personnel should be trained in the method before initiating the procedure alone.

## 7. HEALTH AND SAFETY

Low-flow purging techniques with bladder pumps involve the use of compressed gases supplied either by a compressor or a compressed gas cylinder. Compressed gas cylinders present special hazards due to the low temperature of the gas under high pressure and the potential for sudden uncontrolled release of the compressed gas.

Care will be taken when handling and transporting compressed gases. When transporting compressed gas cylinders in a vehicle, the cylinders will be adequately secured to prevent shifting, and regulators should be removed and valve caps secured before moving.

If the sampling crew is utilizing a gas powered air-compressor, note the fire hazards associated with gas powered equipment. When operating the air compressor, make sure the compressor is placed downwind from the location where the samples will be collected and make sure the compressor is not located in close proximity to dry brush or grass. When refueling gas powered equipment, use the proper PPE for personal protection and to eliminate the chance of cross contamination. Never refuel the compressor while it is still hot.

## 8. QUALITY ASSURANCE/QUALITY CONTROL

The following general quality assurance/quality control (QA/QC) procedures apply:

1. Pertinent data will be recorded.

2. Low-flow purge and parameter measurement equipment will be operated in accordance with operating instructions as supplied by the manufacturer.

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**APPENDIX A**
**SECTION 1.3**

**GROUNDWATER SAMPLING**
**STANDARD OPERATING PROCEDURE**

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## 1. SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure (SOP) is to provide general reference information on proper procedures for sampling groundwater wells. This guideline is primarily concerned with the collection of representative groundwater samples from the saturated zone of the subsurface. The goal is to collect samples that are representative of the particular zone of water being sampled at the time of collection. These procedures are to be used in conjunction with analyses for groundwater constituents (e.g., volatile and semi-volatile organic compounds, general minerals, metals).

These are standard (i.e., typically applicable) operating procedures which may be varied or changed as required, dependent upon site conditions, equipment limitations, or limitations imposed by the procedure. The actual procedures employed should be documented.

This procedure is intended for use by field samplers and others associated with performing field investigations at hazardous waste sites. It applies to the collection and handling of groundwater samples from existing and newly installed wells. It addresses the specific activities to be performed prior to going to the field and upon arrival at each sampling location. This procedure also explains the process of groundwater sample collection, preparation or collection of quality control and quality assurance (QA/QC) samples, and sampling event documentation.

Sample containers and preservatives for water samples are described in the Quality Assurance Project Plan (QAPP), and in Table A-II of this FSP. Chain-of-Custody protocols for sample shipment to analytical laboratories are provided in the Sample Management SOP.

Guidelines for purging monitor wells using a low-flow purge method are presented in the Standard Operating Procedure for Low-Flow Purge included in the Field Sampling Plan.

## 2. METHOD SUMMARY

To obtain a representative groundwater sample for chemical analysis, it is important that the sample is formation water, originating from outside the well. This can be accomplished either by purging the complete volume of water in the borehole/casing one to three times, or alternatively, by purging the well at a rate approximately equal to recovery. Pumping at a rate near or slightly greater than well capacity minimizes drawdown, and ensures that water will be pumped from the aquifer adjacent to the pump or tubing intake. Mixing of water from the borehole, above or below the intake, is minimized or eliminated in this manner. In the low-flow method, the well is purged at the low-flow rate until a specified set of parameters (pH, temperature, specific conductance, dissolved oxygen, turbidity, oxidation reduction potential) are stabilized. At that point samples are collected from the pump discharge.

# 3. INTERFERENCES AND POTENTIAL PROBLEMS

## 3.1 General

The primary goal in performing groundwater sampling is to obtain a representative sample of the groundwater aquifer. Field personnel can compromise analysis in two primary ways: (1) taking an unrepresentative sample or (2) by incorrect handling of the sample.

## 3.2 Purging

In a non-pumping well, there may be little or no vertical mixing of the water, and stratification may occur. Mixing may occur in the screened or open section of a well, but the well water above the screened or open section may remain isolated, become stagnant, and may not be representative of the groundwater. A non-representative sample can result from excessive pre-pumping of the monitoring well. Excessive pumping could dilute or increase the constituent concentrations from what is representative of the sampling point of interest. To safeguard against collecting non-representative stagnant water, the following guidelines and techniques should be adhered to during sampling:

- As a general rule, monitor wells will be purged prior to sampling. Purging until the parameters have stabilized is recommended for a representative sample.
- When purging, the pump should generally be set at the approximate mid-point of the saturated screened interval, or saturated open borehole.
- The flow rate for pumped wells should be maintained at a rate that is approximately equal to the recharge rate of the well by following the procedures described in the Low-Flow Purge SOP (Section 1.5).

## 3.3 Materials

Equipment used in multiple wells should be decontaminated between uses. Disposable or dedicated equipment should be employed when practicable to help reduce the likelihood of cross-contamination.

The tendency of VOCs to adsorb onto many materials makes the selection of appropriate purging and sampling equipment materials important for reliable trace analyses. VOCs may sorb onto (and subsequently leach from) material made of silicone rubber, polyvinyl chloride, polypropylene, polyethylene and Teflon. Materials made from Teflon are considered the optimal material for use in sample tubing and other flexible components of groundwater sampling equipment. For rigid components, stainless steel is considered to be the optimum material of construction. Other materials may also be deemed appropriate for well construction and sampling apparatus. A record of construction materials utilized in each well will be maintained as part of well maintenance activities.

# 4. EQUIPMENT

Planning for a sampling event entails assessing, selecting, and assembling the equipment, instruments, and supplies necessary to perform the work. Prior to going to the field, instrumentation shall be assembled, calibrated in a manner consistent with manufacturers recommendations (if applicable), and tested. Listed below are types of equipment, instruments, and supplies used for groundwater sampling from wells:

- Water-level indicator
- Discharge piping or tubing,
- Flow meter or calibrated vessel
- Pump controllers (Variable Frequency Drive and Bladder Pump controllers) for low-flow sampling pumps
- Compressed gas cylinder or oil-less compressor for bladder-pump operation
- Generator for Variable Frequency Drive style low-flow pump operation
- Flow cell for measurement of groundwater parameters
- Air-hoses, couplers and adaptors, as needed
- Tools necessary for set-up and field maintenance of pumping equipment
- Fuel for generator or compressor
- Containers (e.g., drums and/or tanks) for purged well water
- Personal Protective Equipment (PPE), including nitrile gloves and safety glasses
- Measuring tape
- Sample containers and preservatives supplied by the laboratory
- Filtration equipment and 0.45-micron filters (if field filtering for dissolved constituents is required)
- Field sampling and field instrument calibration records
- Coolers and ice for preserving samples
- Decontamination supplies
- Keys to well box locks
- Cellular phone and radio to communicate with project managers and other field staff
- Watch with a stopwatch function
- Calculator
- Sample labels and fine-point permanent markers
- Chain-of-Custody forms
- Custody seals
- Instrument calibration forms
- Material safety data sheets (MSDS)
- Water Quality Sampling and Analysis Plans.

## 5. REAGENTS

Reagents may be used for preservation of samples and for decontamination of sampling equipment. The preservatives required are specified by the analysis to be performed, and summarized in the QAPP. The analytical laboratory that will perform the sample testing should provide the reagents required for sample containers. Decontamination solutions are specified in the Equipment Decontamination SOP.

# 6. PROCEDURES

This procedure addresses the specific activities to be performed to accomplish a groundwater sampling event or round. The procedure includes:

- a review of the FSP,
- preparation of a delivery order for analytical laboratory services,
- procurement of equipment and supplies,
- field inspection of wells to be sampled,
- well water-level measurement,
- well purging and measurement of field parameters,
- groundwater sample collection, and
- field documentation requirements.

## 6.1 Preparation

In preparation for a groundwater sampling event, the field sampler shall review the site WQSAPs, FSP, and QAPP to obtain the following information:

- Identification number(s) of the well(s) to be sampled,
- Locations of the wells,
- Well location access requirements (e.g., locked gates, road conditions),
- Field data recording requirements,
- Field and analytical parameters to be tested,
- Type and number of sample containers needed,
- Volume of sample required for analysis,
- Type and number of QA/QC samples to be collected (e.g., duplicates, splits, and blanks),
- Anticipated weather conditions, and
- Type of equipment needed for the scheduled sampling activity.

A well location map and summaries of well completion data and pump specifications shall be available for field reference.

A request for sample containers, which specifies the sample media, number of samples, and analytical parameters to be tested shall be prepared with sufficient advance notice and forwarded to the laboratory(-ies) contracted to complete the analyses. The analytical laboratory, in accordance with the sampling schedule and the sample volume requirements, will provide sample containers, preservatives, and quality control samples, as requested.

Equipment shall be calibrated according to the equipment manufacturers’ protocols prior to use.

### 6.2 Well Inspection

Prior to sampling a well, its condition shall be inspected and recorded. Signs of vandalism, unauthorized entry, settlement, or ponding around the well shall be documented, along with the well identification number and the date.

If the presence of volatile organic vapors was indicated in a well during water-level monitoring activities, the well vault shall be unlocked and the well cap removed to allow the well to vent for approximately 2 minutes prior to purging and sampling.

### 6.3 Water-Level Measurement

The depth to water shall be measured from the well reference point in accordance with the Manual Water-Level Measurement SOP. The water level shall be recorded to the nearest 0.01 foot along with the time of day when the measurement was obtained.

### 6.4 Well Purging

Wells will generally be purged according to the procedures described in the Low Flow Purge SOP (Section 1.2). Exceptions to low-flow purging protocol include wells equipped with Westbay or FLUTe multilevel sampling systems, off-site private wells, artesian wells, groundwater extraction wells or other wells not equipped with low-flow apparatus (such as bladder pumps or Variable Frequency Drive electric submersible pumps). Procedures for wells not equipped with low-flow apparatus are presented in Section 4.2.2 of the Field Sampling Plan, the Westbay Multilevel System SOP (Section 1.4) and the FLUTe Multilevel System SOP (Section 1.5).

### 6.5 Groundwater Sample Collection

Samples collected from dedicated pump systems (low-flow or submersible) will be collected from the pump discharge. For low-flow purge systems, the sample point is prior to the flow cell. Water samples can not pass through the flow cell. If there is no sample port "upstream" of the flow cell, remove the in-line parameter flow cell and associated plumbing before sampling. For wells with submersible pumps, the sample point is prior to the flow meter and any flow control valves.

Wells shall be sampled for analytes in the following sequence, as applicable:

1. Volatile Organic Analysis:
    - Volatile Organic Compounds including
        - 1,2-Dibromo-3-chloropropane
        - 1,2-Dibromoethane
        - 1,2,3-Trichloropropane
        - 1,4-Dioxane
        - Isopropanol
2. Extractable Organic Analysis:
    - Semi-Volatile Organic Compounds including
        - 1,3-Dinitrobenzene
        - Hexachlorophene
        - N-nitrosodimethylamine (NDMA)

Nitrobenzene
Pentachlorophenol
Chloroxphenoxy Herbicides
Dioxins/Furans
Formaldehyde
Gasoline and Diesel Range Organics
Organophosphorus Pesticides
Pesticides
Polychlorinated Biphenyls (PCBs)
Total Petroleum Hydrocarbons

3. Hydrazines
4. Unfiltered Metals
5. Perchlorate
6. Cyanide
7. Chloride, Fluoride, Sulfate
8. Sulfide
9. Nitrate and Ammonia
10. General Minerals and Parameters:
    - Bicarbonate and carbonate (or alkalinity)
    - pH
    - specific conductance (or electroconductivity)
    - total dissolved solids
    - turbidity
11. Unfiltered Radiochemicals
12. Filtered Metals

The project WQSAPs shall be consulted for the specific analytes required to be sampled for from each well.

Groundwater samples designated to be tested for volatile organic compounds have special requirements. The sample vials shall be slowly filled without aerating the sample by tilting the vial until it is nearly full then holding it upright until a convex meniscus forms at the top of each vial. The vial shall be capped with a Teflon-lined cap and the cap firmly tightened. Each VOA vial shall then be inverted and sharply tapped to check for air bubbles. If bubbles are observed, the vial shall be discarded and the sample re-collected. Samples shall be labeled and put in a sealable plastic bag and placed inside a cooler with ice. The use of cool packs (blue ice) is not recommended.

Samples to be submitted for analysis of dissolved metals will be filtered prior to acidifying. The samples are filtered in the field prior to filling the pre-preserved container. Alternatively, they may be filtered by the laboratory if the samples are collected in unpreserved containers and prior arrangements are made with the lab to assure filtering within the required time frame (QAPP). If samples are to be field filtered, a 0.45-micron, in-line filter should be attached to the sample port on the discharge piping or tubing. Approximately 200 milliliters of discharge water shall be flushed through the filter prior to collecting the sample. The filter shall be replaced when flow of water through the filter is impaired.

Whenever feasible, samples should be collected in the following recommended sampling order by sample type:

1. Equipment rinse blank samples, if applicable
2. Samples for verification or follow-up sampling
3. Primary samples
4. Matrix spike and matrix spike duplicate samples
5. Field duplicate samples
6. Field split samples
7. Field blank samples

Prior to placement into the cooler, each sample should be double-checked to make certain it is properly identified and appropriately labeled. Sample handling, labeling, and transportation are discussed in the Sample Management SOP (Section 1.6).

## 6.6 Recording of Information

Relevant information pertaining to field activities should be recorded on a regular basis. In order to avoid the potential to not document important information, the record should be in plain sight near the work area and be readily accessible so that observations, readings, and other pertinent information can be easily recorded whenever possible. Observations and other information should be recorded as soon as practicable, or at a minimum, a brief note and the time recorded for later elaboration. The types of information to be recorded may include:

- Arrival and departure times at the site and at individual wells. Dates should be recorded in the format MM/DD/YY. Times should be based on a 24-hour military type format for the given time zone (Pacific Standard Time [PST] or Pacific Daylight Time [PDT]). For example, 8:45 a.m. should be recorded as 0845. The time 2:45 p.m. should be recorded as 1445.
- Information regarding instrument calibrations and the calibration standards used.
- Readings of organic vapor concentrations in the well vault.
- Depth to water.
- Damage or concerns regarding wells or access.
- Method and equipment used to purge wells.
- Pump depths.
- Method and equipment used to collect samples.
- Groundwater parameters.
- Purge volumes, times and estimated flow rates.
- Dates, times and volumes of samples collected.
- Decontamination procedures, if required.
- Times and names of visitors on the site and their purpose.
- Problems or potential problems with equipment.
- Potential health or safety issues that may require revision to the HASP.
- Accidents or injuries.

## 6.7 Sample Containers and Preservatives

Requirements for groundwater sample containers, preservation requirements, and holding times are addressed in the QAPP.

## 6.8 Quality Control Samples

For each sampling event, additional samples are required for quality assurance and quality control (QA/QC) purposes. Quality assurance and quality control samples shall be collected, preserved, and handled at the same time and in the same manner as the other groundwater samples collected. The various types of QA/QC samples are discussed in the QAPP (Appendix B of the WQSAPs).

## 6.9 Sample Documentation

### 6.9.1 Chain of Custody

The appropriate sample custody documentation shall be completed in accordance with the Sample Management SOP. Entries on the Chain-of-Custody form shall be entered using indelible ink. Identified errors shall be lined out with a single line, initialed, and dated. Chain-of-Custody forms shall be fully completed, with applicable blocks having entries and the signatures of samplers and recipients.

### 6.9.2 Field Activities Record

The groundwater samples collected from each well, along with the QA/QC samples prepared or collected, shall be identified in the field record. The field sampler shall be responsible for completing the entries. The record shall be submitted to the project manager for review and kept in the project file.

### 6.9.3 Well Conditions

Any observations by the sampler on the condition of the well pad, well vault, well seal or downhole equipment should be noted on the water-level measurement record (Table A-I) and the field sampling record (Table A-III).

## 7. PERSONNEL QUALIFICATIONS

Field samplers are required to take the 40-hour health and safety training course and refresher courses as required by 29 CFR 1910.120 prior to engaging in field collection activities. In addition, field personnel should be trained in the appropriate methods before initiating the procedure alone.

## 8. HEALTH AND SAFETY

Site personnel perform air monitoring at the well head as the monitoring well cover is removed during the initial water-level measurement phase of each monitoring event. The results of air monitoring during the water-level measurements may indicate the need for additional monitoring during the groundwater sampling phase and possible upgrade of the personal protection level according to the current approved site Health and Safety Plan (Appendix C of the WQSAPs).

# 9. QUALITY ASSURANCE/QUALITY CONTROL

The following general quality assurance/quality control (QA/QC) procedures apply:

- Pertinent data and activities will be recorded.
- Equipment will be calibrated and operated in accordance with operating instructions as supplied by the manufacturer.

# APPENDIX A
# SECTION 1.4

# WESTBAY MULTILEVEL SYSTEM
# STANDARD OPERATING PROCEDURE

**TABLE OF CONTENTS**



**LIST OF ATTACHMENTS**

## 1. INTRODUCTION

The Westbay System is a multilevel monitoring and sampling system that allows testing of hydraulic conductivity, monitoring of fluid pressure, and collection of fluid samples from multiple zones within a single borehole. This system has an advantage over some other groundwater sampling systems in that it can be used to collect samples without purging prior to each sampling event. The unique customizable Westbay casing system is made of PVC and uses intervals of hydraulically-inflated packers to provide engineered seals between monitoring zones. Monitoring, sampling, and hydraulic testing are accomplished by lowering wire-line operated tools into the casing system. These tools access the surrounding groundwater in formation via valve ports located within each isolated monitoring zone.

## 2. SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure (SOP) is to present the proper procedures for sampling a groundwater well completed with a Westbay multilevel sampling system. The Westbay system design provides for the collection of a sample that is representative of the particular zone of water being sampled at the time of collection. This SOP pertains only to the operation of the Westbay system components and should be used in conjunction with the general field sampling procedures described in the Quality Assurance Project Plan (QAPP) and the Sample Management SOP (Section 1.6).

This procedure is intended for use by field samplers and other personnel who provide assistance during the collection of samples using the Westbay system. It describes the specific activities to be performed prior to going into the field and upon arrival at each sampling location.

These standard operating procedures may be revised to accommodate changing site conditions or to address procedural limitations that may be identified in the future. The actual procedures employed should be documented.

## 3. METHOD SUMMARY

Sampling is performed using a remotely controlled probe connected to one or more evacuated stainless steel sampling cylinders. The probe is lowered to the depth of the monitoring interval to be sampled. Once the probe has been lowered to the approximate depth of the desired sampling port, the sampling technician activates the probe's location arm to allow proper positioning of the probe relative to the targeted sampling port. After the probe is seated firmly at the desired port, a mechanical foot is deployed to press and seal the probe's sampling valve against the sampling port. Water residing outside of the Westbay casing then flows into the sampling cylinder(s). The probe is retrieved to the surface, and the sample is transferred to the appropriate sampling containers. Sample containers shall be labeled and stored in a cooler with ice packs until they are relinquished to a laboratory courier or packaged for shipping. The stainless steel sampling cylinders will be decontaminated after each depth interval is sampled to avoid cross-contamination. Field personnel will be trained by an experienced Westbay operator in the use of the specialized tools and equipment required for monitoring and sampling of the Westbay system.

## 4. EQUIPMENT REQUIRED

Depending on the laboratory analysis to be performed, the type, size, and number of sampling containers will vary. However, the following equipment should be available in the field during each sampling event:

- Water-level indicator appropriate for Westbay technology
- Personal Protective Equipment (PPE), including nitrile gloves and safety glasses
- Heavy duty paper towels
- Cellular phone and radio to communicate with project managers and other field staff
- Keys to well box locks
- Watch with a stopwatch function
- Blank Westbay Groundwater Field Sampling Sheets (Attachment A1.4-1)
- Instrument calibration forms
- Chain-of-Custody forms
- Tools necessary to set up and operate the Westbay system
- Containers for purge water
- MOSDAX Sampler Probe
- MOSDAX Automated Groundwater Interface (MAGI)
- Hand Held Controller (HHC)
- MOSDAX-compatible winch with cable
- Stainless steel sample cylinders and connecting tubes
- Westbay casing log(s) showing depths to ports and couplings in the well(s) to be sampled
- Groundwater Sampling Field Data Sheets (Table A-III)
- 12 VDC, 2 amp power source (battery pack, car/truck, or transformer)
- Counter and tripod
- Sampling Kit including vacuum pump
- Measuring tape
- Sample containers and preservatives supplied by the laboratory
- Sample labels and fine-point indelible marker
- Cooler and ice
- Calculator
- Custody seals
- Decontamination supplies
- Material safety data sheets (MSDS)
- Water Quality Sampling and Analysis Plans.

## 5. REAGENTS

Reagents may be used for preservation of samples and for decontamination of sampling equipment. The preservatives required depend on the analysis to be performed (see the Quality Assurance Project Plan, Appendix B of the Water Quality Sampling and Analysis Plans). Upon request, the laboratory selected to perform the analyses will provide sample containers that have been prepared with the appropriate preservatives. Decontamination should be performed using the solutions specified in the Equipment Decontamination SOP (Section 1.7).

## 6. PREPARATION

In preparation for a groundwater sampling event, the field sampler should review the Groundwater Monitoring Field Sampling Plan and obtain the required information and equipment as described in the Groundwater Sampling SOP (Section 1.3) and the additional Westbay multilevel sampling system equipment described in this SOP (Section 1.4.4).

# 7. SAMPLING

This section follows the sampling procedure outlined in the Operations Manual for the Westbay MOSDAX Sampler Probe Model 2531, prepared by Schlumberger Water Services, revision 2.0, dated 06 February 2009 (Attachment A1.4-2).

## 7.1 Surface Checks

1. Remove the MOSDAX Sampler from its storage case. Inspect the probe housing and body for damage. Contact Westbay for advice on cover tube damage.
2. Assemble the tripod and counter over the well. Run the cable over the counter.
3. Connect the probe to the cable. Before attaching, inspect the O-ring at the top of the probe for wear and lubricate with silicone if necessary. The O-ring should be clean and intact. Tighten the nut by hand only.
4. Connect the 2-pin cable from the MAGI to the cable reel. With the MAGI OFF connect the 3-pin cable from the MAGI to the 12 v power supply (truck battery).
5. Connect the 9-pin cable from the HHC to the MAGI and turn the MAGI ON.
6. MOSDAX Sampler Checks - perform the following surface checks to ensure that the location arm and the shoe mechanisms are operating normally:
   i. Release the location arm. The location arm should extend smoothly. The number of revolutions used to release the location arm is displayed and should be 15 to 16 revolutions. If a smaller number of revolutions are reported, retract the arm and repeat.
   ii. Place the probe in a piece of Westbay casing or coupling.
   iii. Activate the shoe. The shoe should extend and hold the probe firmly in the coupling or casing. The display should indicate 16 to 19 revolutions. A reading of 23 revolutions indicates the probe is activated in open air.
   iv. Retract the backing shoe.
7. Check that the face plate for sampling and the plastic plunger are installed on the sampler. Once steps 1 through 7 are complete, the probe is ready to be lowered down the Westbay casing.
8. Attach the stainless steel sample cylinders. Depending on the sample volume to be collected, the sample cylinders can be connected in series; each has a volume capacity of 250 ml.
9. Locate the supplied vacuum coupling and attach it to the top of the Westbay casing.
10. Release the location arm. Insert the probe in the vacuum coupling until it locks into the helical groove.
11. Deploy the shoe.
12. Close the sampler valve. The motor should run for about 5 seconds. The display should indicate one revolution.
13. Use the vacuum pump to apply a vacuum through the vacuum coupling. The vacuum should remain constant. If the vacuum is not maintained, inspect for leaks at the face seal of the probe, the connection to the pump, and the probe sampling valve.

14. Once a vacuum has been maintained, open the sampler valve. Apply a vacuum again to check that connections are sealed.
15. Close the sampler valve. A vacuum has now been applied to the steel sample cylinders.
16. Retract the shoe.

### 7.2 Sampling

1. Lower a water-level indicator and check recent pressure logs of the hole to confirm that the head inside the Westbay casing is lower than the head outside the measurement port to be sampled. If there is a leak in the seal between the casing and sampler, this step will ensure that water will flow into the casing from the formation, not vice versa.
2. Obtain the completed Westbay Casing Log and a blank Groundwater Field Sampling Sheet, which will be filled in with each step of the MOSDAX operation.
3. With the location arm retracted, lower the probe into the Westbay casing until it is immediately below the lowest measurement port coupling to be sampled. The Collar Detect Command function on the MAGI is used to detect the magnetic collars installed on the Westbay casing. As the MOSDAX lowers past one of these collars, a beep can be heard form the MAGI. If desired, the Collar Detect Command can be cancelled by pressing key on the HHC.
4. Release the location arm. The display should update and beep after the arm is released.
5. Raise the probe about 0.5 m (1.5 ft) above this measurement port. If the probe is accidentally lifted above the next higher coupling, it will be necessary to retract the location arm and lower the probe to below the measurement port and release the arm.
6. Lower the probe gently until the location arm rests in the measurement port.
7. Record the pressure reading.
8. Activate the probe and record the formation pressure.
9. Open the sampler valve. The pressure should drop and then slowly increase as the steel sample cylinders fill. When the pressure in the cylinders equals the zone pressure measured during Step 8, the cylinders are full. Wait a maximum of two minutes per sample cylinder even if the pressures are not equal.
10. Close the sampler valve and retract the shoe.
11. Record the pressure reading. A reading the same as that measured in Step 7 indicates that the sample is properly sealed and contained.
12. Reel the sampler to the surface and remove it from the Westbay casing.
13. **Do not open the sampler valve as damage to the probe or injury to the operator could occur.**
14. Remove the cap from the bottom sample cylinder and open the valve to release the pressure and to transfer the sample to the appropriate packaging containers.
15. Open the sampler valve to allow the sample to flow from the cylinders. Once the pressure in the sampler and cylinders has decreased to atmospheric, the cylinders may be disconnected to speed the process.
16. Take particular care in handling pressurized samples.

### 7.3 Decontamination

Reagents used for decontamination of sampling equipment are specified in the Equipment Decontamination SOP (Section 1.7). The probe should be submerged at each wash/rinse stage with the sampler valve open. The sample bottle connectors should also be submerged with the valves open at each wash/rinse state. Other decontamination procedures are as specified in the Equipment Decontamination SOP (Section 1.7).

## 8. INTERFERENCES AND POTENTIAL PROBLEMS

The primary goal in performing groundwater sampling with a Westbay system is to obtain a sample that is representative of the groundwater at a specific depth. Several potential problems may interfere with this process.

### 8.1 Operator Error

The two most probable types of operator error are: a) deployment of the sampling probe at a depth that is inconsistent with the depth of the desired sampling port, and b) incorrect handling of the sample. The former can be avoided by paying close attention to the Westbay Casing Log and completing the checklist provided on the Groundwater Field Sampling Sheet as each step is performed. This will ensure that the sample is collected from the appropriate Westbay interval and will minimize potential damage to the sample probe. Incorrect handling of the sample will generally occur during transfer of the sample from the downhole sampling cylinders to the appropriate sample containers. Care must be taken when disconnecting the cylinders from the probe to avoid spilling the sample.

### 8.2 Failure to Connect with Port

In the event that the shoe is unable to seal around the sampling/measurement port, the operator should perform the following troubleshooting steps: 1) Retract the shoe.2) Raise the sampler to the next highest sampling/measurement port.3) Repeat steps 6 – 8 of Section 7.2.4) If the shoe is unable create a seal at either port, retrieve the probe to the surface. Perform maintenance procedures as outlined in Section 4 of the Westbay MOSDAX Sampler Probe Operator's Manual (Attachment 1). Re-attempt to collect samples after completing maintenance procedures. If the probe fails again, seek additional guidance by calling Westbay Technical Support at (604) 430-4272.

### 8.3 Excess Head Inside Casing

In the event that the water level inside the Westbay casing is higher than the equivalent head in formation, the operator will need to pump the excess water out of the casing using a double check-valve or hydrostatic lift pump. The volume of water to be removed may be determined using the following equation:

$$V = 0.0282*(P1 - P2)$$

where P1 is the pressure measured inside the Westbay casing prior to opening the port, and P2 is the formation pressure measured while the port is open. Field personnel should consult the operator’s manual that pertains to the pump being used. All purged water should be transported and disposed of according to procedures described in the Groundwater Monitoring Field Sampling Plan.

## 9. PERSONNEL QUALIFICATIONS

Field personnel are required to have completed 40-hour health and safety training and necessary refresher courses before conducting sample collection activities, as required by Federal OSHA Standard 29 CFR 1910.120. Field personnel should also be trained by an experienced Westbay operator in the appropriate methods before initiating this procedure alone.

## 10. HEALTH AND SAFETY

At a minimum, standard Level D personal protective equipment (safety glasses, nitrile gloves, boots, and fully covered sleeves) should be worn when retrieving and handling the sampler probe and during fluid transfer of the samples into appropriate containers. Actual PPE should be selected based on the criteria presented in the Health and Safety Plan (Appendix C of the WQSAPs). Care and common sense should be used around the well head to avoid dropping tools and/or field equipment down the Westbay or well casings. Field personnel should be aware of their surroundings, terrain, and be familiar with the emergency response procedures described in the Health and Safety Plan.

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Schlumberger
WATER SERVICES

# Groundwater Sampling
## Field Data Sheet

Project: ____________________________

Monitoring Well No.: ____________________________

Sampling Zone No(s).: ____________________________

Date: ____________________________

Start Time: ____________ Atm. Reading: ______________

End Time: ____________ Atm. Reading: ______________

Operators: ____________________________

| Port No. | Run No. | Surface Function Tests (probe in flushing collar) | | | | | | Position Sampler | | | | Sample Collection Checks (probe located at sampling zone in Westbay casing) | | | | | | | | Comments (volume recovered) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Shoe Out | Close Valve | Check Vacuum | Open Valve | Evacuate Bottles (3-5 psi) | Close Valve | Shoe In-Arm In | Locate Port | Arm Out | Land Probe | Pressure in Westbay ( ) | Shoe Out | Zone Pressure ( ) | Open Valve | Zone Pressure ( ) | Close Valve | Shoe In | Pressure in Westbay ( ) | |
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Additional Comments: (pH, turbidity, S.C., etc.)

# OPERATIONS MANUAL

## Westbay MOSDAX Sampler Probe - Model 2531

Schlumberger
WATER SERVICES

# NOTICE

Operation of Westbay System equipment should only be undertaken by qualified instrument technicians who have been trained by Schlumberger authorized personnel.



# DO NOT OPEN THE SAMPLER

All warranties expressed or implied will be void if, after examination by Schlumberger Water Services personnel, it is established that any of the instrument housings have been opened without prior authorization from Schlumberger Canada Limited.



# DO NOT LET THE SAMPLER FREEZE

Extreme care should be taken to avoid freezing the MOSDAX Sampler probe. Permanent transducer damage may result from freezing.

Manual Revision: 2.0 February 6, 2009

Issued for Serial No.: ______________

Date: ______________

Signature: ______________

# Contents

# 1. DESCRIPTION

## 1.1 MOSDAX Sampler Probe, Model 2531

The MOSDAX Sampler is a downhole probe designed to collect fluid pressure information and fluid samples from Westbay System monitoring wells. Each MOSDAX pressure sensor is calibrated over its full pressure range for nonlinearity and temperature variation. MOSDAX Sampler probes are available in a variety of pressure ranges to permit operation to various depths. The shoe and valve motors can be operated from the surface. The power for the shoe and valve motors is supplied from the surface.

## 1.2 MOSDAX Automated Groundwater Interface (MAGI), Model 2536

The MOSDAX Sampler can be operated directly by the keypad on the MOSDAX Automated Groundwater Interface (MAGI), or by a Hand Held Controller (HHC) connected to the MAGI, or with a computer running Microsoft Windows (2000 or higher) and Westbay software connected to the MAGI. The MAGI translates the signals between the computer or HHC and the MOSDAX Sampler. The MAGI requires 12 volt DC power to operate.

Older versions of MOSDAX sampling equipment may incorporate a Model 2522 MOSDAX PC Interface (MPCI) and HHC rather than a MAGI. For such systems, reference to the MAGI in this document can be considered as reference to the MPCI and HHC.



## 1.3 Cable Reels

The manual cable reel can operate all Westbay probes and tools to a depth of 300m (1,000 ft) on a single-conductor cable. The manual reel is hand operated with an internal brake to control the speed of descent of the probe in the well. The two-pin cable connects the MAGI to the reel and the signals pass through a slipring located in the hub of the reel into the control cable. For maintenance information, see the appropriate cable reel manual.

Motorized cable reels are available for deeper applications.

## 1.4 Sample Containers

Sample containers can be used with the MOSDAX Sampler. The nonvented stainless steel sample containers maintain samples under formation pressure while the sampler and container are brought to the surface.

# 2. PRESSURE PROFILING

## 2.1 Items Required

- MOSDAX Sampler Probe, Model 2531
- MAGI, Model 2536 with:
  - one two-pin data cable
  - one three-pin power cable
  - hand held controller with cable and user's guide (optional)
  - computer running Windows 2000 or higher with one nine-pin computer cable and MProfile software (optional)
- MOSDAX-compatible winch with cable
- Sheave with counter and tripod
- 12 VDC, 2 Amp power source (Battery pack, car/truck battery, or transformer)
- Water level measuring tape
- MProfile User's Guide for computer or the Handheld Controller Operations Manual
- Westbay Casing Log showing depths to ports and couplings in hole to be tested.



## 2.2 Surface Checks

1. Remove the MOSDAX Sampler from its storage case. Inspect the probe housing and body for any damage. Please contact Westbay for advice on any cover tube damage.
2. Assemble the tripod and counter over the well. Run the cable over the counter.
3. Connect the probe to the cable. Before attaching, inspect the O-ring at the top of the probe and lubricate with silicon. The O-ring should be clean and intact. Tighten the nut hand tight only.
4. Connect the two-pin cable from the MPCI to the cable reel. With the MPCI OFF connect the three-pin cable from the MPCI to the 12 v power supply.
5. Connect the 9 pin cable from computer or HHC to the MPCI and turn the MPCI ON.
6. Perform the following surface checks to ensure that the location arm and the shoe mechanisms are operating normally: Release the location arm. The location arm should extend smoothly. The number of revolutions used to release the location arm is displayed and should be 15 to 16 revolutions. If a smaller number of revolutions is reported, retract the arm and repeat. Place the probe in a piece of Westbay casing or coupling. Activate the shoe. The shoe should extend and hold the probe firmly in the coupling or casing. The display should indicate 16 to 19 revolutions. A reading of 23 revolutions indicates the probe is activated in open air. Retract the backing shoe.

7. Check that the face plate for sampling and the plastic plunger are installed on the sampler.
8. The probe is now ready to be lowered down the well.

## 2.3 Pressure Measurement Procedures

1. Obtain the completed Westbay Casing Log.
2. With the location arm retracted, lower the probe into the Westbay casing to immediately below the lowest measurement port coupling to be monitored. If magnetic collars have been installed on the well, the Collar Detect Command can be used to detect the collars. The Collar Detect Command is cancelled by pressing any key.
3. Release the location arm. The display should update and beep after the arm is released.
4. Raise the probe about 0.5 m (1.5 ft) above this measurement port. If the probe is accidentally lifted above the next higher coupling, it will be necessary to retract the location arm and lower the probe to below the measurement port and release the arm.
5. Lower the probe gently until the location arm rests in the measurement port.
6. Record the pressure and temperature inside the Westbay casing.
7. Optional: If a water level tape is available, measure and record the depth to water in the Westbay casing.
8. Activate the shoe. The pressure on the display should change to the formation pressure.
9. When the reading has stabilized, record the formation pressure.
10. Once the pressure has been recorded, retract the shoe.
11. Record the pressure of the fluid in the Westbay casing. This reading should be similar to that recorded in Step 6. If a large difference is noted between the readings, record the water level inside the Westbay casing again using the water level tape.
12. The three pressure readings plus the time and water level constitute a complete set of readings at a measurement port coupling.
13. Continue up the Westbay casing to obtain the pressure data from other measurement ports.
14. Take one last set of pressure and temperature readings at the surface. These readings should be similar to those recorded in Step 2.

**CAUTION: If a water level tape was used, remove the water level tape from the Westbay casing before removing the sampler probe from the well to prevent them from becoming jammed.**

# 3. FLUID SAMPLING

## 3.1 Items Required

- MOSDAX Sampler, Model 2531
- MAGI, Model 2536 with:
  - one two-pin data cable
  - one three-pin power cable
  - hand held controller with cable and user's guide (optional)
  - computer running Windows 2000 or higher with one nine-pin computer cable and MProfile software (optional)
- MOSDAX-compatible winch with cable
- Sample containers and connecting tubes
- Westbay Casing Log
- Groundwater Sampling Field Data Sheet
- 12 VDC, 2 amp power source (battery pack, car/truck, or transformer)
- Counter and tripod
- Westbay Sampling Kit including vacuum pump



## 3.2 Surface Checks and Preparation

1. Set up the MOSDAX Sampler probe following Steps 1 through 8 of Section 2.2.
2. Attach the sample containers.
3. Release the location arm. Locate the probe in the vacuum coupling.
4. Activate the shoe in the vacuum coupling.
5. Close the sampler valve. The motor should run about 5 seconds. The display should indicate one revolution.
6. Use the vacuum pump to apply a vacuum through the vacuum coupling. The vacuum should remain constant. If the vacuum is not maintained, inspect for leaks at the face seal of the probe, the connection to the pump and at the probe sampling valve.
7. Once a vacuum has been maintained, open the sampler valve. Apply a vacuum again to check that all connections are sealed.
8. Close the sampler valve. A vacuum has now been applied to the sample bottles.
9. Retract the shoe.

## 3.3 Drillhole Sampling

1. Check recent pressure logs of the hole and ensure that the head inside the Westbay casing is lower than the head outside the measurement port to be sampled.
2. After completing the surface checks, follow Steps 1 to 5 of Section 2.3 to locate the sampler at the measurement port in the monitoring zone to be sampled.
3. Record the pressure reading.
4. Activate the probe and record the formation pressure.
5. Open the sampler valve. The pressure should drop and then slowly increase as the bottles fill. When the pressure in the bottle equals the zone pressure from Step 4, the bottle is full. Wait a maximum of two minutes per sample bottle even if the pressures are not equal.
6. Close the sampler valve and retract the shoe.
7. Record the pressure reading. A reading the same as in Step 3 indicates that the sample is OK.
8. Reel the sampler to the surface and remove it from the Westbay casing.
9. **Do not open the sampler valve as damage to the probe or injury to the operator could occur.**
10. Remove the cap from the bottom sample bottle and open the valve on the bottle to release the pressure and to transfer the sample.
11. Open the sampler valve to allow the sample to flow from the bottles. Once the pressure in the sampler and bottles has decreased to atmospheric, the bottles may be disconnected to speed the process.
12. Take particular care in handling pressurized samples.



## 3.4 Rinsing Instructions

Rinse the sampler around the face seal and the bottom connector. With the sampler valve open, flush the interior of the sampler from the bottom connector. Rinse the sample bottles and connectors.

**Note: Project specific procedures for decontaminating the sampler and sample bottles are the responsibility of the project manager and are not covered in this manual.**

# 4. Care and Maintenance

The MOSDAX Sampler System must be routinely maintained for optimum performance. The procedures outlined here are required to keep the instrument operating properly. For any additional information or advice, please contact Schlumberger Canada Limited.

## 4.1 MAGI

The MAGI should be cleaned to remove dirt and dust and inspected for damage or wear. If any part requires replacement, contact Schlumberger Water Services for information.

## 4.2 Cable Reels and Control Cable

The cable reels should be kept clean and protected from damage. The cable and cable head should be inspected for kinks and corrosion. Rehead the cable if necessary. For more information concerning cable reels and the control cable, refer to the appropriate reel manual.

## 4.3 MOSDAX Sampler Probe

1. Never allow the probe to freeze or the pressure transducer may be damaged.
2. Clean and inspect the probe for dents and scratches on the cover tube. Clean the threads with a nylon brush, such as a toothbrush. DO NOT use a wire brush. Protect the O-rings from damage and dirt.

### 4.3.1 Face Seal

Inspect the face seal and replace if damaged or worn.

1. Remove the two screws holding the face plate to the probe body and lift the face plate off.
2. Remove the face seal and plunger. Set the location arm assembly aside. Clean the plunger and probe body.
3. When reinstalling the face plate hold the face seal, plunger and location arm assembly in place. Replace the two screws the hold the face plate on the probe.

### 4.3.2 Location Arm

Release the location arm. Check that the arm moves smoothly and freely and check for damage and sharp edges due to wear. Replace the location arm if necessary.

1. Release the location arm. Remove the two screws and face plate (Section 4.3.1).
2. Remove the location arm with its spring and pivot pin. Clean and inspect all parts and replace if needed.
3. Insert the spring and pivot in the location arm and place the assembly in the probe body. Place the face plate over the face seal and location arm and tighten the two screws.

Check that the arm is moving freely and the face seal insert and plunger are held securely in place.

### 4.3.3 Shoe Replacement

Activate the shoe and inspect for damage or wear. The shoe should rotate freely about the pivot pin. When the shoe is retracted it should retract quickly and smoothly back into the probe. The shoe may be replaced in the following manner:

1. Release the location arm and extend the shoe to expose the pivot pin.
2. Unscrew the shoe pivot pin from the lever arm and remove the shoe.
3. Place a new shoe in the lever arm and install the shoe pivot pin.

### 4.3.4 Actuator Nut

The actuator nut needs to be routinely cleaned to remove particles of grit which can interfere with its movement. Remove the actuator nut in the following manner:

1. Remove the two set screws that hold in the lever arm pivot pin. Using the Allen key, push the lever pivot pin out of the probe body.
2. Remove the set screws on the side of the probe body that holds the plastic support block.
3. Remove the screw closest to the top of the probe.
4. Lift out the lever arm, guide plate, shoe, spring and plastic support block as one unit.
5. Use the Clean Nut Command to remove the actuator nut from the actuator screw. Turn off the MPCI and remove the nut from the probe.
6. Clean the actuator nut with the cleaning tap. Use the Clean Nut Command and clean the actuator screw with a nylon brush. DO NOT use a wire brush.
7. Apply a thin coating of silicone lubricant to the actuator screw. Place the actuator nut in the probe body against the actuator screw and retract the arm to thread the nut onto the actuator screw. Allow the nut to travel along the full length of the screw. YOU MAY HAVE TO REPEAT THIS OPERATION.
8. Install the single unit from Step 4 in the probe body. Install the lever arm pin through the probe body, lever arm, and spring. Lock the pin in position with two set screws.
9. Install the top screw into the guide plate and install the set screws to secure the support block.



## 5. CALIBRATION

The Westbay System permits frequent or periodic calibration of the transducers used for pressure measurement. Contact Schlumberger Water Serices for details.

# 6. SPARE PARTS LIST

| Item | Part No. or Size | Qty |
|---|---|---|
| Face Seal Insert | 200302 | 5 |
| Plunger | (see Note 1) | 5 |
| Location Arm | 252112 | 5 |
| Shoe | 252313 | 5 |
| Pin 3 (Location Arm) | 252320 | 2 |
| Spring 2 (Location Arm) | 252319 | 2 |
| Pin 1 (Shoe) | 252316 | 2 |
| Spring 1 (Shoe Lever) | 252318 | 2 |
| Pan Head Screw | # 4-40 x 1/4 - inch | 2 |
| Pan Head Screw | # 6-32 x 3/16 - inch | 2 |
| Pan Head Screw | # 6-32 x 1/2 - inch | 2 |
| Hex Socket Head Screw | # 8-32 x 1/8 - inch | 4 |
| Hex Socket Head Screw | # 10-32 x 3/16 - inch | 4 |
| Hex Socket Set Screw | # 8-32 x 5/16 - inch | 2 |
| Allen Key | 5/64 - inch | 1 |
| Allen Key | 3/32 - inch | 1 |
| Actuator Nut Tap | 208001 | 1 |
| Cablehead Parts: | | |
| O-ring | # 111 B | 2 |
| Termination Sleeve | 251805 | 1 |
| Termination Insert | 251806 | 1 |
| Feedthru Connector | 251814 | 1 |
| Bushing 1 | 251812 | 1 |
| Bushing 2 | 251813 | 1 |
| O-Ring | # 108 V | 1 |
| O-Ring | # 010 V | 1 |
| O-Ring | # 004 V | 1 |
| Boot | JF0602CF | 1 |
| Contact | JF0603CF | 1 |
| Cable Heading Tool | 208100 | 1 |

1. Plunger appropriate to type of measurement port to be accessed.

**APPENDIX A**
**SECTION 1.5**

**FLUTe MULTILEVEL SYSTEM**
**STANDARD OPERATING PROCEDURE**

**TABLE OF CONTENTS**



**LIST OF ATTACHMENTS**

# 1. INTRODUCTION

The FLUTe system is a multilevel monitoring and sampling system that allows hydraulic testing, fluid pressure monitoring, and fluid sample collection from multiple zones within a single borehole. The FLUTe multilevel system uses a flexible liner made of polyurethane-coated nylon fabric to provide engineered seals between monitoring zones. Monitoring, sampling, and hydraulic testing are accomplished by applying gas pressure to drive the groundwater sample to the surface. After purging the tubing, the sample water does not contact the drive gas.

## 2. SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure (SOP) is to present the proper procedures for sampling a groundwater well completed with a FLUTe multilevel sampling system. The FLUTe system design provides for the collection of a sample that is representative of the particular zone of water being sampled at the time of collection. This SOP pertains only to the operation of the FLUTe system components and should be used in conjunction with the general field sampling procedures described in the Quality Assurance Project Plan (QAPP) and the Sample Management SOP (Section 1.6).

This procedure is intended for use by field samplers and other trained personnel who provide assistance during the collection of samples using the FLUTe multilevel system. Sample collection should not be performed by personnel not specifically field trained in the use of the FLUTe system. This SOP describes the specific activities to be performed prior to going into the field and upon arrival at each sampling location.

These standard operating procedures may be revised to accommodate changing site conditions or to address procedural limitations that may be identified in the future. The actual procedures employed should be documented.

## 3. METHOD SUMMARY

The groundwater level in each liner should be between 5 and 10 feet above the highest formation water level to provide a good seal of the liner in the hole. Groundwater flows from the formation through the spacer pore space, through the port tube, through the first check valve, and fills the pump tube and the sample tube at the same time (Attachment A1.5-1, Figure 1). Purging should be performed prior to sample collection to remove stagnant groundwater in the pump tube and the sample tube. Purging is accomplished by connecting a drive gas source to the pump tube. Groundwater is purged from the tubing by applying the recommended purge pressure to the interface at the static water level in the pump tube (Attachment A1.5-1, Figures 1 and 2). Groundwater is driven down in the pump tube and up through the second check valve to the surface via the sample tube. The purge stroke is complete when the water is evacuated and gas is expelled from the sample tube. After three to four purge strokes, groundwater sampling is best accomplished using a recommended sampling pressure that is less than that needed to drive gas through the bottom of the pump tube. Groundwater samples are collected from the sample tube in containers as required by the analytical laboratory. Sample containers will be labeled and stored in a cooler with ice packs until they are relinquished to a laboratory courier or packaged for shipping. Field personnel will be trained by an experienced FLUTe operator in the use of the specialized tools and equipment required for monitoring and sampling of the FLUTe system.

## 4. EQUIPMENT REQUIRED

Depending on the laboratory analysis to be performed, the type, size and number of the sampling containers will vary. However, the following equipment should be available in the field during each sampling event:

- Water-level indicator appropriate for FLUTe methodology
- Measuring tape
- Personal Protective Equipment (PPE), including nitrile gloves and safety glasses
- Heavy duty paper towels
- Cellular phone and radio to communicate with project managers and other field staff
- Keys to well box locks
- Watch with a stopwatch function
- Tools necessary to operate the FLUTe system
- Vessels (i.e tanks or drums) to contain purged water
- Instrument calibration forms
- Chain-of-Custody forms
- Field sampling forms
- Drive gas source (e.g., ultra high-purity nitrogen)
- Flow regulator
- FLUTe As-built Summary Sheet for the wells to be sampled
- FLUTe purge pressure and sampling pressure spreadsheet
- Groundwater Sampling Field Data Sheets (Table A-III)
- Sample containers and preservatives supplied by laboratory
- Sample labels and fine-point indelible marker
- Cooler and ice
- Calculator
- Custody seals
- Decontamination supplies
- Material safety data sheets (MSDS)
- Water Quality Sampling and Analysis Plans

## 5. REAGENTS

Reagents may be used for preservation of samples and for decontamination of sampling equipment. The preservatives required depend on the analysis to be performed (see the Quality Assurance Project Plan, Appendix B of the Water Quality Sampling and Analysis Plans). Upon request, the laboratory selected to perform the analyses will provide sample containers that have been prepared with the appropriate preservatives. Decontamination should be performed using the solutions specified in the Equipment Decontamination SOP (Section 1.7).

## 6. PREPARATION

In preparation for a groundwater sampling event, the field sampler should review the SSFL Field Sampling Plan and obtain the following information:

- Identification number(s) of well(s) to be sampled
- Locations of the wells
- Well location access requirements (if applicable)
- Field data recording requirements
- Field and analytical parameters to be tested
- Type and number of sample containers needed
- Volume of sample required for analysis
- Type and number of QA/QC samples to be collected (e.g., duplicates, splits, and blanks)
- Anticipated weather conditions

A request for sample containers, specifying sample media, number of samples, and analytical parameters to be tested, shall be prepared with sufficient advance notice and forwarded to the laboratory(-ies) contracted to complete the analyses. The analytical laboratory, in accordance with the sampling schedule and the sample volume requirements, will provide sample containers, preservatives, and quality control samples, as requested.

# 7. SAMPLING

This section follows the sampling procedure outlined in the "Sampling Guidelines for Water FLUTe systems," prepared by Flexible Liner Underground Technologies, L. L.C., revised April 2007 (Attachment A1.5-1).

## 7.1 Pre-sampling Water-Level Measurements

The water level in the liner should be checked prior to each sampling episode. The liner water level should be 5 to 10 feet above the highest formation water level to provide a good seal of the liner. The formation water level can be measured via the pump tube for each port (Attachment A1.5-1, Figure 1), or via the associated pressure transducer (if so equipped). The water level inside the liner should be tagged in the 0.5-inch inside diameter tube labeled "TAG" adjacent to the sampling tubes. If the water level is measured in the liner outside the "TAG" Tube (as is necessary in some older liners that are not equipped with a TAG tube), lower the weighted tag line very slowly to avoid damage to the liner. If needed, water can be added to the liner by simply pouring water into the liner or through the TAG tube, whichever is easier. Do not fill the liner more than 10 feet above the highest formation water level. It should be noted that filling the liner with de-ionized water can give a false water-level reading.

## 7.2 Drive Gas Setup

The water is pumped with compressed gas, usually ultra high-purity nitrogen. The FLUTe pump design is such that there is very low risk of aeration of the sample. The compressed gas source is usually a nitrogen bottle with a regulator for setting the prescribed driving pressure. The arrangement of the FLUTe gas drive system is shown in Attachment A1.5-1, Figure 2. The regulator is set to the proper gas pressure (defined later) by closing the three-way valve to prevent gas flow out of the quick connect fitting. The pressure gauge on the FLUTe pump driver is much more sensitive than the gauges on the regulator. The FLUTe pump driver will be securely connected to the regulator at the normal ¼-inch NPT connection on the regulator outlet. The regulator is attached to the top fitting on the compressed gas bottle (*note*: a special nitrogen regulator fitting is required for nitrogen tanks). Turn the pressure regulator handle counter-clockwise until it moves freely (the "no pressure" position). Rotate the main valve on the regulator (nearer the bottle) clockwise until fully closed. Open the valve on the bottle (counter-clockwise). The main bottle pressure gauge on the regulator will rise to the bottle pressure. Close the regulator valve (clockwise) until the pressure starts to rise on the pressure gauge on the FLUTe pump driver (three-way valve closed with no flow out of the quick connect). Adjust the regulator to the desired pressure for purging, as determined using the FLUTe purge pressure and sampling pressure spreadsheet. Connect the quick connect to the top fitting of the pump tube (Attachment A1.5-1, Figure 2). Slowly open the three-way valve to drive the groundwater out of the pump.

## 7.3 Purging

Groundwater is pumped from the tubing by applying the gas pressure to the interface at the static water level in the pump tube (Attachment A1.5-1, Figures 1 and 2). The groundwater is driven down in the pump tube and up through the second check valve to the surface via the sample tube. By driving the water with a sufficient gas pressure (the "recommended purge pressure"), the water in the pump tube and the sample tube is expelled at the surface. A purge stroke is complete when gas is expelled from the sample tube following the water flow. After each purge stroke, the pressure in the system will be vented (i.e., dropped to atmospheric pressure by turning the three-way valve to the vent position) to allow the pump tube to refill naturally via the port tube (Attachment A1.5-1, Figure 1). The recharge flow from the port tube consists of the port tube water, the water in the pore space of the spacer, and water from the formation. Because of the relatively large volume in the pump tube, most of the recharge is from the formation. The recharge will take about as long as the first purge stroke. However, a low conductivity formation can take considerably longer to recharge.

Purging the pump tube a second time will remove stagnant formation water that has resided in the spacer and port tube. If the recharge rate is prompt, the second purge water volume will be similar to the first stroke. A third purge stroke is recommended to remove water that may have been in long contact with the liner or spacer.

### 7.4 Sampling

Groundwater sample collection shall commence after the third (or fourth) purge cycle using the recommended sampling pressure determined using the FLUTe purge pressure and sampling pressure spreadsheet. The sampling pressure is less than that needed to drive gas through the bottom of the pump tube. Sampling pressures are calculated in the spreadsheet provided with each FLUTe system. The pressure regulator shall be reduced to the appropriate sample pressure for each port in the liner; sampling pressures should not exceed their respective purging pressures. Opening the three-way valve will now apply the sample pressure to the system causing flow from the sample tube.

The first flow of the sampling cycle sweeps along droplets of water left in the tubing from the purge cycle. That residual water is depleted of volatile components. Tests have shown that the first tube volume of the sample flow should be discarded as depleted in volatile compounds. The discard volume is also calculated in the spreadsheet. Groundwater samples can be collected from the sample tube outflow after the discard volume has been achieved. Groundwater flow from the sample tube will initially be fast; it will then decrease gradually toward the end of the sampling stroke and cease at the end of the sampling stroke. The typical sampling pressure drives the water level to within 25 feet of the bottom of the pump tube. The large buffer zone remaining in the pump tube is intended to minimize aeration of the sample.

It should be noted that in slow recharging conditions, there may be insufficient groundwater in the pump to fill the sample tube to the surface during the sample stroke. If this is the case, there will be gas discharging from the sample tube along with water, followed by a continuous flow of gas only. Proper sample flow should not include a gas discharge, and groundwater should flow gradually and decrease until it stops flowing altogether. Should there be evidence of insufficient or slow recharge conditions, allow the pump to refill for a longer time and repeat the sample stroke. The water level in the large tube, as described in Attachment A1.5-1 Section 7.1, should be gauged to assure that the pumping system has been sufficiently recharged prior to the sampling stroke.

If the Water FLUTe uses PVDF tubing, the purge of the entire system after sampling should not be neglected, even if head measurements are not to be made. This removes the water column from the sampling tube. For deep water tables, the long-term pressure of the standing water in the sampling tube might lead to excessive creep of the tubing, which is susceptible to "cold flow," a characteristic of Teflon-like materials. This is not a concern except for very deep water tables (>300 feet).

In most cases, the performance of a final purge of the system after sampling is useful, even if not essential.

### 7.5 Simultaneous Purging and Sampling of Multiple Ports

The FLUTe pumping system for each port is essentially identical in length, pump volume, and elevation in the hole. This allows the ports to be purged and sampled simultaneously for a greater sampling efficiency. Simultaneous multiport sampling requires a tube from the pressure source to each of the port fittings at the wellhead. The recommended purge and sample pressures are the same as used for single port sampling.

In some cases, the buoyancy of the sampling system is so great when emptied of water during the simultaneous purge that the tubing bundle can cause the liner to invert. The sampling volume spreadsheet that is provided with the liner indicates whether the ports can be purged simultaneously.

### 7.6 Decontamination

Reagents used for decontamination of sampling equipment are specified in the Equipment Decontamination SOP (Section 1.7). Sample liners that are removed should be submerged at each wash/rinse stage with the valves open. The sample bottle connectors should also be submerged with the valves open at each wash/rinse stage. Other decontamination procedures are as specified in the Equipment Decontamination SOP (Section 1.7).

## 8. INTERFERENCES AND POTENTIAL PROBLEMS

The primary goal in performing groundwater sampling with a FLUTe system is to obtain a sample that is representative of the groundwater at multiple discrete depths in a single borehole. The three most probable sources of error in this process are attributable to: a) insufficient purging prior to sampling, b) insufficient recharge prior to the sampling stoke, and c) incorrect handling of the sample. The first two sources of error can be avoided by paying close attention to the FLUTe As-built Summary Sheet and completing the driving pressure calculations using the FLUTe purge pressure and sampling pressure spreadsheet. This will ensure that the sample is collected from the appropriate FLUTe interval and that appropriate purge and sampling pressures are used. Incorrect handling of the sample may involve mislabeling the sample containers or using the wrong chemical preservative and/or sample containers for the analysis.

## 9. PERSONNEL QUALIFICATIONS

Field personnel are required to have completed 40-hour health and safety training and refresher courses before conducting sample collection activities, as required by Federal OSHA Standard 29 CFR 1910.120. Field personnel should also be trained by an experienced FLUTe operator in the appropriate methods before initiating this procedure alone.

## 10. HEALTH AND SAFETY

At a minimum, standard Level D personal protective equipment (safety glasses, nitrile gloves, boots, and fully covered sleeves) should be worn during sampling. Actual PPE should be selected based on the criteria presented in the Health and Safety Plan (Appendix C of the WQSAPs). Care and common sense should be used around the well head to avoid dropping tools and/or field equipment down the FLUTe liners or well casings. Field personnel should be aware of their surroundings and terrain, and be familiar with the site health and safety plan and updated emergency response procedures.

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# Sampling guidelines for *Water FLUTe* systems

Rev. April, 2007

**Water level in the liner.**
The liner water level should be 10 ft above the highest formation water level to provide a good seal of the liner in the hole (5 ft minimum excess head). The formation water level can be measured via the "pump tube" for each port. The water level inside the liner should be tagged in the ½" id tube labeled "TAG" adjacent to the sampling tubes. If the water level inside the liner is measured in the liner, outside the Tag Tube, lower the weighted tag line very slowly to avoid damage to the liner. Water can be added to the liner by simply pouring water into the liner or through the TAG tube, whichever is easier. Do not fill the liner more than 10 ft above the highest formation water level. The water level in the liner should be checked prior to each sampling episode. (Beware that filling the liner with de-ionized water can give a false water level reading.)

**Water flow**
The water flow into the pumping system is shown in Fig. 1. Water flows from the formation through the spacer pore space, through the port tube, through the first check valve, and fills the "pump tube". The "sample tube" is also filled at the same time. The water level rises in the pump tube to the water table for that port.

**Setting up the gas pressure source**
The water is pumped with gas pressure. The FLUTe pump design is such that there is very low risk of aeration of the sample. The gas source is usually a nitrogen bottle with a regulator for setting the prescribed driving pressure. The arrangement of the FLUTe gas drive system is shown in Fig. 2. The regulator is set to the proper gas pressure defined later by closing the three way valve to prevent gas flow out of the quick connect fitting. The pressure gauge on the FLUTe pump driver is much more sensitive than the regulator for setting the regulator pressure. The FLUTe pump driver must be securely connected to the regulator at the normal ¼" NPT connection on the regulator outlet.

The regulator is attached to the top fitting on the gas bottle ( a special nitrogen regulator fitting connects to a nitrogen bottle). Turn the pressure regulator handle counter-clockwise until is moves freely (the no pressure position). Rotate the main valve on the regulator (nearer the bottle) clockwise to fully closed. Open the valve on the bottle (counter clockwise). The main bottle pressure gauge on the regulator will rise to the bottle pressure. Close the regulator valve (clockwise) until the pressure starts to rise on the pressure gauge on the FLUTe pump driver (three way valve closed with no flow out of the quick connect). Adjust the regulator to the desired pressure for purging, provided by FLUTe. Connect the quick connect to the top fitting of the pump tube (see Fig. 2). Open the three way valve to drive the water out of the pump.

**Purging**

Water is pumped from the tubing by applying the gas pressure to the interface at the static water level in the pump tube (Fig. 1 and 2). The water is driven down in the pump tube and up through the second check valve to the surface via the sample tube. By driving the water with a sufficient gas pressure (the "recommended purge pressure") to drive all of the water in the pump tube and the sample tube to the surface, the water in the pump tubing is nearly all expelled. The purge stroke is complete when gas is expelled from the sample tube following the water flow. The pressure in the system must then be vented (i.e., dropped to atmospheric by turning the three way valve to the vent position), to allow the pump tube to refill by flow via the port tube. The recharge flow from the port tube consists of the port tube water, the water in the pore space of the spacer, and water from the medium. Because of the relatively large volume in the pump tube, most of the recharge is from the medium. The recharge will take about as long as the first purge stroke. However, a low conductivity medium will require more time.

Purging the pump tube a second time will remove any of the water that has resided in the spacer and port tube volume. That is highly recommended, since the water resident in the tubing and spacer is probably not typical of the formation water. If the refill has been prompt, the second purge water volume will be similar to the first stroke. If in doubt, or if in a sedimentary formation or screened well, a third purge stroke is recommended to remove water that may have been in long contact with the liner or spacer.

**Sampling**
The sampling flow is best driven on the third (or fourth) cycle by a "recommended sampling pressure" which is less than that needed to drive gas through the bottom of the pump tube. The pressure recommended is that which will drive the water to near, but not out of, the bottom of the large tube. That recommended pressure, "the sampling pressure," is calculated in the spreadsheet provided with each system. The pressure regulator is set to the sample pressure, which is lower than the purge pressure. Opening the three way valve will now apply the sample pressure to the system causing flow from the sample tube.

*The first flow of the sampling cycle sweeps along droplets of water left in the tubing from the purge cycle. That residual water is depleted of volatile components. Tests have shown that the first tube volume of the sample flow should be discarded as depleted in volatiles (the "discard volume" is also calculated in the spreadsheet). Thereafter, the samples can be collected from the sample tube outflow. The volume to be discarded is shown in the spreadsheet as "discard volume".* The sample tube water flow rate will start fast, then slow, and finally stop. That occurs as the water column being driven approaches the applied pressure/head. The typical sampling pressure drives to within 25 ft. of the bottom of the pump tube (the U). The large buffer zone remaining in the pump tube assures against aeration of the sample.

This procedure should provide an ample sample of good quality drawn directly from the formation.

**Caution:** If the pumping system refills very slowly, there may not be sufficient water in the pump to fill the "sample tube" to the surface when the stroke is performed. In that case, there will be spitting of gas from the sample water and it will be followed by a flow of gas only. The sample water should never show "spitting" and the stroke should never end with gas flow from the sample tube. The proper sample flow will slow until it stops flowing. Should this evidence of insufficient recharge be observed, allow the pump to refill for a longer time and repeat the sample stroke. One can tag the water level in the large tube, as described in the head measurement procedure, to assure that the pumping system has been sufficient refilled.

**Measuring the head in the system**

The water level in the large tubes may not be the current water level. After sampling, if there is any leakage of the second check valve (sand in the tube, etc…) the water in the sample tube can backflow into the larger tube, adding to the water that fills the large tube during the recharge. Also, if the water level in the formation is dropping between head measurements, the water level in the pump tube will not follow the descent if the first check valve is a good seal. For these two reasons, and for the freezing concern below, it is best to finish the sampling stroke by raising the pressure to the "purge pressure" value to purge the pumping system of all water. Then upon refilling, the level is the current head for each port. If head measurements are made between sampling events, each port's pumping system should be first be purged to allow the tubing to refill to the current head value.

**If the water might freeze in the sampling tubing near the surface,** purge the entire volume of water from each sampling line, after sampling, before leaving it. Use the recommended purge pressure to remove all water, not the sampling pressure. **Each line should be blowing gas when the purge is complete.** If the lines were purged after sampling for head measurements, that is sufficient.

**If the Water FLUTe uses PVDF tubing,** the purge of the entire system after sampling should not be neglected, even if head measurements are not to be made. This removes the water column in the sampling tube. For deep water tables, the long term pressure of the standing water in the sampling tube might lead to excessive creep of the tubing which is susceptible to "cold flow", a characteristic of Teflon like materials. (This is not a concern except for very deep water tables (>300 ft).

In most cases, the performance of a final purge of the system after sampling is useful, even if not essential.

**Simultaneous purge and sampling of all tubes**

The FLUTe pumping system for each port is essentially identical in length, pump volume and elevation in the hole. This allows all ports to be purged and sampled simultaneously for a great saving in sampling time. The only difference for simultaneous sampling is that the pressure source must include a tube to each port fitting at the wellhead. FLUTe offers a manifold pump driver system at extra cost (the single port driver is provided with the Water FLUTe). The recommended purge and sample pressures are the same as used for single port sampling.

In some cases, the buoyancy of the sampling system is so great when emptied of water during the simultaneous purge that the tubing bundle can cause the liner to invert. The sampling volume spreadsheet provided with the liner notes whether the system can be purged simultaneously. This is only a problem for smaller hole diameters, many ports, and a small excess head in the liner. However, increasing the excess head in the liner to overcome the buoyancy of the tubing can be a hazard to the liner.

**A short summary is provided as the following checklist:**

<u>Check List</u>

1. Check/restore the water level in the liner.
2. Connect the gas driver source to the gas drive tube for the port.
3. Set the regulator to the recommended purge pressure.
4. Expel the tube water at the suggested purge pressure. Collect the purged water volume for verification of a good purge. Note the water flow time of the purge stroke.
5. Allow the tubing to refill. Repeat the purge. Collect the purge volume to assure the amount removed is at least the "port tube volume". Was the refill long enough?
6. Purge a third time, if desired.
7. Allow the tubing to refill for the sample stroke.
8. <u>Reduce the driving pressure</u> to the "sampling pressure". Apply the pressure and collect the first flow to measure the discard volume. Discard that water.
9. Reduce the pressure, if needed, to slow the flow and collect the samples.
10. Perform a final purge of the water out of the sampling lines by raising the driving pressure to the purge pressure value.

11. When the sampling system has refilled, tag the water level, if desired, for the current water table. If a port system is refilling very slowly, tag it at a later time.

See the spreadsheet provided with each *Water FLUTe* for the recommended purge and sampling pressures. Those are the pressures that can be used for a simultaneous purge of the several ports, but be sure that the buoyancy of the tubing will not lift the tubing, and the wellhead. The spreadsheet flags the condition where all ports should not be purged simultaneously. In most cases, several, to all, of the ports can be purged simultaneously.

**Optimum sampling procedure:**
Since it is often desirable to minimize the amount of time that the sample water resides in the pumping tubing, it is useful to note the actual time that is required for the recharge of the system. Since the fill rate slows dramatically for the last portion of the recharge, it is not necessary to wait for a complete refill. For most formations, the recharge is dominated by the tubing pressure drop. In that case, the time required for the purge stroke to be completed is about the same time required for the refill. (The exception is for a tight formation that recharges the tubing very slowly.) Hence the second purge can be started after waiting the same length of time as the first purge endured. If the second purge is of a similar volume (usually somewhat less) than the first purge volume, the refill time was long enough. After the same delay, the sampling stroke can be initiated. This timing of the strokes allows one to reduce the retention time in the pumping system. For very large sample volumes produced, the refill time can be shortened even more, as long as the sample volume is adequate after the discard of the first flow.

In some situations, the retention time is still too long. FLUTe can often increase the sample tube and port tube diameters for greater flow rates. However, the standard design is well matched for to a wide range of hole diameters, depths, and water table elevations. For very deep wells, the tubing may need to be of higher pressure capacity for the required driving pressures. For water table depths below 700 ft., this may be a concern. FLUTe initiated a design change from Nylon 11 to PVDF tubing in the Water FLUTe systems in 2002 to avoid any concern about tubing interaction with the sample water. However, the prescribed purge is sufficient for the use of Nylon tubing systems.

**Questions:** Call 888-333-2433 and ask for Carl Keller, or a field engineer.

Figure 1. Water FLUTe pump system

(Single port system shown for clarity)

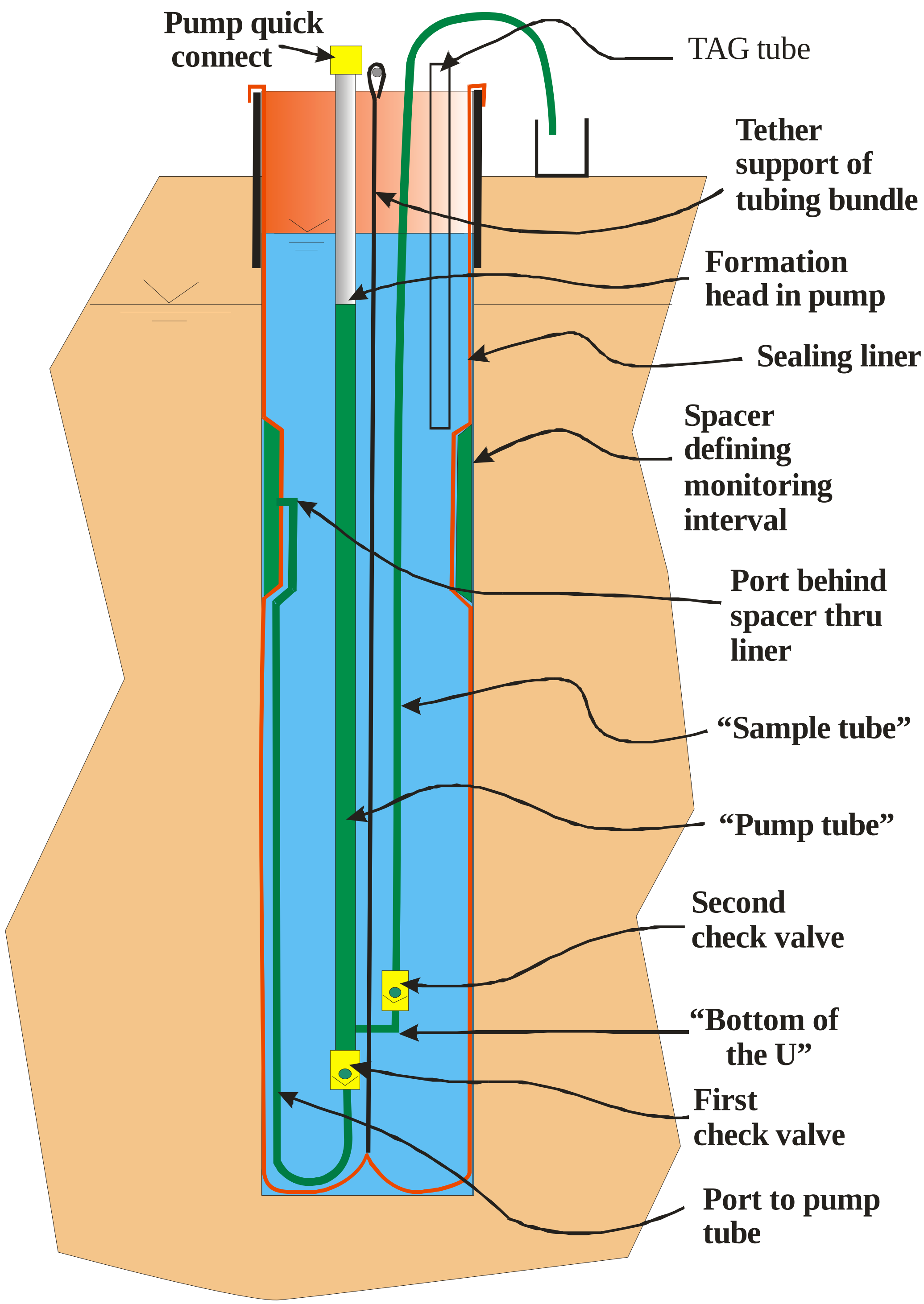
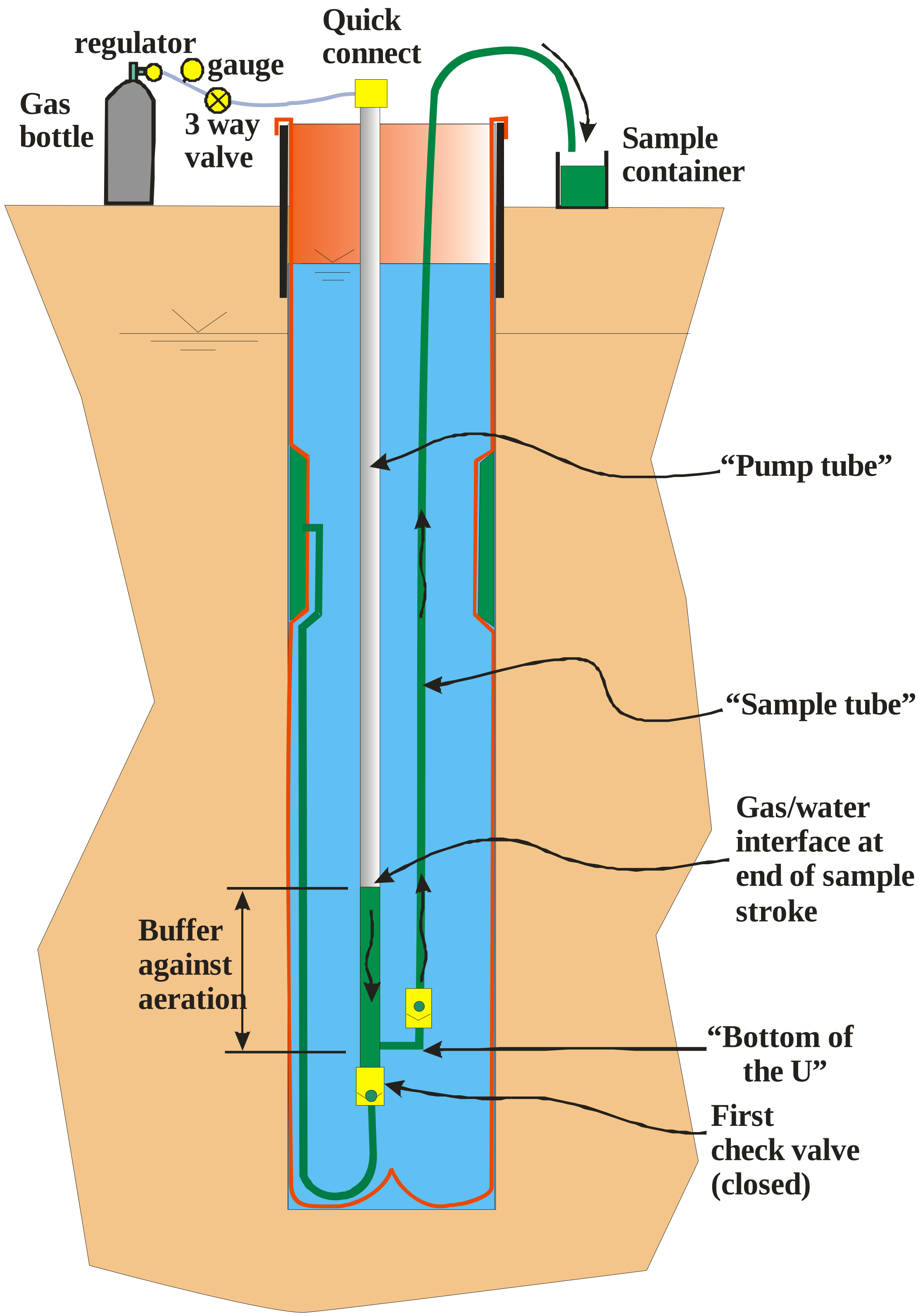


Fig. 2.  Pumping Procedure



**APPENDIX A**
**SECTION 1.6**

**SAMPLE MANAGEMENT**
**STANDARD OPERATING PROCEDURE**

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## 1. SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure (SOP) is to set guidelines for sample handling, shipping of samples from the field to the laboratory, and documentation of sample shipment using chain-of-custody protocols.

Sample handling and shipping (also known as sample management) is the continuous care given to each sample from the point of collection to receipt at the analytical laboratory. Good sample management is intended to result in samples that are properly recorded, properly labeled, and not lost, broken, or exposed to conditions that affect the sample's integrity.

The sample submissions will be accompanied with a Chain-of-Custody document to record sample collection and submission (Table A-IV in this Field Sampling Plan).

## 2. EQUIPMENT

- Sample labels
- Chain-of-Custody forms
- Well list
- Map
- Water-proof re-sealable bags
- Fine-point indelible markers
- Prepared sample containers, labels, markers, ice chests, and ice or cool packs/blue ice
- Shipping forms and labels
- Field sampling record

# 3. PROCEDURES

## 3.1 Preparation

Prior to entering the field area where sampling is to be conducted the sampler should ensure that materials necessary to complete the sampling are available.

If samples are required to be maintained at a specified temperature after collection, coolers and ice will be present at the sampling site. Consideration should be given to keeping reserve ice on hand if sampling events will be of long duration and ambient temperatures are elevated. Conversely, when sampling in extremely cold weather, proper protection of water samples, equipment rinse blanks, trip blanks, and field blanks from freezing will be considered.

Personnel performing groundwater sampling tasks will check the sample preparation and preservation requirements presented in the Quality Assurance Project Plan (Appendix B of the Water Quality sampling and Analysis Plans).

The sampling personnel will also confirm before the sample event the amount of bottle filling required for the respective sample containers.

## 3.2 Procedures

Samples will be properly labeled as soon as practical after collection.

The Quality Assurance Project Plan should be reviewed to determine additional requirements.

### 3.2.1 Sample Labels/Sample Identification

The samples will be labeled with:

- a unique sample name;
- Grab or composite sample
- date and time;
- analyses to be performed;
- preservative (no preservative indicated as “none”)
- analytical laboratory
- file number and project;
- comments, if any; and
- sampler's initials.

Labels should be secured to the bottle and should be written in indelible ink. Note that the data identified for the sample label are the minimum required.

The unique sample identification number may follow the format recommended below, or a specific sample protocol for labeling may be determined prior to sampling. Recommended sample names will include the following:

1. Well identifier
2. If applicable, multi-level port code indicated in parentheses [e.g.,(Z01), (Z06)]
3. Underscore
4. Date, *mmddyy*
5. Underscore
6. Two digit sample type
7. If applicable, H for samples submitted on hold
8. If applicable, R for equipment rinsate samples
9. Underscore
10. If applicable, DISS for filtered samples
11. If applicable TOT for unfiltered samples
12. Underscore
13. One- to four-character laboratory code

Two digit sample types are defined as the following:

- Primary samples = 01.
- Duplicate samples = 36.
- Split samples = 03.
- Trip blanks = 78.
- Field or equipment rinse blanks = 19.
- Spiked samples = 06.

Trip blanks will be labeled with a well ID that was sampled during that shipment. Each sampler will carry a trip blank. Trip blanks should be labeled with the first well he/she samples for the day. Example: RD-45C_050808_78_L.

Field blanks will be labeled with a well ID that was sampled during the event. Example: ES-06_050808_19_L.

Equipment rinse blanks will be labeled with a well ID that was sampled during the event. Example: SH-04_050808_19R_L.

For composited samples, list each sample to be composited on the Chain-of-Custody form (e.g., RD-10(Z1)_050808_01_L, RD-10(Z2)_050808_01_L, RD-10(Z3)_050808_01_L). In the comment section of the Chain-of-Custody form, direct the lab to composite the samples into one sample with a sample name such as RD-10(Comp)_050808_01_L.

The following table provides sample name examples.

| Type of Sample | Object ID (well; well&flute port) | Sample Date | Sample Type Number | Lab Code | Sample Name |
|---|---|---|---|---|---|
| Primary sample | RD-01_ | 050808_ | 01 | L | RD-01_050808_01_L |
| Duplicate sample | RD-01_ | 050808_ | 36 | L | RD-01_050808_36_L |
| Split sample | RD-01_ | 050808_ | 03 | T | RD-01_050808_03_T |
| Field blank | RD-01_ | 050808_ | 19 | L | RD-01_050808_19_L |
| Trip blank | RD-01_ | 050808_ | 78 | L | RD-01_050808_78_L |
| Equipment rinse blank | RD-01_ | 050808_ | 19R | L | RD-01_050808_19R_L |
| Spike | RD-01_ | 050808_ | 06 | L | RD-01_050808_06_L |

### 3.2.2 Packaging

Whenever possible, sample container preparation and packing for shipment should be completed in a well-organized and clean area, free of potential cross-contaminants.

Sample containers should be prepared for shipment as follows:

1. Containers should be wiped clean of debris and water using paper towels.
2. If the container size and number of containers allow, the sample containers collected from an individual well for an individual laboratory will be placed into one cooler.
3. Tighten the bottle caps to prevent leakage.

The following packing guidelines should be followed.

1. Plan time to pack samples (and make delivery to shipper if applicable). Proper packing and manifesting takes time. A day's worth of sampling can be easily wasted due to a few minutes of neglect when packing the samples.
2. Allow for more coolers and more padding rather than crowd samples in the shipping containers. The cost associated with the packing and shipment of additional coolers is usually small in comparison with the cost of having to resample due to breakage during shipment.
3. Line the bottom of the cooler with packing material. Line the cooler with a plastic bag to prevent leakage and tie shut around samples.
4. Do not bulk pack. For containers larger than 40 milliliters (ml), each container will be individually padded and will stand upright in the cooler.
5. 40-ml volatile organic analysis (VOA) vials should be placed in separate, re-sealable plastic bags for each sample for each analysis. Groups of VOA vials should be placed in a larger, re-sealable plastic bag, which should then be wrapped in bubble wrap.
6. One-liter or larger glass containers require much more space between containers. Glass containers will be individually wrapped in bubble wrap and sealed.
7. Ice is not a packing material due to the reduction in volume when it melts.

The following is a list of standard guidelines that should be followed when packing samples for shipment.

1. Double bag ice in plastic, re-sealable bags.
2. Double-check to ensure trip blanks have been included for shipments containing volatile organic compounds (VOCs) and gasoline-range organics (GROs), or where otherwise specified in the Quality Assurance Project Plan (QAPP), Appendix B of the WQSAPs.
3. Enclose the Chain-of-Custody form in a plastic re-sealable bag and attach to the inside top of the cooler.
4. Place custody seals (two, minimum) on each cooler if the cooler is shipped by means other than laboratory supplied courier. Coolers with hinged lids should have both seals placed on the opening edge of the lid. Coolers with "free" lids should have seals placed on opposite diagonal corners of the lid. Place clear tape over custody seals.
5. Ensure that the stickers, markings and prior address labels have been removed from coolers being used that previously contained such materials.

### 3.2.3 Chain-of-Custody Records

Chain-of-Custody forms (Table A-IV) will be completed for the samples collected. The form documents the transfer of sample containers.

The Chain-of-Custody record, completed at the time of sampling, will contain, but not be limited to:

- Sample name (corresponding to the sample ID on the sample labels)
- Project or file number
- Project/client name and location
- Sampler’s(s’) signature(s)
- Date/time of sample collection
- Type of samples (composite or grab; soil or water matrix)
- Analytical requirements
- Number and type of containers
- Remarks (e.g., analyze MS/MSD, etc.)
- Date and time samples were relinquished
- Date and time samples were received

Each sample cooler being shipped to the laboratory will contain an original Chain-of-Custody form. The sampler will make and retain a copy. The original Chain-of-Custody form will be enclosed in a waterproof envelope taped inside to the inside of the lid of the cooler containing the samples. The cooler will then be sealed for shipment. The laboratory, upon receiving the samples, will complete the original Chain-of-Custody form and prepare a copy. The laboratory will retain the copy for their records. The original Chain-of-Custody form will be returned with the data deliverables package.

The following list provides guidance for the completion and handling of Chain-of-Custody forms.

1. Custody forms used should be standard forms (as in Table A-IV) or those supplied by the analytical laboratory. Do not use custody forms from other labs, even if the heading is blocked out.
2. Custody forms will be completed in indelible ink only.

3. Custody forms will be completed neatly using printed text.
4. Do not use "Ditto" or quotation marks to indicate repetitive information in columnar entries. If repetitive entries will be made in the same column, place a continuous vertical arrow between the first entry and the next different entry.
5. If necessary, place additional instructions directly onto the custody form. Do not enclose separate loose instructions.
6. When shipping samples via an overnight express service (i.e., Federal Express), the air-bill number for the shipment should be noted on the custody form.
7. Include a contact name and phone number on the custody form in case there is a problem with the shipment.
8. Before using an acronym on a custody form, define clearly the full interpretation of your designation [i.e., polychlorinated biphenyls (PCBs)].

### 3.2.4 Shipment

The samples will be delivered to the laboratory by the samplers, transported by a laboratory-supplied courier or shipped to the laboratory using an overnight carrier. Prior to the start of the field sampling, the laboratory or shipper should be contacted to determine if pickup can be made at the field site location. If pickup at the field site can be made, the "no-later-than" time for having the shipment ready will be determined.

If pickup is unavailable at the site, the nearest pickup or drop-off location should be determined. Again, the "no-later-than" time for each location should be determined.

Sufficient time will be allowed not only for packaging but also for delivery of samples.

Sample shipments will not be left at unsecured drop locations (i.e., if the cooler will not fit in a remote drop box, do not leave the cooler unattended next to the drop box).

Some overnight carriers do not provide "overnight" shipment to/from some locations. Do not assume. Call the carrier in advance before the start of the fieldwork.

## 4. PERSONNEL QUALIFICATIONS

The field samplers are required to take the 40-hour health and safety training course and refresher courses as required by 29 CFR 1910.120 prior to engaging in field collection activities. In addition, field personnel should be trained in the method before initiating the procedure alone.

# 5. HEALTH AND SAFETY

In some instances, sample containers may contain preservatives that can cause bodily injury if they come in contact with eyes or skin, or are ingested. Care should be taken to wear the appropriate personal protective equipment (PPE) during sample handling, in conformance with the Health and Safety Plan (Appendix C of the WQSAPs) and material safety data sheets (MSDS).

## 6. QUALITY ASSURANCE/QUALITY CONTROL

The following general quality assurance/quality control (QA/QC) procedures apply:

1. The data will be documented in the record.

2. Any corrections to entries will have a single line through the information being corrected along with the correct information and the person's initials and date.

3. Dates should be recorded in the format MM/DD/YY. Times should be based on a 24-hour military type format for the given time zone (Pacific Standard Time [PST] or Pacific Daylight Time [PDT]). For example, 8:45 a.m. should be recorded as 0845. The time 2:45 p.m. should be recorded as 1445.

# APPENDIX A
# SECTION 1.7

# EQUIPMENT DECONTAMINATION STANDARD OPERATING PROCEDURE

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## 1. SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure (SOP) is to provide a description of the methods used for preventing, minimizing, or limiting cross-contamination of samples due to inappropriate or inadequate equipment decontamination. This SOP also provides general guidelines for developing decontamination procedures for sampling equipment to be used during hazardous waste operations. This SOP does not address personnel decontamination.

These are standard (i.e., typically applicable) operating procedures, which may be varied or changed as required, dependent upon site conditions, equipment limitations, or limitations imposed by the procedure. The ultimate procedures employed will be documented.

## 2. METHOD SUMMARY

Equipment utilized for groundwater sampling at multiple locations requires decontamination prior to reuse.

The decontamination procedure may be summarized as follows:

1. Physical removal
2. Non-phosphate detergent wash
3. Tap water rinse
4. Distilled/deionized water rinse
5. Air dry

Any modifications to the standard procedure should be documented.

# 3. EQUIPMENT

The following standard materials and equipment are recommended for decontamination activities:

## 3.1 Decontamination Solutions

- Non-phosphate detergent
- Tap water
- Distilled or deionized water

## 3.2 Decontamination Tools/Supplies

- Brushes
- Drop cloth/plastic sheeting
- Paper towels
- Plastic or galvanized tubs or buckets
- Pressurized sprayers ($H_2O$)
- Aluminum foil
- Tables, plastic sheeting, or other devices to keep equipment off of the ground

## 3.3 Health and Safety Equipment

Personal protective equipment shall include safety glasses or splash shield, and appropriate gloves [as per the Health and Safety Plan, Appendix C of the Water Quality Sampling and Analysis Plans (WQSAPs)].

## 3.4 Waste Disposal

- Trash bags
- Labeled drums provided by the Boeing-contracted waste-handler
- Containers for storage and disposal of decontamination solutions
- Container labels and permanent markers

## 4. REAGENTS

Water and non-phosphate detergent are utilized for decontamination purposes.

# 5. PROCEDURES

Procedures can be established to minimize the potential for contamination. This may include:

- work practices that minimize contact with potential contaminants;
- using remote sampling techniques;
- covering monitoring and sampling equipment with plastic, aluminum foil, or other protective material;
- watering down dusty areas;
- avoid laying down equipment in areas of obvious contamination; and
- use of disposable sampling equipment.

## 5.1 Field Sampling Equipment Decontamination Procedures

<u>Steps 1 and 2: Physical Removal and Detergent Wash</u>

Place plastic sheeting on the ground to minimize impacts from spillage of decontamination fluids.

Fill a wash basin, a large bucket, child size plastic swimming pool or other suitable container with non-phosphate detergent and tap water. A brush or brushes to physically remove contamination should be dedicated to this station. The volume of water required will depend upon the amount of equipment to decontaminate and the amount of contamination. Scrub equipment with soap and water using brushes.

<u>Step 3: Tap Water Rinse</u>

Fill a wash basin, a large bucket, child size swimming pool or other suitable container with tap water. A brush or brushes should be dedicated to this station. Use a volume of water similar to that used for Step 1. Wash soap off of equipment with water by immersing the equipment in the water while brushing.

<u>Step 4: Distilled/Deionized Water Rinse</u>

Fill a low-pressure sprayer with distilled/deionized water. Provide a 5-gallon bucket or basin to contain the water during the rinsing process. Rinse sampling equipment with distilled/deionized water with the low-pressure sprayer.

<u>Step 5: Air Dry</u>

Lay clean equipment on plastic sheeting to dry. Once dry, the sampling equipment may be wrapped with aluminum foil, plastic, or other protective material.

Follow these steps at the completion of decontamination:

1. Empty soap and water liquid wastes from basins and buckets and store in appropriate drum or container. Refer to the Boeing Company requirements for appropriate containers based on the contaminant of concern.

2. Use low-pressure sprayers to rinse basins and brushes. Place liquid generated from this process into the wash water rinse container.

3. Empty low-pressure sprayer water into an appropriate waste container.

4. Place solid waste materials generated from the decontamination area (i.e., gloves and plastic sheeting, etc.) in a labeled drum provided by the Boeing-contracted waste-handler.

5. Complete labels for waste containers and make arrangements for disposal by the Boeing-contracted waste-handler. Consult Boeing procedures for the appropriate label for each drum generated from the decontamination process.

## 6. PERSONNEL QUALIFICATIONS

Field samplers are required to take the 40-hour OSHA HAZWOPER training course and refresher courses as required by 29 CFR 1910.120 prior to engaging in field collection activities. In addition, field personnel should be trained in the method before initiating the procedure alone.

## 7. HEALTH AND SAFETY

When working with potentially hazardous materials, follow OSHA, U.S. EPA, corporate, and the Health and Safety Plan (Appendix C of the WQSAPs).

Decontamination can pose hazards under certain circumstances. Hazardous substances may be incompatible with decontamination materials. For example, the decontamination solution may react with contaminants to produce heat, explosion, or toxic products. Also, vapors from decontamination solutions may pose a direct health hazard to workers by inhalation, contact, fire, or explosion.

The decontamination solutions will be determined to be acceptable before use. Decontamination materials may degrade protective clothing or equipment. If decontamination materials do pose a health hazard, measures should be taken to protect personnel or substitutions should be made to eliminate the hazard.

Material generated from decontamination activities requires proper handling, storage, and disposal. Personal Protective Equipment may be required for these activities.

Material safety data sheets (MSDS) are required for the decontamination solutions.

# APPENDIX B

## Groundwater Monitoring
## Quality Assurance Project Plan

# GROUNDWATER MONITORING
# QUALITY ASSURANCE PROJECT PLAN
# SANTA SUSANA FIELD LABORATORY
# VENTURA COUNTY, CALIFORNIA
# REVISION 1

**for**

**The Boeing Company, and**
**National Aeronautics and Space Administration (NASA), and**
**U.S. Department of Energy (DOE)**
**Canoga Park, California**

**by**

**Haley & Aldrich, Inc.**
**Tucson, Arizona**

**File No. 20090-456/556/656/M504**
**December 2010**

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# 1. INTRODUCTION

Three (3) Water Quality Sampling and Analysis Plans (WQSAP) provide guidance for the Santa Susana Field Laboratory (SSFL) to conduct groundwater monitoring and maintain the groundwater monitoring network at the site. One (1) WQSAP is applicable to the Areas I and III Regulated Unit Groundwater Monitoring Program to support data collection activities stipulated pursuant to Post-Closure Permit #PC-94/95-3-02 (MOD SC3-111904-A), another WQSAP is applicable to the Area II Regulated Unit Groundwater Monitoring Program to support data collection activities stipulated pursuant to Post-Closure Permit # PC-94/95-3-03 (MOD SC3-111904-B), and the third WQSAP is applicable to the Site-Wide Groundwater Monitoring Program.

This revised Quality Assurance Project Plan (QAPP) presents the data collection method for groundwater sampling and analysis described in the WQSAP and applicable regulatory programs.

## 1.1 Purpose and Scope

This QAPP addresses quality control (QC) procedures for field sampling and analysis required by groundwater monitoring activities at SSFL. This report provides definitions and describes processes common to SSFL groundwater monitoring programs.

Figure B-1 illustrates the location of SSFL within Ventura County.

The purpose of the groundwater monitoring programs is to:

- Monitor for temporal changes in constituents of concern and/or general water quality at SSFL,
- Determine if the spatial distribution of affected groundwater is stable or migrating, and
- Evaluate whether affected groundwater poses an unacceptable risk to human health or the environment or contributes to degradation of water resources.

This QAPP includes quality assurance/quality control (QA/QC) procedures such as tracking, reviewing, and auditing to ensure that field and laboratory data are of sufficient quality and that project work meets the appropriate quality assurance (QA) objectives for the intended data uses. Additionally, the objectives of this QAPP are to ensure the project work performed is in accordance with professional standards and regulatory guidelines.

This document has been prepared with guidance from:

- U.S. Environmental Protection Agency, *Requirements for Quality Assurance Project Plans for Environmental Data Operations*, EPA QA/R-5, 1999.

- U.S. Environmental Protection Agency, *Requirements for Quality Assurance Project Plans*, EPA QA/R-5, EPA/240/B-01/003, March 2001.

- U.S. Environmental Protection Agency, *EPA Region 9, Requirements for Quality Assurance Program Plans, Draft*, R9QA/03.1, August 2001.
- U.S. Environmental Protection Agency, *EPA Guidance for Quality Assurance Project Plans*, EPA/240/R-02/009, December 2002.

- U.S. Environmental Protection Agency, *Data Quality Objectives Process for Hazardous Waste Site Investigations*, EPA QA/G-4, February 2006.

# 2. PROJECT ORGANIZATION

## 2.1 Quality Assurance Responsibilities

The project team consists of a Project Coordinator, Project Manager, Program Quality Assurance Officer (QAO), Project Quality Assurance Officer (QAO), Laboratory QAO, Data Validation Staff, Health and Safety (H&S) Coordinator, Regulatory Quality Assurance Reviewer (QAR), and various task leaders and field personnel. Figure B-2 shows the project quality assurance team organization.

A description of the project organization and responsibilities of key personnel is presented in the Field Sampling Plan (FSP; Appendix A of the WQSAP). Personnel responsibilities specifically related to quality assurance activities are as follows:

<u>Project Coordinator</u>

The Project Coordinator is responsible for project implementation and has the authority to commit the resources necessary to meet project objectives and requirements. The Project Coordinator's primary function is to ensure that technical, financial and scheduling objectives are achieved successfully. The Project Coordinator will provide the major point of contact and control matters concerning the project. The Project Coordinator will also establish project policy and procedures to address the specific needs of the project as a whole.

<u>Project Manager</u>

The Project Manager will assist the Project Coordinator in day-to-day project management. The Project Manager will be responsible for coordinating field activities and the procurement of project subcontractors. Additional responsibilities include assisting in monitoring the progress and quality of investigative collection, preparing and reviewing interim monitoring reports, and providing technical support of project activities.

<u>Project Quality Assurance Officer (QAO)</u>

The Project Quality Assurance Officer (QAO) will be responsible for overseeing the review of field and laboratory produced data for:

- Assuring the application and effectiveness of the QAPP by the analytical laboratory and the project staff;
- Serving as a resource to the project manager in quality matters;
- Aiding in the selection of analytical methodology;
- Conducting internal quality checks of the investigation activities; and
- Providing input to the Project Manager as to corrective actions required resulting from the above-mentioned evaluations.

Data Validation Staff

The QAO will be assisted by the Data Validation Staff in the evaluation and validation of field- and laboratory-generated data. The QAO and Data Validation Staff will monitor the activities of the project laboratories to ensure that the Data Quality Objectives (DQOs) for the project are met. The data validator will have sole responsibility for review and validation of the analytical laboratory data. The data validator will be a professional independent of the laboratory and familiar with the analytical procedures performed.

The data validation services will utilize the EPA's "National Functional Guidelines for Low Concentration Organic Data Review", 06/01; "National Functional Guidelines for Superfund Organic Methods Data Review", 06/08; and "National Functional Guidelines for Inorganic Data Review", revised 7/02; and the "Multi-Agency Radiological Laboratory Analytical Protocols Manual (MARLAP)", NUREG-1576, EPA 402-B-04-001A, NTIS PB2004-105421, 07/04. Radiochemical data will be assessed in accordance with protocols established for the U.S. Department of Energy "Evaluation of Radiochemical Data Usability" (Paar & Porterfield, 1997).

The data usability assessment will include a review of the validation criterion prescribed by the guidelines and presented in a Data Validation Report (DVR) for each analytical data package.

State of California Environmental Protection Agency (CalEPA) Department of Toxic Substances Control (DTSC) Project Manager

The CalEPA/DTSC Project Manager (PM) is responsible for overview of this project. The CalEPA/DTSC PM is responsible for review and approval of the QAPP or submitting this QAPP and subsequent revisions or amendments to the appropriate CalEPA/DTSC personnel for review and approval.

CalEPA/DTSC Quality Assurance Reviewer (QAR)

The QAR responsibilities include:

- Ensuring that environmental information collection activities are managed by appropriate quality system documentation;
- Ensuring that sampling and analytical methods are documented through Standard Operating Procedures (SOPs);
- Assists in determining the need for, type, and frequency of performance evaluation (PE) and standard reference material (SRM) samples; and
- Assists in solving QA-related problems.

## 2.2 Field Quality Assurance Responsibilities

The Project Manager or designated Task Manager is responsible for field quality assurance. Depending on the task, appropriately experienced personnel will be assigned as Task Managers. The Field Team Leader is responsible for the overall operation of the field team. The Field Team Leader works with the

Health & Safety (H&S) Coordinator to conduct operations in compliance with the Site Health & Safety Plan (Appendix C of the WQSAP). The Task Manager will facilitate communication and coordinate efforts between the Project Manager and the field team personnel.

Field Team Personnel involved in investigation activities are responsible for:

- Performance of field activities as detailed in the Field Sampling Plan (FSP) and in compliance with the data quality objectives (DQO) outlined in this document; and

- Taking reasonable precautions to prevent injury and immediately report accidents and/or unsafe conditions to the H&S Coordinator and Project Manager.

### 2.3 Laboratory Responsibilities

The specific responsibilities of laboratory personnel involved in the project are as follows:

Laboratory Project Manager

The Laboratory Project Manager will report directly to the Project Manager and/or QAO and will be responsible for ensuring resources of the laboratory are available on an as-required basis. The Laboratory Project Manager will also sign final laboratory data reports provided from the analysis of the project samples and will provide Case Narrative descriptions of data quality issues encountered during laboratory analyses.

Laboratory Quality Assurance Officer

The Laboratory Quality Assurance Officer is responsible for the quality of the analytical data produced by the analytical chemistry and/or radiochemistry laboratory. The Laboratory QAO will monitor the QA processes to ensure the generation of data of a known quality and will perform and document audits and data reviews to ensure this quality. The Laboratory QAO and staff will maintain independence in laboratory organization. The Laboratory QAO is also responsible for the quality of subcontracted analytical work. The Laboratory QAO will provide written communications to the Project Manager and/or QAO for anomalies or corrective actions implemented that affect the reported results for the project samples.

Sample Custodian

The Sample Custodian will receive and inspect the incoming sample containers, record the condition of the incoming sample containers and sign Chain–of-Custody documentation. The Custodian will notify the Project Manager and/or QAO of non-conformances identified during sample receipt and inspection and assign a unique identification number to each sample. After log-in, the Sample Custodian will initiate transfer of the samples to appropriate laboratory sections and monitor access/storage of samples and extracts.

### 2.4 Special Training/Certification Requirements

Field sampling team members shall have received the 40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) safety training and annual 8-hour refresher courses required by 29 CFR Parts 1910 and 1926.

The laboratory performing sample analyses will be accredited by the State of California Department of Public Health (CalDPH) Environmental Laboratory Accreditation Program (ELAP) or National Environmental Laboratory Accreditation Council (NELAC). The laboratory will be approved under ELAP for each analytical method or approved for the parameter of analysis under NELAC. If there is no California accreditation of an analytical parameter, accreditation through another NELAC accreditation body or by a Department of Defense (DoD) quality assurance program will be considered with approval from the Regulatory QAR. Additional consideration will be given to emerging technology utilized to meet a specific site characterization or project need.

### 2.5 Project Quality Assurance (QA) Team Organization

The organizational structure for the Santa Susana Field Laboratory (SSFL) Investigation is provided in Figure B-2.

# 3. PROBLEM DEFINITION

## 3.1 Problem Definition

This QAPP has been prepared to accompany Water Quality Sampling and Analysis Plans (WQSAP) prepared for the Regulated Units and Site-wide Groundwater Monitoring Programs and includes the quality control (QC) procedures such as data tracking, reviewing and auditing to ensure that field and laboratory data meet the appropriate DQO for the intended data uses.

This plan has been prepared to prescribe sampling procedures, sample custody, analytical procedures, data reduction, validation, and reporting, and personnel requirements to ensure that the data are of sufficient quality and quantity to adequately characterize the groundwater impacts at the SSFL and enable the assessment of risk to human health and the environment.

A detailed description of each of the groundwater monitoring tasks is described in the three (3) WQSAP.

## 3.2 Project/Task Description

The purpose of the groundwater monitoring programs is to:

- Monitor for temporal changes in constituents of concern and/or general water quality,
- Determine if the spatial distribution of affected groundwater is stable or migrating, and
- Evaluate whether affected groundwater poses an unacceptable risk to human health or the environment or contributes to degradation of water resources.

The monitoring is intended to meet multiple regulatory requirements, such as the Regulated Unit monitoring requirements prescribed in California Code of Regulations (CCR) Title 22, Division 4.5, Article 6, Chapter 14.

# 4. QUALITY OBJECTIVES AND CRITERIA FOR MEASUREMENT DATA

## 4.1 Data Quality Objectives (DQO)

DQO are qualitative and quantitative statements derived from the outputs of each step of the investigative process. The DQO process is a series of planning steps based on the scientific method that is designed to ensure that the type, quantity and quality of environmental data used in decision making are appropriate for the intended application.

The seven (7) steps of the DQO process include:

1. the statement of the problem;
2. the identification of the decision;
3. the identification of the inputs to the decision;
4. the definition of the boundaries of the study;
5. the development of a decision rule;
6. the specification of the limits on decision errors; and
7. the optimization of the design for obtaining data.

The decision rules for the major investigation activities are provided below.

### 4.1.1 Groundwater Investigation

The decision rules for the groundwater investigation are:

- If the concentrations of organic and inorganic parameters detected in groundwater samples collected from monitoring wells are less than their respective site water quality protection standards (i.e., concentration limits, or other applicable screening criteria if concentration limits do not exist), then the vertical and horizontal extent of impacted groundwater has been defined;

- For inorganic parameters, if concentrations exceed site water quality protection standards (i.e., concentration limits, or other applicable screening criteria if concentration limits do not exist) and are less than naturally occurring background levels, then the extent of impacted groundwater has been delineated.

The inputs to the decision for the groundwater investigation are data from previous and proposed investigations and referenced groundwater standards. The spatial boundaries for the groundwater investigation consist of the SSFL groundwater monitoring well locations.

The temporal boundaries for the investigation are the monitoring periods of the groundwater sampling events.
The decision errors for the groundwater investigation include the following:

Type I decision error (false rejection error):

- Conclude groundwater beneath the site is not impacted, when groundwater is impacted.
- Decision is to limit further sampling and analysis based on this information.
- Consequences involve possible underestimation of site risk and under-determination of the extent of contamination.

Type II decision error (false acceptance error):

- Conclude that groundwater is impacted, when in fact it is not impacted.
- Decision is to complete additional sampling to define extent of impact.
- Consequences involve the unnecessary expenditure of additional resources to conduct additional sampling and analysis.

## 4.2 Measurement Performance Criteria

The procedures prescribed in this QAPP are designed to produce investigative data of the quality necessary to achieve the project objectives and meet or exceed the minimum requirements for field and analytical methods.

To achieve this objective, the sampling and analysis programs at SSFL will include:

- A mechanism for the measurement of continuous quality control and evaluation of data quality, and

- A quantitative measure of data quality in terms of precision, accuracy, representativeness, completeness, and comparability (PARCC).

The following general discussion of the PARCC criteria will be used to measure the field and laboratory analytical data quality.

### 4.2.1 Precision

#### 4.2.1.1 Definition

Precision is defined as a quantitative measure of the degree to which two or more measurements are in agreement. The overall precision of measurement data is a mixture of sampling and analytical factors. Precision will be determined by collecting and analyzing field duplicate samples and by creating and analyzing laboratory duplicates from one or more of the field samples. The analytical results from the field duplicate samples will provide data on sampling precision. The results from duplicate samples created by the laboratory will provide data on analytical precision. For the SSFL programs, precision will be stated in terms of replicate percent difference (RPD).

#### 4.2.1.2 Field Precision Sample Objectives

Field precision will be assessed through collection and measurement of co-located field samples. The results of field duplicate samples reported above the laboratory reporting limits (RL) will be compared to evaluate sampling precision.

4.2.1.3 Laboratory Precision Sample Objectives

Laboratory duplicate analyses will be performed through the use of matrix spike/matrix spike duplicates (MS/MSD), and laboratory control sample (LCS) and laboratory control sample duplicate (LCSD) samples. The precision criteria for laboratory MS/MSD and LCS/LCSD analyses are defined in the analytical methods (Table B-IV). These criteria are based on the standard QA/QC requirements of the referenced analytical methodology. If precision criteria are not specified for an analytical method in the respective published manuals, laboratory-defined criteria will be adopted.

### 4.2.2 Accuracy

4.2.2.1 Definition

Accuracy is defined as the degree of agreement between a measurement and an accepted reference or true value. Sources of error can include the sampling process, background contamination, preservation techniques, sample handling, sample matrix, sample preparation and analytical procedure limitations. Accuracy will be stated in terms of percent recovery (%R). The accuracy criteria are listed in Table B-IV.

4.2.2.2 Field Accuracy Objectives

Sampling bias will be assessed by evaluating the results of equipment rinse, field and trip blank samples. Equipment rinse and trip blank samples will be collected for each sampling event.

Equipment rinse blanks will be collected by passing ASTM Type II water or equivalent over and/or through the respective field sampling equipment used. One (1) equipment rinse blank will be collected for each type of non-dedicated sampling equipment used for a sampling event to evaluate the effectiveness of decontamination procedures. Equipment rinse blanks will be analyzed for each target parameter for which groundwater samples have been collected. (Note: If dedicated or disposable sampling equipment is used, equipment rinse samples may not be collected.)

One field blank will be prepared for analysis during each sampling event. The field blank will consist of ASTM Type II water provided by the Laboratory and contain preservatives, if applicable, for the method of analysis. The field blanks will be prepared by filling sample containers with the Laboratory water and preservatives used for the groundwater samples and will be analyzed for each target parameter for which groundwater samples have been collected.
Trip blank samples will be prepared by the laboratory and provided within each shipping container that will be used for volatile organic compound (VOC) and gasoline range organic (GRO) analysis containers. Trip blank samples will be analyzed for each VOC and GRO for which groundwater samples have been collected for analysis.

#### 4.2.2.3 Laboratory Accuracy Sample Objectives

Analytical bias will be assessed through the use of known laboratory control samples (LCS) and site-specific matrix spike (MS) sample analyses. LCS and MS sample analysis will be performed as prescribed by the analytical method SOPs. LCS analyses will be performed with each analytical batch of project samples to determine the accuracy of the analytical system.

One MS/MSD pair will be collected in the field at a frequency of one per every twenty (20) site samples being analyzed for the same analytical method to assess the accuracy of identification and quantification of analytes. Additional sample volume will be collected at sample locations selected for MS/MSD analyses so that standard reporting limits (RL) can be met. Although MS/MSD analyses may be performed on non-SSFL samples within the analytical batch containing SSFL project samples, only the results for MS/MSD analyses performed using SSFL project samples will be evaluated.

The results of the LCS and MS/MSD analyses will be presented in a summary table reporting format and evaluated versus the acceptance criteria presented in the referenced analytical methods.

The accuracy of organic parameter analyses is also monitored through the analysis of surrogate compounds. Surrogate compound recoveries provide information on the effect of the sample matrix on the accuracy of the analyses. Surrogate compounds are added to each sample, standard, and QC sample prior to the sample preparation and analysis. These criteria are based on the requirements of the referenced analytical methodology. If precision and accuracy criteria are not specified for an analytical method in the respective published manuals, laboratory-defined criteria will be used.

### 4.2.3 Representativeness

#### 4.2.3.1 Definition

Representativeness expresses the degree to which sample data represent a characteristic of a population, a parameter variation at a sampling point, or an environmental condition. Representativeness is a qualitative parameter that is dependent upon the design of the sampling program. The representativeness criterion is satisfied by proper selection of sampling locations, the methods utilized for sample collection and analysis, and the quantity of samples collected.

#### 4.2.3.2 Measures to Ensure Representativeness of Field Data

Representativeness will be addressed by describing sampling techniques and the rationale used to select sampling locations. Sampling locations may be biased (based on existing data, instrument surveys, observations, prior site use information) or unbiased (completely random or stratified-random approaches).

For the SSFL project, sampling will generally be biased unless otherwise noted in the respective investigation work plan; that is, sampling associated with groundwater monitoring will be based on the observed presence or absence of site-specific contaminants and/or site knowledge. Specific sampling technique descriptions, which allow consistency, repetitiveness and thus representativeness, will be prescribed in the investigation work plans.

4.2.3.3 Measures to Ensure Representativeness of Laboratory Data

Representativeness in the laboratory is ensured by using proper analytical procedures and analyzing duplicate samples. By definition, duplicate samples are prepared and analyzed to be representative of a given point in space and time. Thus, sample duplicates provide both precision and representativeness information.

### 4.2.4 Comparability

4.2.4.1 Definition

Comparability is a qualitative parameter expressing the confidence with which one data set can be compared to another.

4.2.4.2 Measures to Ensure Comparability of Field Data

Investigative data should be comparable to other measurement data for environmental samples and sample conditions observed at SSFL and other locations. This goal is achieved through the use of standard operating procedures (SOPs) to collect, preserve, transport and analyze representative samples, and the presentation of the analytical results. The approved field SOPs prescribed by the investigation work plans for the various activities to be conducted at SSFL will be designed to provide reproducible results that are comparable to applicable, relevant and appropriate regulations and reference standards published by appropriate regulatory agency(s).

4.2.4.3 Measures to Ensure Comparability of Laboratory Data

Comparability of laboratory data generated from groundwater samples collected at SSFL are achieved through the use of Standard Reference Materials (SRM) or Performance Evaluation (PE) samples obtained from either EPA Cooperative Research and Development Agreement (CRADA) suppliers or the National Institute of Standards and Technology (NIST) or private, accredited vendors for standards for analytical instrument initial and continuing calibration verification. The reported analytical data will be presented in standard units of mass of contaminant within a known volume of water. The units for specific analytes are described in Table B-II and for aqueous matrices are typically as follows:

- Micrograms (ug) contaminant per liter (L) for organic parameters, and
- Milligrams (mg) per liter (L) for inorganic parameters.

### 4.2.5 Completeness

#### 4.2.5.1 Definition

Completeness is a measure of the amount of valid (usable) data compared to the amount that was expected to be obtained. The completeness goal is that a sufficient amount of valid data be generated so that determinations can be made related to the intended data use with a high degree of confidence.

#### 4.2.5.2 Field Completeness Objectives

Completeness is a measure of the amount of valid measurements obtained from measurements taken in this project. The field completeness objective for the groundwater-based investigation effort for the SSFL program will be 90 percent (%) or greater. That is, for every 10 samples collected, 9 samples will provide usable data in the evaluation of current environmental conditions.

#### 4.2.5.3 Laboratory Completeness Objectives

Laboratory data completeness objective is a measure of the amount of valid data obtained from laboratory measurements. The evaluation of the data completeness will be performed at the conclusion of each sampling event. Corrective actions, such as revised sample handling procedures, will be implemented if problems are noted.

The completeness of the data generated will be determined by comparing the amount of valid data to the total data set. The completeness goal will be 90% or greater for data generated during the groundwater quality investigations. That is, for every 10 samples analyzed, 9 measurements will be deemed valid through independent environmental data validation procedures.

### 4.2.6 Sensitivity

Sensitivity is the ability of a method or instrument to detect a parameter to be measured at a level of interest. For field measurements, two (2) primary types of instruments will be used: (1) meters for the measurement of VOC in work zone breathing space for compliance with health and safety protocols (i.e., photo ionization detectors [PID]) and (2) parameter meters used to determine groundwater characteristics (i.e., dissolved oxygen [DO] probes, turbidity meters, etc.).
For laboratory analyses of constituents of concern, sensitivity criteria are based on the analytical reporting limits determined by each subcontract laboratory. The analytical reporting limits will be determined based on the completion of instrument-specific method detection limit (MDL) studies performed at least annually in accordance with the methods prescribed by 40 Code of Federal Regulation (CFR) Part 136, Appendix B (USEPA, 1984). The reporting limit (RL) will be established by multiplying the statistically calculated MDL by a factor ranging from 3 to 5 as recommended by general accepted laboratory practices and is further supported by the lowest-level analytical standard in the initial calibration process.

4.2.6.1 Field Sensitivity Criteria

The sensitivity of field instruments used to evaluate ambient air for VOC will be less than the background readings of ambient air. The field sensitivity of equipment used for groundwater characteristics is prescribed in the standard operating procedure (SOP) for each analysis. The SOP and/or method reference is provided in Table B-I of this document.

4.2.6.2 Laboratory Sensitivity Criteria

The analytical reporting limits (RL) for the analytes are provided in Table B-II.

## 4.3 Field Measurements

Field activities outlined in the WQSAP include measurement of field water quality parameters (i.e., electrical conductivity, pH, dissolved oxygen, oxidation and reduction potential (ORP), temperature, turbidity), organic vapors, well discharge rates, and static groundwater elevations. These field measurements will be performed during groundwater monitoring activities.

Field personnel will perform validation of data obtained from field measurements by checking calibration procedures utilized in the field. Section 5 addresses QC measures that will be implemented for data validation and inspection of field measurement and analytical data.

### 4.3.1 Field Parameters

Results of field water quality parameters will be used to determine if purging procedures are sufficient prior to sample collection. Details of field measurement procedures are presented in the FSP (Appendix A of the WQSAP) and in the literature provided by the field sampling equipment manufacturer.

### 4.3.2 Groundwater Elevation Monitoring

Water level measurements will be used to evaluate groundwater flow conditions, and to evaluate well/pump performance. Water levels will be measured to the nearest 0.01 foot, and will be used along with measuring point elevation data to prepare water level elevation contour maps and water level hydrographs. Procedures for groundwater elevation measurements are presented in the FSP (Appendix A of the WQSAP).

### 4.3.3 Well Pump Discharge

Well pump discharge measurements will be collected during sampling activities to determine pumping rates and to determine the appropriate purge volume prior to sample collection. Well discharge measurements will be used in conjunction with groundwater elevation data to gauge well performance and to determine pump equipment performance. Well discharge measurements will be made using flow meters and/or a calibrated vessel and a stopwatch. Procedures for well discharge monitoring and adjustments are presented in the Low-Flow Purge SOP included in the FSP.

## 4.4 Documentation and Records

The documents, records, and reports generated during environmental investigation activities at SSFL are identified in the following subsections.

### 4.4.1 Field and Laboratory Records

The documents and records to be generated during the project include sample collection records, field measurement records, laboratory records, and data handling records.

### 4.4.2 Data Reporting Format

Field data will be tabulated and included in project reports or submittals, as appropriate. Example field forms are presented in the FSP (Appendix A of the WQSAP).

Laboratory data will be presented in standard data packages including QC data summary formats. The laboratory Project Manager will perform a final review of the QC data summary packages and case narratives to determine whether the report meets the project requirements. In addition to the record of the Chain-of-Custody, the final laboratory data report format shall consist of the following.

Title Page

- project name and number;
- laboratory project or lot number;
- signature of the Laboratory QA Officer or his/her designee; and
- date issued.

Case Narrative

- number of samples and respective matrices;
- laboratory analysis performed;
- deviations from intended analytical strategy;
- definition of data qualifiers used;
- QC procedures utilized and references to the acceptance criteria;
- condition of samples "as received";
- discussion of whether or not sample holding times were met;
- discussion of technical problems or other observations which may have created analytical difficulties; and
- discussion of laboratory QC checks which failed to meet project criteria.

Shipping and Receiving Documents

- sample container documentation; and
- sample reception information and original Chain-of-Custody record.

Laboratory Certification

- list of laboratory certifications for each method performed; and
- list of subcontract laboratory certifications.

Chemistry Data Package by Analytical Method (i.e., EPA 8260B)
The chemistry data package with include sample reporting limits (RL), method detection limits (MDL) and estimated (J) values for parameters detected between the RL and MDL; method of sample preparation and analysis; dilution factors (where applicable); sample chronology; and raw data for sample results (dated chromatograms, parameter specific quantitation reports, mass spectra and instrument printouts).

- QC Summary Data

  1. matrix spike and matrix spike duplicate recoveries,
  2. laboratory control samples,
  3. method blank results,
  4. surrogate compound recoveries,
  5. GC/MS tuning results,
  6. internal standard recoveries,
  7. serial dilutions,
  8. reagent blank results, and,
  9. interference check standards.

- Calibration Data

  1. initial calibration data,
  2. initial calibration checks,
  3. continuing calibration verification/check standards,
  4. initial and continuing calibration blanks,
  5. instrument performance checks,
  6. resolution checks and specific compound degradation checks, and
  7. raw data (dated chromatograms, parameter specific quantitation reports, mass spectra and instrument printouts).

- Miscellaneous Data

  1. instrument run logs,
  2. sample preparation records, and
  3. instrument conditions.

The laboratory will maintain traceable records of reagents utilized by the laboratory and standards used in calibration and QC sample preparation. In addition, raw data files for the MDL studies, Instrument Detection Limit (IDL), QC limits determination statistics (upper and lower control limits) and inter-element correction (IEC) factors will be maintained at the laboratory and will be available upon request.

### 4.4.3 Data Archiving and Retrieval

Records will be archived in accordance with the documentation requirements prescribed by the SSFL Data Management Plan (DMP) (CH2MHill, 2007).

# 5. DATA GENERATION AND ACQUISITION

The implementation of the measurement systems that will be used, including sampling design and procedures, analytical protocols, sample handling procedures, and data handling and documentation, are described in the following subsections.

## 5.1 Sampling Process Design

The rationale for sampling process design for groundwater as part of the SSFL monitoring program is provided in the WQSAP for the Regulated Units and Site-wide Monitoring Programs.

### 5.1.1 Sampling Methods

Sampling methods for the collection of groundwater will be based on guidance provided by the California Department of Toxic Substances Control (DTSC) and the USEPA. Specific procedures are provided in the WQSAP.

#### 5.1.1.1 Field Equipment and Sample Container Cleaning Procedures

Field equipment will be prescribed by the sampling methods selected in the respective work plans for each investigative activity. Suitable equipment will be selected based on use. Decontamination of non-dedicated field equipment will be conducted at the conclusion of each sampling event. Decontamination procedures will be prescribed within the respective sampling and analysis plans.

The laboratory(s) will provide sample containers for each sampling event. Containers will be pre-cleaned in accordance with the USEPA guidance document entitled "Specifications and Guidance for Contaminant-Free Sample Containers", EPA 540/R-93/051 (USEPA, 1992). Example certificates of analysis for each lot of containers will be maintained at the laboratory and provided upon request.

### 5.1.2 Field Equipment Maintenance, Testing, and Inspection Requirements

Prior to use in the field, the measurement equipment will be maintained, calibrated, and the performance information recorded in accordance with the procedures provided in the FSP (Appendix A of the WQSAP).

## 5.2 Sample Handling and Custody Requirements

The general procedures for sample handling, labeling, shipping, and Chain-of-Custody documentation are provided in the subsections that follow.

Specific sample containers, preservatives, shipping, and packaging requirements for each parameter are provided in Table B-III.

### 5.2.1 Sample Handling

The procedures used to collect and label the investigation samples are provided in the Groundwater Sampling and Sample Management SOPs included in the FSP. The sample numbering system for the project has been designed to uniquely identify each sample from each sampling program and event.

The samples will be shipped to the laboratory via an overnight courier service. The laboratory will group the samples in sample delivery groups (SDG). An SDG is a group field samples (including field QC samples) listed on the same Chain-of-Custody record.

### 5.2.2 Sample Custody

Custody of a sample begins when it is collected by or transferred to an individual and ends when that individual relinquishes or disposes of the sample. A sample is under a person's custody if:

- The person is in actual possession of the item;
- The item is in view of the person after being in actual possession by the person;
- The item was in actual possession but is stored to prevent tampering; or
- The item is in a designated and identified secure area.

The following procedures will be used to maintain the integrity of the samples:

- Upon collection, samples are placed in the proper containers.
- Samples will be assigned a unique sample number and will be affixed with a sample label. The information to be placed on the sample label will include: the sample ID number, the sample type, the sampler's initials, date and time collected, and analyses to be performed.
- Information on the labels will be completed with indelible ink.
- Appropriate volumes will be collected to insure that reporting limits (RL) can be successfully obtained and that the required level of quality control relative to both precision and accuracy can be completed.
- A Chain-of-Custody record will be completed during sample collection and will accompany the samples to the laboratory.
- Sample transfer will require the individuals relinquishing and receiving the samples to sign, date and note the time of sample transfer on the Chain-of-Custody record.
- Samples will be shipped or delivered in a timely fashion to the contract laboratory so that holding times as prescribed by the methodology can be met.

Chain-of-Custody procedures will be followed to track the samples. The Chain-of-Custody form will document the transfer of samples from the field to the laboratory. The Chain-of-Custody will summarize the contents of the shipment and track the dates and times of custody transfer with signatures of each party relinquishing and receiving the samples.

From the time the sample is collected, it will be under the control of sampling personnel. Before sampling personnel relinquish the samples to the designated courier or a laboratory representative, the samples will be inspected, their condition documented and the samples will then be relinquished to the designated courier or laboratory representative.

Field personnel will keep written records of field activities on applicable preprinted field forms or in a bound field notebook. These records will be written legibly to record field data collection activities. Field logbooks will be bound field survey books or notebooks with consecutively numbered pages.

Logbook entries will be made in ink, signed, and dated. If an incorrect logbook entry is made, the incorrect information will be crossed out with a single strike mark, initialed and dated by the person making the correction. The correct information will be entered into the logbook adjacent to the original entry.

Whenever a sample is collected or a measurement is made, a description of the location will be recorded in the logbook or standard field form. Photographs taken at a location, if any, will also be noted in the logbook or standard field form. Equipment used to obtain field measurements will be recorded in the field logbook or standard field form. In addition, the calibration data for field measurement equipment will be recorded in the field logbook or on standard field forms.

The equipment used to collect samples, time of sample collection, sample description, volume, number of containers, and preservatives added (if applicable) will be recorded in the field logbook or standard field forms.

### 5.2.3 Laboratory Custody Procedures

Laboratory Sample Custodian staff will receive incoming samples. The Custodian will document if samples are received in good condition, that the associated paperwork, such as Chain-of-Custody forms, have been completed and will sign the Chain-of-Custody forms. The Custodian will also document if sufficient sample volume has been received to complete the analytical program and verify that the information on the sample identification matches the Chain-of-Custody records. The Custodian will notify the Project Manager of sample receipt and confirm the work order prior to the initiation of analyses. The Sample Custodian will then place the samples into secure, limited access storage.

Consistent with the analyses requested on the Chain-of-Custody form, analyses by the contract laboratory's analysts will begin in accordance with the appropriate methodologies. The laboratory will use the sample identification number or assign a unique laboratory number to each sample, and store samples in an appropriate and secure area. The laboratory will return completed copies of the Chain-of-Custody forms with the analytical results. The completed forms will indicate custody of the samples by date and signature, and the work order for each sample.

Groundwater samples will be tested in accordance with the requested analytical procedures identified in the project specific sampling and analysis plans. Analytical laboratories performing sample analyses will assure that applicable method specific quality control measures are performed in accordance with the laboratory SOPs.

### 5.2.4 Analytical Method Requirements

The field and laboratory analytical methods that will be used during the investigation are detailed in the following subsections.

### 5.2.5 Field Measurement and Sample Collection

Groundwater samples will be collected during monitoring well purging and will be analyzed for pH, temperature, electrical conductivity (EC), oxidation reduction and potential (ORP), dissolved oxygen (DO), and turbidity. The data from these analyses will be used to determine when the groundwater is suitable for the collection of representative samples for off-site laboratory analysis. Field-portable pH, temperature, conductivity, ORP, DO, and turbidity meters will be used to analyze the samples.

SOPs for field measurements and sample collection procedures are included in the FSP (Table B-I).

### 5.2.6 Laboratory Analytical Methods

Groundwater samples will be analyzed by the laboratory in accordance with the requirements promulgated in:

- "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods", SW-846 EPA, USEPA Office of Solid Waste, 3rd Edition and promulgated updates, 1986.

- "Guidelines Establishing Test Procedures for the Analysis of Pollutants", 40 CFR Part 136, (EPA 600/4-84-0041, April 1984).

The most current version of the analytical methods will be utilized by the laboratory with the concurrence of the Quality Assurance Officer (QAO). The analytical methodology that will be used for the analysis of groundwater samples collected for the SSFL groundwater monitoring programs is specified in the WQSAP and included in Table B-III.

5.2.6.1 Radiological Aqueous Sample Processing

Radiological samples will be processed in the laboratory following the procedure defined in the *Quality Assurance Project Plan for Groundwater, Surface Water, and Sediment, Area IV Radiological Study, Santa Susana Field Laboratory, Ventura County, California* published 11 August 2010 by HydroGeoLogic, Inc. Section 3.3.6 of the Area IV QAPP is quoted below.

*"The following steps will be used to collect and process aqueous samples in a manner that allows for accurate determination of dissolved and total radiological concentrations. This procedure is not to be performed for the sample fraction submitted for tritium analysis. Sample fractions submitted for tritium analysis will be collected in dedicated glass bottles. At the laboratory, these bottles will be transferred to the analyst for preparation and analysis in accordance with the laboratory's tritium SOP. Performing these procedures on the tritium sample fraction will invalidate the subsequent analytical results.*

*"1. Aqueous samples collected for radiological analyses will be shipped unpreserved to the laboratory.*

*"2. On receipt, the laboratory will determine whether the sample aliquots contain gross suspended material.*
*"3. The laboratory will measure and record the volume of the sample as received to the nearest milliliter.*
*"4. If gross suspended material is noted, the samples will be pre-filtered through a qualitative filter in order to prevent clogging of the 0.45 micron (µm) filter. Any filtered residue generated from this step will be retained for quantitative analysis.*
*"5. The sample is filtered through a 0.45 µm membrane filter using a Büchner apparatus. Any filtered residue generated from this step will be combined with any residue from Step 3 above and retained for quantitative analysis. The graduated cylinder will be rinsed into the filter apparatus with a minimum volume of deionized water to facilitate full transfer of non-dissolved solids to the filter medium.*
*"6. The filtrate will be transferred to a graduated cylinder and the Büchner apparatus will be rinsed with dilute (1 N) nitric acid to ensure complete transfer of dissolved material to the final filtrate. The rinsate will be added to the filtrate in the graduated cylinder.*
*"7. The laboratory will measure and record the volume of the final filtrate to the nearest milliliter.*
*"8. Each sample filtrate will be transferred back to the original sample bottle and acidified to pH<2 with nitric acid.*
*"9. A holding time of 48 hours will be imposed from the time of collection for processing unpreserved samples through all steps above.*
*"10. In order to ensure that any dissolved material that plated out onto the sides of the sample container have sufficient time to re-dissolve in the acidified aliquot, processed sample filtrates will be held for a minimum of 16 hours after acidification before analysis begins.*
*"11. The laboratory will perform all requested analyses on both the aqueous and residue fractions of each sample aliquot. The activities detected in the aqueous fraction will be used to calculate the dissolved concentration. The activities detected in the solid fraction will be used to calculate the concentration of the suspended phase, in picocuries per liter (pCi/L), using the volumetric information recorded by the laboratory in Steps 3 and 7 above. The dissolved and suspended concentrations will then be combined arithmetically to determine the total concentration.*
*"12. The laboratory will report all results as 'dissolved' and 'total', in pCi/L.*

*"This approach will minimize sample handling and processing in the field, where conditions are not as controlled as in a laboratory. There is potential impact associated with submitting samples unpreserved, as dissolved constituents may plate out onto the sides of the sample container. There is also a concern that dissolved constituents may precipitate out of solution due to changed oxidation-reduction and dissolved oxygen conditions in the sample container which are no longer representative of in situ conditions. These concerns are partially addressed by steps 8 and 10 above, which will re-dissolve any plated material. However, any dissolved material that precipitates out in particles greater than 0.45 µm will be counted as suspended activity rather than dissolved activity; the reported total concentration will not be affected, and any*

*precipitate particles of less than 0.45 μm will be correctly counted in the dissolved fraction. The proposed procedure corresponds with what is currently allowed by USEPA for the submission of unpreserved metals samples for laboratory filtering (USEPA, 2005). USEPA guidance allows for a holding time of five days from collection for processing unpreserved metals samples; however, considering the level of analytical sensitivity required for this project and the expectation of low concentrations relative to analytical capabilities, 48 hours is proposed to minimize the time the sample is unpreserved but still allow for sufficient time for the laboratory to process the samples upon receipt."*

## 5.3 Quality Control (QC) Requirements

The field and laboratory QC requirements are discussed in the following subsections.

### 5.3.1 Quality Control Procedures for Field Measurements

Specific QC procedures to be followed during collection of field measurements are outlined in the project specific sampling and analysis plans.

#### 5.3.1.1 Organic Vapor Measurements

Organic vapor measurements will be obtained by utilizing a PID or FID meter as specified in the Health and Safety Plan (HASP; Appendix C of the WQSAP).

### 5.3.2 Quality Control Procedures for Sample Collection

The following QC procedures have been established to ensure that groundwater samples are collected in a manner consistent with QA objectives. QC procedures during sample collection will include the following:

- Sample duplicates will be collected for approximately 5% of the samples collected for analysis during each sampling event. Duplicates will be submitted as blind samples to the laboratory. The field personnel will assign unique sample identification to the sample and record this in the field record. The field personnel will record the location of each field duplicate.

- One field blank will be collected when samples are collected for analysis during each sampling event. The field blank will be placed in containers equivalent to the sample containers used for the groundwater samples. Field blanks will be submitted as blind samples to the laboratory. The field personnel will assign unique sample identification to the sample and record this in the field record.

- One trip blank will be carried in the sample coolers containing field samples for volatile organic compound (VOC) and gasoline range organics (GRO) analysis. The trip blanks will be analyzed for VOC and GRO only. The field personnel will assign unique sample identification to the trip blank sample and record this in the field record.

- Split samples will be collected at least once a year, when the primary analyzing laboratory changes, and/or when verification sampling is needed, and will be submitted to a confirmation laboratory. Split samples will be collected to check the performance of the primary laboratory. Samples will be collected at the same time, preserved and packaged in equivalent containers, and shipped under the same QA/QC procedures.

- Equipment rinse blanks will be collected daily for each type of non-dedicated sampling equipment used for a sampling event. Equipment rinse blanks will be analyzed for each parameter for which groundwater samples have been collected. (Note: If dedicated or disposable sampling equipment is used, equipment rinse samples may not be collected.)

### 5.3.3 Analytical Quality Control

Analytical procedures are documented in the reference methodology which addresses the minimum QC requirements for the procedure. The internal quality control checks will include the following QC elements:

i) Instrument Performance Checks;
ii) Initial and Continuing Calibration Checks;
iii) Internal Standard Performance;
iv) Method Blank Samples;
v) Laboratory Control Sample (LCS) analyses and Calibration Check Samples;
vi) Performance Evaluation (PE) Samples.

QC data will be recorded and provided in each sample data package. QC criteria conformance will be noted by the laboratory in the sample data package case narrative. Site-specific matrix samples will be re-analyzed, if sufficient sample volume is available, to verify matrix interference.

## 5.4 Instrument/Equipment Testing, Inspection, and Maintenance Requirements

The procedures used to verify that instruments and equipment are functional and properly maintained are described in the following subsections.

### 5.4.1 Field Instrument Maintenance

Specific preventive maintenance procedures to be followed for field equipment are those recommended by the manufacturer. Field instruments will be checked and calibrated in accordance with procedures provided in the FSP.

### 5.4.2 Laboratory Instrument Maintenance

As part of the laboratory Quality Assurance program, the laboratory will conduct routine preventive maintenance program to minimize the occurrence of instrument failure and analytical system malfunctions. Designated laboratory employees will regularly perform routine scheduled maintenance and repair (or coordinate with the instrument manufacturer for the repair of) instruments. Maintenance that is performed will be documented in the laboratory's maintenance logbooks. Laboratory instruments are maintained in accordance with manufacturer's specifications.

### 5.5 Calibration Procedures and Frequency

The procedures for maintaining the accuracy for the instruments and measuring equipment which are used for conducting field tests and laboratory analyses are described in the following subsections. These instruments and equipment will be calibrated prior to each use or according to a periodic schedule.

#### 5.5.1 Field Instruments and Equipment

Instruments and equipment used to gather environmental data will be calibrated as specified by the manufacturer’s specifications. Field instruments used during environmental sampling and on-site health and safety air monitoring will be calibrated in accordance with the procedures provided in the FSP.

#### 5.5.2 Laboratory Instruments

Calibration procedures for a specific laboratory instrument will consist of initial calibration, initial calibration verification, and continuing calibration verification. The initial calibration will be verified using an independently prepared calibration verification solution.

The use of materials of known purity and quality will be utilized for the analysis of environmental samples. The laboratory will carefully monitor the use of laboratory materials including solutions, standards and reagents through well-documented procedures.

Solid chemicals and acids/bases used by the laboratory will be reagent grade or better. Gases will be high purity or better. Performance Evaluation (PE) Materials will be obtained from approved vendors of the NIST (formerly National Bureau of Standards), the USEPA Environmental Monitoring Support Laboratories (EMSL), or reliable CRADA certified commercial sources.

Materials including standards or standard solutions will be dated upon receipt, and will be identified by material name, lot number, purity or concentration, supplier, receipt/preparation date, recipient/preparer's name, expiration date, and other pertinent information.

### 5.6 Inspection/Acceptance Criteria for Supplies and Consumables

The procedures that will be used to ensure that supplies and consumables used in the field and laboratory will be available as needed and free of contaminants are detailed in the following subsections.

#### 5.6.1 Field Supplies and Consumables

Supplies and consumables including standard reference materials (SRM) for field meter calibration, sampling equipment, cleaning supplies, distilled water for equipment decontamination, pump tubing, and personal protective equipment (PPE) will be obtained from vendors as prescribed by the SOPs provided in the FSP.

### 5.6.2 Laboratory Supplies and Consumables

The Laboratory QA Officer or designee will be responsible for ensuring the acceptability of supplies and consumables used in the collection, preservation, preparation, and analysis of groundwater samples.

## 5.7 Data Acquisition Requirements

Data acquisition for direct reading instruments will be recorded manually within Field Logbooks or on pre-printed dedicated forms using indelible ink. Corrections will be performed using a single-line strikeout and noted with the date and initials of the individual performing the data correction.

Data acquisition from automated instruments using datalogging or electronic measurement capabilities will be recorded on electronic media with time and date stamps. Data acquired will be maintained in accordance with the requirements of the SSFL data management plan.

## 5.8 Data Management

A detailed description of methods and procedures for data storage and retrieval is provided in the Data Management Plan (DMP) prepared by CH2MHill (2007). The general procedures for the management of environmental data from generation to final use and storage are described in the following subsections.

### 5.8.1 Field Data Recording

Field data will be recorded in field logbooks or on standard forms and consist of measurements from direct reading instruments or direct measurements. Field staff will be responsible for recording field data and the QAO will be responsible for identifying and correcting recording errors.

### 5.8.2 Data Validation

Validation of field data will consist of manual review for transcription errors of data recorded in field logbooks or on standard forms. Data transcribed from the field logbook or standard forms into summary tables for reporting purposes will be verified for correctness by the Project QAO or designee. Limitations on the use of field data will be included in Quality Assurance Management reports (see Section 6.2).

Validation of the analytical data will be performed by the QAO or designee based on the evaluation criteria outlined in "USEPA Contract Laboratory Program National Functional Guidelines for Low Concentration Organic Data Review", USEPA-540-R-00-006, June 2001; "USEPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review", USEPA-540-R-08-0, June 2008; "USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review", EPA 540-R-01-008, July 2002; "Multi-Agency Radiological Laboratory Analytical Protocols Manual (MARLAP)", NUREG-1576, EPA 402-B-04-001A, NTIS PB2004-105421 (USNRC, 2004); and "Evaluation of Radiochemical Data Usability" (Paar & Porterfield, 1997).

The evaluation and action criteria specified in these documents will be used for further qualification of the data. Qualifiers assigned to the data will be consistent with those specified in the National Functional Guidelines.
Data from groundwater monitoring activities at SSFL will be validated at the frequency and Levels specified in Section 6.

The levels of validation are described below:

Level I:

- Sample management (collection techniques, sample containers, preservation, handling, transport, Chain-of-Custody, and holding times), and
- Method blank sample results, if applicable to the method.

Level II:

- Sample management (collection techniques, sample containers, preservation, handling, transport, Chain-of-Custody, and holding times),
- Method blank sample results,
- Laboratory control sample (LCS) or LCS/LCS duplicate (LCS/LCSD) recoveries and/or precision, and
- Surrogate recoveries (if applicable).

Level III:

- Sample management (collection techniques, sample containers, preservation, handling, transport, Chain-of-Custody, and holding times),
- Initial and continuing calibration,
- Method blank sample results,
- Laboratory control sample (LCS) or LCS/LCS duplicate (LCS/LCSD) recoveries and/or precision,
- Surrogate recoveries (if applicable),
- Matrix spike/matrix spike duplicate (MS/MSD) recoveries and precision,
- Field QA/QC sample results, and
- Other QC indicators as applicable.

Level IV:

- Sample management (collection techniques, sample containers, preservation, handling, transport, Chain-of-Custody, and holding times),
- Sample preparatory information (benchsheets, clean-up documentation, and run logs),
- Initial and continuing calibration,
- Method blank sample results,
- Instrument blanks (initial calibration blanks, continuing calibration blanks, and blanks following highly contaminated samples)
- Laboratory control sample (LCS) or LCS/LCS duplicate (LCS/LCSD) recoveries and/or precision,
- Surrogate recoveries (if applicable),
- Matrix spike/matrix spike duplicate (MS/MSD) recoveries and precision,
- Field QA/QC sample results,
- Gas Chromatography/Mass Spectrometry (GC/MS) tuning, if a GC/MS is used; ICP/MS tuning if an ICP/MS is used,
- Internal standards performance,
- Interference check sample results for inorganic analyses, and
- Raw data to verify identification, quantitation and to evaluate the potential for errors of omission and commission.

Level V:

- Sample management (collection techniques, sample containers, preservation, handling, transport, Chain-of-Custody, and holding times),
- Method blank sample results,
- Laboratory control sample (LCS) or LCS/LCS duplicate (LCS/LCSD) recoveries and/or precision,
- Surrogate recoveries (if applicable),
- Matrix spike/matrix spike duplicate (MS/MSD) recoveries and precision,
- Field QA/QC sample results, and other QC indicators as applicable.

### 5.8.3 Data Transformation/Data Reduction

The pH, DO, ORP, conductivity, temperature, turbidity, and PID or FID readings collected in the field will be generated from direct read instruments and/or recording meters. Field data will be written into field logbooks or standard forms immediately after measurements are taken. If errors are made, results will be legibly crossed out, initialed and dated by the field team member, and corrected in a space adjacent to the original entry.
Quality control data to be collected during laboratory analysis will include laboratory duplicates, surrogates, MS/MSD and method blank samples. QC data will be compared to the method acceptance criteria. Data considered to be acceptable will be entered into the laboratory computer system. Data summaries will be sent to the Laboratory QAO for review. Unacceptable data shall be appropriately qualified in the laboratory report. Case narratives will be prepared which will include information concerning non-conforming sample analysis data and other anomalous conditions encountered during sample analysis. Case narratives will be provided with each laboratory report for electronic archival.

### 5.8.4 Data Transmittal/Transfer

The Project QAO or designee is responsible for verifying the correctness of the field data after the data are transferred to a spreadsheet and/or database format. The chemical analysis data are maintained in a database that is described below.

A database has been developed to manage the data collected at the SSFL site. The database will be used to integrate field and analytical data to allow the access and evaluation of analytical and field data by the project team. Quality assurance and quality control will be maintained through the use of electronic data deliverables (EDD), reducing the need to manually enter data and the potential for transcription errors.

### 5.8.5 Data Analysis

The field and laboratory data collected will be used to delineate the nature and extent of constituents of concern. Survey, geologic and hydrogeologic characteristics information will be utilized to determine iso-concentration contours and gradients of impacted media.

### 5.8.6 Data Assessment

Assessment of laboratory data will be performed using the procedures detailed in the standard operating procedures presented in Section 7. These assessments include determining the mean, replicate percent difference (RPD) and percent recovery (%R) for quality control sample analyses.

The statistical equations to determine %R, RPD, and % completeness are provided in Section 7.3 of this QAPP.

### 5.8.7 Data Tracking

Data tracking will be performed in accordance with the procedures prescribed in the WQSAP.

### 5.8.8 Data Storage and Retrieval

Field records will be maintained by the Project Manager between sampling events and then archived in accordance with the requirements of the SSFL data management plan (CH2MHill, 2007).
Laboratory data will be stored for 10 years. Electronic instrument data will be maintained on electronic media (i.e., computer disc, magnetic hard drive) for this same time period. Laboratory records for this project will be maintained consistent with the storage requirements of regulatory agencies and the SSFL data management plan.

### 5.8.9 Data Security

Archived data will not be accessed without authorization from the Project Coordinator. The name of personnel accessing archived data will be recorded and maintained with the permanent records archived for 10 years.

# 6. ASSESSMENT/OVERSIGHT

The following subsections describe the procedures used for implementation of this QAPP and to assess the effectiveness of the associated quality assurance activities.

## 6.1 Assessments and Response Actions

Assessments consisting of internal and external audits may be performed during the project. Internal audits of both field and laboratory procedures will be conducted to verify that sampling and analysis are being performed in accordance with the procedures established in the WQSAP, the Field Sampling Plan (FSP), and this QAPP. External (field and laboratory) audits may also be conducted by USEPA, DTSC, or their designated contractors.

Internal audits of field activities include the review of sampling and field measurements conducted by the Project QAO or designee to verify compliance with SOPs. Internal audits will be conducted once during each phase of the sampling and at the conclusion of the project.

Internal audits will include examination of the following:

i) Field sampling records, screening results, instrument operating records;
ii) Sample collection;
iii) Handling and packaging in compliance with procedures;
iv) Maintenance of QA procedures; and
v) Chain-of-Custody reports.

Follow-up audits will be conducted to verify that procedures are maintained throughout the investigation and/or to resolve identified deficiencies.

## 6.2 Data Reduction, Validation, and Reporting

These procedures specify the documentation needed and the technical criteria for data reduction, validation, and reporting. The laboratory will be required to submit results that are supported by sufficient backup data and QA/QC sample analysis results to enable the reviewer to determine the validity of the data.

### 6.2.1 Field Measurement Data

Field personnel will evaluate the data obtained from field measurements by checking calibration procedures utilized in the field, checking calibration records generated in the field, and by checking sampling forms and water level records for completeness.

### 6.2.2 Laboratory Analytical Data

Laboratory analytical data will be reviewed to determine the precision, accuracy, and completeness of the reported results. Examples of the calculations of sample precision for each analytical method and matrix include the mean and the RPD calculated for matrix spike and matrix spike duplicate (MS/MSD), inorganic matrix duplicates, and field sample duplicates.

Laboratories will be required to submit QC sample analysis results to enable the reviewer to determine the usability of the data. The reviewer will evaluate field duplicates, LCS, MS/MSD, and blank samples for each batch of analytical samples. In the event of noncompliant results, corrective action will be initiated.

### 6.3 Internal Quality Control (QC)

Internal QC consists of examination and inspection of collected data as described in the procedures for field data collection, sample collection, and analysis. Internal QC also includes the review of field data and reports and a check of calculations. Documentation of internal QC actions will be provided on field logs, data reports, and correspondence, and maintained in the project file.

### 6.4 Performance and System Audits

Field activities will be monitored to evaluate the implementation of the project QA program to produce reliable sampling and field measurement data.

USEPA, DTSC, or their designated contractors may conduct an external audit during field operations. These audits may or may not be announced and are conducted at the discretion of USEPA, DTSC, or their designated contractors.

Field audits will evaluate the execution of sample collection, sample identification, sample control, Chain-of-Custody, field documentation, instrument calibration, field measurement, and data acquisition procedures. System audits will evaluate data reduction and management activities, project record completeness and conformance to procedures for the issuance of work products. Audit reports will be issued to the Project Manager.

The selected project analytical laboratory(s) will maintain current State of California Department of Public Health (CalDPH) Environmental Laboratory Approval Program (ELAP) certification for the parameters of analysis for the SSFL groundwater monitoring programs. The CalDPH may perform laboratory audits and the audit findings will be available upon request.

The Laboratory QAO or designee will conduct an internal laboratory audit. The laboratory audit will be conducted, at a minimum, on an annual basis. The Laboratory QAO will evaluate the results of the audit and provide a report to the Laboratory Operations Manager that includes deficiencies and/or noteworthy observations.

External audits may be conducted by QA personnel of the USEPA, DTSC, or their designated contractors.

### 6.5 Specific Routine Procedures to Assess Data

The primary goal of the data validation program is to ensure that the data reported are representative of current site conditions. To meet this goal, a combination of statistical procedures and qualitative evaluations will be used to evaluate data quality. If non-compliant results are noted, the reported environmental data will be annotated within the database.

Data verification and validation will be performed in accordance with guidelines prescribed by the "USEPA Contract Laboratory Program National Functional Guidelines for Low Concentration Organic

Data Review", USEPA-540-R-00-006, June 2001; "USEPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review", USEPA-540-R-08-0, June 2008; "USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review", EPA 540-R-01-008, July 2002; "Multi-Agency Radiological Laboratory Analytical Protocols Manual (MARLAP)", NUREG-1576, EPA 402-B-04-001A, NTIS PB2004-105421 (USNRC, 2004); and "Evaluation of Radiochemical Data Usability" (Paar & Porterfield, 1997).

Level V data validation will be performed on all groundwater sample results. Upon selection of a new laboratory or utilization of new methodology, the initial sample delivery group data package will be validated at Level IV. At the discretion of the Project Manager or designee, Level IV data validation will be performed, as necessary, on a subset of groundwater sample results including:

- Groundwater results from the first sampling event at new monitoring locations, and
- Data that appear to be inconsistent with historical data trends or the current understanding of transport and fate of chemical constituents.

## 6.6 Corrective Actions

The need for corrective action may be identified during review of data reports, during field and system audits, or during monitoring of QA activities. Corrective actions will be implemented immediately if data may be adversely impacted. The Project QAO will recommend corrective action to the Project Manager. The Field Task Leaders and field team will perform implementation of corrective actions.

Corrective actions will be documented in the project file. Follow-up audits will be performed as necessary to verify that deficiencies have been corrected, and that the QA/QC procedures described in this QAPP and the FSP are maintained.

Laboratory nonconformance may be noted during routine analytical data assessment and inspection. In such instances, the Laboratory QAO and appropriate technical specialist will discuss the situation, and a corrective action will be implemented. If necessary, an audit of the laboratory will be performed to confirm that appropriate corrective actions have been implemented.

Corrective action resulting from deficiencies identified during the internal laboratory technical system audit will be implemented immediately. The Laboratory QAO will ensure implementation and documentation of the corrective action. Follow-up will be performed as necessary to verify that deficiencies have been corrected, and that the QA/QC procedures described in the QAPP are maintained throughout the project.

## 6.7 Reports to Management

Quality Assurance (QA) Management Reports may be prepared during the project by the Project QAO. The QA Management Reports will include project status, results of performance evaluations and system audits, results of periodic data quality validation and assessment and data use limitations, and significant QA problems identified and corrective actions taken.

The QA Management Reports will be provided to the Project Manager and maintained within the project files and will be available upon request. The QA Management Report will summarize data quality information and provide an overall data quality assessment compared to the data quality objectives outlined in this QAPP.

# 7. DATA VERIFICATION, VALIDATION, AND USABILITY

The data verification and validation process conducted for environmental monitoring programs entails evaluating site sample data for compliance with the method-specific QA/QC acceptance criteria to determine data validity and usability. This information is used to determine if sufficient analytical results exist for regulatory compliance monitoring, site characterization, and determination of potential impact on human health and/or the environment.

## 7.1 Data Review, Verification, and Validation Requirements

For each offsite laboratory used, the initial data packages received will be validated following full Level IV data validation procedures using the USEPA functional guidelines (USEPA, 2001b, 2002a, 2008), "Multi-Agency Radiological Laboratory Analytical Protocols Manual (MARLAP)" (USNRC, 2004), and U.S. Department of Energy radiochemical evaluation guidelines (Paar & Porterfield, 1997).

The following data qualifiers may be applied during the data validation process, following USEPA guidance:

- U Parameter not detected
- J Estimated concentration
- UJ Estimated Reporting Limit
- N Identity presumptive and tentative
- R Rejected, unusable

Data qualified as rejected, “R,” will not be used in compliance monitoring, characterization, or risk assessment. Qualified data will be used as deemed appropriate by the Data Validator and Project Manager.

A detailed explanation of the data validation qualifiers and codes is presented in Tables 7-1 and 7-2.

**Table 7-1 Data Qualifier Definitions**

| Qualifier | Organics | Inorganics | Radiological |
|---|---|---|---|
| U | The analyte was analyzed for, but was not detected above the reported sample quantitation limit. | The material was analyzed for, but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit. | Not detected above the minimum detectable activity (MDA). Numerical value represents the radionuclide activity for radiological data. |
| J | The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample. | The associated value is an estimated quantity. | Analyte is detected at a level less than contract-required MDA and greater than or equal to the MDA. Or quality control deficiencies have compromised result accuracy. |

| Qualifier | Organics | Inorganics | Radiological |
|---|---|---|---|
| N | The analysis indicates the presence of an analyte for which there is presumptive evidence to make a "tentative identification." | Not applicable. | Not applicable. |
| NJ | The analysis indicates the presence of an analyte that has been "tentatively identified" and the associated numerical value represents its approximate concentration. | Not applicable. | Not applicable. |
| UJ | The analyte was not deemed above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample. | The material was analyzed for, but was not detected. The associated detection limit value is an estimate and may be inaccurate or imprecise. | The material was analyzed for, but was not detected. The associated detection limit value is an estimate and may be inaccurate or imprecise. |
| R | The sample results are rejected due to serious deficiencies in the ability to analyze the sample and to meet quality control criteria. The presence or absence of the analyte cannot be verified. | The data are unusable. (Note: Analyte may or may not be present). | The data are unusable. (Note: Analyte may or may not be present). |

**Table 7-2 Qualification Code Definitions**

| Reason Code | Organics | Inorganics |
|---|---|---|
| H | Holding times were exceeded. | Holding times were exceeded. |
| S | Surrogate recovery was outside QC limits. | The sequence or number of standards used for the calibration was incorrect |
| C | Calibration %RSD or %D was noncompliant. | Correlation coefficient is <0.995. |
| R | Calibration RRF was <0.05. | %R for calibration is not within control limits. |
| B | Presumed contamination as indicated by the preparation (method) blank results. | Presumed contamination as indicated by the preparation (method) or calibration blank results. |
| L | LCS/LCSD %R was not within control limits. | Laboratory Control Sample %R was not within control limits. |
| Q | MS/MSD recovery was poor or RPD high. | MS recovery was poor. |
| E | Not applicable. | Duplicates showed poor agreement. |
| I | Internal standard performance was unsatisfactory. | ICP ICS results were unsatisfactory. |
| A | Not applicable. | ICP Serial Dilution %D were not within control limits. |
| M | Tuning (BFB or DFTPP) was noncompliant. | Not applicable. |
| T | Presumed contamination as indicated by the trip blank results. | Not applicable. |
| + | False positive – reported compound was not present. | Not applicable. |
| - | False negative – compound was present but not reported. | Not applicable. |
| F | Presumed contamination as indicated by the field blank or equipment rinse blank results. | Presumed contamination as indicated by the field blank or equipment rinse blank results. |
| $ | Reported result or other information was incorrect. | Reported result or other information was incorrect. |
| ? | TIC identity or reported retention time has been changed. | Not applicable. |
| D | The analysis with this flag should not be used because another more technically sound analysis is available. | The analysis with this flag should not be used because another more technically sound analysis is available. |
| P | Instrument performance for pesticides was poor. | Post Digestion Spike recovery was not within control limits. |
| DNQ | The reported result is above the method detection limit but is less than the reporting limit. | The reported result is above the method detection limit but is less than the reporting limit. |

| Reason Code | Organics | Inorganics |
|---|---|---|
| *# | Unusual problems found with the data that have been described in Section *#, "Data Validation Findings." The number following the asterisk (*) will indicate the subsection where a description of the problem can be found (e.g., *II would indicate an issue address in section II). | Unusual problems found with the data that have been described in Section *#, "Data Validation Findings." The number following the asterisk (*) will indicate the subsection where a description of the problem can be found (e.g., *II would indicate an issue address in section II). |

### 7.2 Verification and Validation Methods

Field data will be verified by reviewing field documentation and Chain-of-Custody records. Data from direct-reading instruments used to measure pH, conductivity, ORP, DO, and turbidity will be internally verified by reviewing calibration and operating records.

The data verification/validation procedure will identify data as being acceptable, of limited usability (qualified as estimated), or rejected. The results of the data verification/validation will be provided in data validation summaries included in Quality Assurance Management Reports.

Data determined to be unusable may require corrective action. Potential types of corrective action may include re-sampling by the field team or reanalysis of samples by the laboratory.

### 7.3 Usability/Reconciliation with Data Quality Objectives

The overall usability of the environmental analysis data will be assessed by evaluating the PARCC of the data set to the measurement performance criteria using basic statistical qualities as applicable. The procedures and statistical formulas to be used for these evaluations are presented in the following subsections.

#### 7.3.1 Precision

Project precision will be evaluated by assessing the Replicate Percent Difference (RPD) data from field duplicate samples. Analytical precision will be evaluated by assessing the RPD data from either duplicate spiked sample analyses or duplicate sample analyses. The RPD between two measurements is calculated using the following simplified formula:

$$RPD = \frac{|R_1 - R_2|}{(R_1 + R_2)/2} \times 100$$

where: $R_1$ = value of first result
$R_2$ = value of second result

Overall precision for the sampling programs will be determined by calculating the mean RPD for the field duplicates in a given sampling program. This will provide an evaluation of the overall variability attributable to the sampling procedure, sample matrix, and laboratory procedures in each sampling program.

The calculation of the mean RPD will include the RPD values for field duplicate sample data that are greater than or equal to 5 times the quantitation limit for an analysis.

### 7.3.2 Accuracy/Bias

The data from method blank, equipment rinse blank, field blank, and trip blank samples; surrogate spikes; MS/MSD; and LCS will be used to determine accuracy and potential bias of the sample data.

The data from method blank samples provide an indication of laboratory contamination that may result in bias of sample data. Sample data associated with method blank contamination will have been identified during the data verification/validation process. The affected sample data will be qualified in accordance with the procedures prescribed in the National Functional Guidelines (USEPA, 2001b, 2002a, 2008), the radiological analytical guidelines (USNRC, 2004), and the radiochemical evaluation guidelines (Paar & Porterfield, 1997).

The data from equipment rinse blank, field blank, and trip blank samples provide an indication of field and transportation conditions that may result in bias of sample data. Sample data associated with contaminated equipment rinse blank, field blank, and trip blank samples will have been identified during the data verification/validation process. The evaluation procedure and qualification of sample data associated with equipment rinse blank, field blank, and trip blank contamination is performed in the same manner as the evaluation procedure for method blank sample contamination.

Surrogate spike recoveries provide information regarding the accuracy/bias of the organic analyses on an individual sample basis. The percent recovery data provide an indication of the effect that the sample matrix may have on the preparation and analysis procedure. Sample data exhibiting matrix effects will have been identified during the data verification/validation process.

Matrix spike sample data provide information regarding the accuracy/bias of the analytical methods relative to the sample matrix. Matrix spike samples are field samples that have been fortified with target analytes prior to sample preparation and analysis. The percent recovery data provide an indication of the effect that the sample matrix may have on the preparation and analysis procedure. Sample data exhibiting matrix effects will have been identified during the data verification/validation process.

Analytical accuracy/bias will be determined by evaluating the percent recovery data of LCS. LCS are artificial samples prepared in the laboratory using a blank matrix that is fortified with analytes from a standard reference material that is independent of the calibration standards. LCS are prepared and analyzed in the same manner as the field samples. The data from LCS analyses will provide an indication of the accuracy and bias of the analytical method for each target analyte.

Percent recovery (%R) is calculated using the following formula:

$$\%R = \frac{SSR - SR}{SA} \times 100$$

where:
SSR = Spiked Sample Result
SR = Sample Result or Background
SA = Spike Added

The percent recovery of LCS samples is determined by dividing the measured value by the true value and multiplying by 100.

Overall accuracy/bias for the sampling events will be determined by calculating the percent of accuracy measurements that meet the measurement performance criteria.

### 7.3.3 Sample Representativeness

Representativeness of the samples will be assessed by reviewing the results of field audits and the data from field duplicate samples. Overall sample representativeness will be determined by calculating the percent of field duplicate sample data that achieved the RPD criteria. Overall sample representativeness will be considered acceptable if the results of field audits indicate that the approved sampling methods or alternate acceptable sampling methods were used to collect the samples and the field duplicate RPD data are acceptable for at least 75 percent of the samples.

### 7.3.4 Completeness

Completeness will be assessed by comparing the number of valid (usable) sample results to the total possible number of results within a specific sample matrix and/or analysis. Percent completeness will be calculated using the following formula:

$$\%\ \text{Completeness} = \frac{\text{Number of Valid (Usable) Measurements}}{\text{Number of Measurements Planned}} \times 100$$

Overall completeness will be assessed by calculating the percent completeness for the entire set of data obtained for each sampling program. Overall completeness will be considered acceptable if at least 90 percent of the data are determined to be valid.

### 7.3.5 Comparability

The comparability of data sets will be evaluated by reviewing the sampling and analysis methods used to generate the data for each data set. Project comparability will be determined to be acceptable if the sampling and analysis methods specified in this QAPP, and approved QAPP revisions or amendments, are used for generating the environmental sample data.

Overall comparability of data from split samples (samples that are collected at the same time from the same location and split between two laboratories using sample containers from the same source or vendor) will be evaluated by determining the RPD of detected analytes in both samples following data verification/validation. Overall comparability of split sample data will be considered acceptable if the RPD for detected analytes with concentrations greater than or equal to 5 times their respective quantitation limits does not exceed RPD acceptance criteria for field duplicate and split samples.

### 7.3.6 Sensitivity and Quantitation Limits

The quantitation limits for the sample data will be reviewed to ensure that the sensitivity of the analyses was sufficient to achieve the site water quality protection standards (i.e., concentration limits), or other applicable project criteria. The method blank sample data and LCS percent recovery data will be reviewed to assess compliance with these measurement performance criteria.

Overall sensitivity will be assessed by comparing the sensitivity for each monitoring program to the requirements for the project specific analyses. Overall sensitivity will be considered acceptable if the reporting detection limits are less than the applicable evaluation criteria (i.e., site water quality protection standards).

### 7.3.7 Data Limitations and Actions

Data use limitations will be identified in data usability summary reports (DUSR). Data that do not meet the measurement performance criteria will be identified and the impact on the project data quality objectives (DQO) will be assessed and discussed in the DUSR reports.

**REFERENCES**

1. CH2MHill, 2007. "Data Management Plan, Revision 5, Environmental Data Management System (EDMS), The Boeing Company, Boeing Realty Corporation." 29 June 2007.

2. HydroGeoLogic, Inc., 2010. "Quality Assurance Project Plan for Groundwater, Surface Water, and Sediment, Area IV Radiological Study, Santa Susana Field Laboratory, Ventura County, California." 11 August 2010.

3. Paar, J.G., and D.R. Porterfield, 1997. "Evaluation of Radiochemical Data Usability." es/er/ms-5. April 1997.

4. USEPA, 1984. "Guidelines Establishing Test Procedures for the Analysis of Pollutants." 40 CFR Part 136. EPA 600/4-84-0041. April 1984.

5. ------, 1986. "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods." SW-846 EPA, USEPA Office of Solid Waste, 3rd Edition and promulgated updates, 1986.

6. ------, 1992. "Specifications and Guidance for Contaminant-Free Sample Containers." EPA 540/R-93/051. December 1992.

7. ------, 1999. "Requirements for Quality Assurance Project Plans for Environmental Data Operations." EPA QA/R-5. 1999.

8. ------, 2001a. "EPA Requirements for Quality Assurance Project Plans." EPA QA/R-5, EPA/240/B-01/003. March 2001.

9. ------, 2001b. "USEPA Contract Laboratory Program National Functional Guidelines for Low Concentration Organic Data Review." OSWER 9240.1-34. USEPA-540-R-00-006. June 2001.

10. ------, 2001c. "EPA Region 9 Requirements for Quality Assurance Program Plans, Draft." R9QA/03.1. August 2001.

11. ------, 2002a. "USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review." OSWER 9240.1-35. EPA 540-R-01-008. July 2002.

12. ------, 2002b. "EPA Guidance for Quality Assurance Project Plans." EPA/240/R-02/009. December 2002.

13. ------, 2005. "Manual for the Certification of Laboratories Analyzing Drinking Water." EPA 815-R-05-00. January 2005.

14. ------, 2006. "Data Quality Objectives Process for Hazardous Waste Site Investigations." EPA QA/G-4. EPA/240/B-06/001. February 2006.

15. ------, 2008. "USEPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review." OSWER 9240.1-46. USEPA-540-R-08-01. June 2008.

16. United States Nuclear Regulatory Commission (USNRC), 2004. "Multi-Agency Radiological Laboratory Analytical Protocols Manual (MARLAP)", NUREG-1576, EPA 402-B-04-001A, NTIS PB2004-105421, July 2004.

| Title | Use | Source |
|---|---|---|
| Equipment Decontamination | Pre/Post Sampling | Refer to Appendix A, SSFL Field Sampling Plan in Water Quality Sampling and Analysis Plans for the Regulated Units and the Site-Wide groundwater monitoring programs, Haley & Aldrich, Inc., (2010a, 2010b, 2010c) for current Field Measurement SOPs. |
| Groundwater Sampling | Sample Collection | |
| Manual Water Level Measurement | | |
| Low-Flow Purge | | |
| FLUTe Multilevel System | | |
| Westbay Multilevel System | | |
| Sample Management | Post Sampling | |

| Method | Analyte | CAS Number | Reporting Limit | Reporting Limit Units | Appendix IX Constituent |
|---|---|---|---|---|---|
| 120.1 | Specific Conductance | E-10184 | 5 | umhos/cm | No |
| 150.1 | pH | E-10139 | 0.01 | pH Units | No |
| 160.1 | Total Dissolved Solids | E-10173 | 30 | mg/L | No |
| 1613 | 1,2,3,4,6,7,8-HpCDD | 35822-46-9 | 24.8 | pg/L | Yes |
| 1613 | 1,2,3,4,6,7,8-HpCDF | 67562-39-4 | 24.8 | pg/L | Yes |
| 1613 | 1,2,3,4,7,8,9-HpCDF | 55673-89-7 | 24.8 | pg/L | Yes |
| 1613 | 1,2,3,4,7,8-HxCDD | 39227-28-6 | 24.8 | pg/L | Yes |
| 1613 | 1,2,3,4,7,8-HxCDF | 70648-26-9 | 24.8 | pg/L | Yes |
| 1613 | 1,2,3,6,7,8-HxCDD | 57653-85-7 | 24.8 | pg/L | Yes |
| 1613 | 1,2,3,6,7,8-HxCDF | 57117-44-9 | 24.8 | pg/L | Yes |
| 1613 | 1,2,3,7,8,9-HxCDD | 19408-74-3 | 24.8 | pg/L | Yes |
| 1613 | 1,2,3,7,8,9-HxCDF | 72918-21-9 | 24.8 | pg/L | Yes |
| 1613 | 1,2,3,7,8-PeCDD | 40321-76-4 | 24.8 | pg/L | Yes |
| 1613 | 1,2,3,7,8-PeCDF | 57117-41-6 | 24.8 | pg/L | Yes |
| 1613 | 2,3,4,6,7,8-HxCDF | 60851-34-5 | 24.8 | pg/L | Yes |
| 1613 | 2,3,4,7,8-PeCDF | 57117-31-4 | 24.8 | pg/L | Yes |
| 1613 | 2,3,7,8-TCDD | 1746-01-6 | 4.97 | pg/L | Yes |
| 1613 | 2,3,7,8-TCDF | 51207-31-9 | 4.97 | pg/L | Yes |
| 1613 | OCDD | 3268-87-9 | 24.8 | pg/L | Yes |
| 1613 | OCDF | 39001-02-0 | 24.8 | pg/L | Yes |
| 1625C | n-Nitrosodimethylamine (NDMA) | 62-75-9 | 20 | ug/L | Yes |
| 1625M | n-Nitrosodimethylamine (NDMA) | 62-75-9 | 0.005 | ug/L | Yes |
| 1668 | Aroclor 1016 | 12674-11-2 | 1 | ug/L | Yes |
| 1668 | Aroclor 1221 | 11104-28-2 | 1 | ug/L | Yes |
| 1668 | Aroclor 1232 | 11141-16-5 | 1 | ug/L | Yes |
| 1668 | Aroclor 1242 | 53469-21-9 | 1 | ug/L | Yes |
| 1668 | Aroclor 1248 | 12672-29-6 | 1 | ug/L | Yes |
| 1668 | Aroclor 1254 | 11097-69-1 | 1 | ug/L | Yes |
| 1668 | Aroclor 1260 | 11096-82-5 | 1 | ug/L | Yes |
| 1668 | Aroclor 1262 | 37324-23-5 | 0.5 | ug/L | No |
| 1668 | Aroclor 1268 | 11100-14-4 | 0.5 | ug/L | No |
| 1668 | Aroclor 5432 | 61788-33-8 | 0.5 | ug/L | No |
| 1668 | Aroclor 5442 | 12642-23-8 | 0.5 | ug/L | No |
| 1668 | Aroclor 5460 | 11126-42-4 | 0.5 | ug/L | No |
| 1668 | PCB 101 | 37680-73-2 | 0.01 | ug/L | No |
| 1668 | PCB 105 | 32598-14-4 | 0.01 | ug/L | No |
| 1668 | PCB 110 | 38380-03-9 | 0.01 | ug/L | No |
| 1668 | PCB 114 | 74472-37-0 | 0.01 | ug/L | No |
| 1668 | PCB 118 | 31508-00-6 | 0.01 | ug/L | No |
| 1668 | PCB 119 | 56558-17-9 | 0.01 | ug/L | No |
| 1668 | PCB 123 | 65510-44-3 | 0.01 | ug/L | No |
| 1668 | PCB 126 | 57465-28-8 | 0.01 | ug/L | No |
| 1668 | PCB 128 | 38380-07-3 | 0.01 | ug/L | No |
| 1668 | PCB 132 | 38380-05-1 | 0.01 | ug/L | No |
| 1668 | PCB 138 | 35065-28-2 | 0.01 | ug/L | No |
| 1668 | PCB 149 | 38380-04-0 | 0.01 | ug/L | No |
| 1668 | PCB 151 | 52663-63-5 | 0.01 | ug/L | No |
| 1668 | PCB 153 | 35065-27-1 | 0.01 | ug/L | No |

| Method | Analyte | CAS Number | Reporting Limit | Reporting Limit Units | Appendix IX Constituent |
|---|---|---|---|---|---|
| 1668 | PCB 156 | 38380-08-4 | 0.01 | ug/L | No |
| 1668 | PCB 157 | 69782-90-7 | 0.01 | ug/L | No |
| 1668 | PCB 158 | 74472-42-7 | 0.01 | ug/L | No |
| 1668 | PCB 167 | 52663-72-6 | 0.01 | ug/L | No |
| 1668 | PCB 168 | 59291-65-5 | 0.01 | ug/L | No |
| 1668 | PCB 169 | 32774-16-6 | 0.01 | ug/L | No |
| 1668 | PCB 170 | 35065-30-6 | 0.01 | ug/L | No |
| 1668 | PCB 177 | 52663-70-4 | 0.01 | ug/L | No |
| 1668 | PCB 18 | 37680-65-2 | 0.01 | ug/L | No |
| 1668 | PCB 180 | 35065-29-3 | 0.01 | ug/L | No |
| 1668 | PCB 183 | 52663-69-1 | 0.01 | ug/L | No |
| 1668 | PCB 187 | 52663-68-0 | 0.01 | ug/L | No |
| 1668 | PCB 189 | 39635-31-9 | 0.01 | ug/L | No |
| 1668 | PCB 194 | 35694-08-7 | 0.01 | ug/L | No |
| 1668 | PCB 201 | 40186-71-8 | 0.01 | ug/L | No |
| 1668 | PCB 206 | 40186-72-9 | 0.01 | ug/L | No |
| 1668 | PCB 28 | 7012-37-5 | 0.01 | ug/L | No |
| 1668 | PCB 37 | 38444-90-5 | 0.01 | ug/L | No |
| 1668 | PCB 44 | 41464-39-5 | 0.01 | ug/L | No |
| 1668 | PCB 49 | 41464-40-8 | 0.01 | ug/L | No |
| 1668 | PCB 52 | 35693-99-3 | 0.01 | ug/L | No |
| 1668 | PCB 66 | 32598-10-0 | 0.01 | ug/L | No |
| 1668 | PCB 70 | 32598-11-1 | 0.01 | ug/L | No |
| 1668 | PCB 74 | 32690-93-0 | 0.01 | ug/L | No |
| 1668 | PCB 77 | 32598-13-3 | 0.01 | ug/L | No |
| 1668 | PCB 81 | 70362-50-4 | 0.01 | ug/L | No |
| 1668 | PCB 87 | 38380-02-8 | 0.01 | ug/L | No |
| 1668 | PCB 99 | 38380-01-7 | 0.01 | ug/L | No |
| 170.1 | Temperature | TEMP | 0.1 | Celsius | No |
| 180.1 | Turbidity | E-10607 | 0.3 | NTU | No |
| 300.0 | Bromide | 24959-67-9 | 0.5 | mg/L | No |
| 300.0 | Chloride | 16887-00-6 | 0.5 | mg/L | No |
| 300.0 | Fluoride | 16984-48-8 | 0.5 | mg/L | No |
| 300.0 | Nitrate | NO3N | 0.5 | mg/L | No |
| 300.0 | Nitrate-N | NO3N | 0.5 | mg/L | No |
| 300.0 | Nitrate-NO3 | NO3N | 0.5 | mg/L | No |
| 300.0 | Nitrite-NO2 | 14797-65-0 | 0.1 | mg/L | No |
| 300.0 | Orthophosphate-PO4 | 14265-44-2 | 0.2 | mg/L | No |
| 300.0 | Sulfate | 14808-79-8 | 1 | mg/L | No |
| 310.1 | Alkalinity | TAlk | 2 | mg/L | No |
| 310.1 | Alkalinity as CaCO3 | TAlk | 2 | mg/L | No |
| 310.2 | Alkalinity | TAlk | 2 | mg/L | No |
| 310.2 | Alkalinity as CaCO3 | TAlk | 2 | mg/L | No |
| 314.0 | Perchlorate | 14797-73-0 | 2 | ug/L | No |
| 331.0 | Perchlorate | 14797-73-0 | 2 | ug/L | No |
| 332.0 | Perchlorate | 14797-73-0 | 2 | ug/L | No |
| 340.2 | Fluoride | 16984-48-8 | 0.5 | mg/L | No |
| 350.1 | Ammonia | 7664-41-7 | 0.5 | mg/L | No |

See last page of table for notes and abbreviations.

| Method | Analyte | CAS Number | Reporting Limit | Reporting Limit Units | Appendix IX Constituent |
|---|---|---|---|---|---|
| 350.1 | Ammonia-N | 7664-41-7 | 0.5 | mg/L | No |
| 350.2 | Ammonia | 7664-41-7 | 0.5 | mg/L | No |
| 350.2 | Ammonia-N | 7664-41-7 | 0.5 | mg/L | No |
| 350.3 | Ammonia | 7664-41-7 | 0.5 | mg/L | No |
| 350.3 | Ammonia-N | 7664-41-7 | 0.5 | mg/L | No |
| 353.2 | Nitrate | NO3N | 0.5 | mg/L | No |
| 353.2 | Nitrate-N | NO3N | 0.5 | mg/L | No |
| 353.2 | Nitrate-NO3 | NO3N | 0.5 | mg/L | No |
| 360.1 | Dissolved Oxygen (DO) | E-14539 | 1 | mg/L | No |
| 375.4 | Sulfate | 14808-79-8 | 1 | mg/L | No |
| 376.2 | Sulfide | 18496-25-8 | 0.1 | mg/L | Yes |
| 377.1 | Sulfite | 14265-45-3 | 0.05 | mg/L | No |
| 415.1 | Organic Carbon, Dissolved | E-10094 | 1 | mg/L | No |
| 504.1 | 1,2,3-Trichloropropane (TCP) | 96-18-4 | 0.005 | ug/L | Yes |
| 504.1 | 1,2-Dibromo-3-chloropropane (DBCP) | 96-12-8 | 0.02 | ug/L | Yes |
| 504.1 | 1,2-Dibromoethane (EDB) | 106-93-4 | 0.02 | ug/L | Yes |
| 521 | n-Nitrosodimethylamine (NDMA) | 62-75-9 | 20 | ug/L | Yes |
| 6010B | Aluminum, Dissolved | 7429-90-5-D | 0.05 | mg/L | No |
| 6010B | Aluminum, Total | 7429-90-5 | 0.05 | mg/L | No |
| 6010B | Antimony, Dissolved | 7440-36-0-D | 0.002 | mg/L | No |
| 6010B | Antimony, Total | 7440-36-0 | 0.002 | mg/L | Yes |
| 6010B | Arsenic, Dissolved | 7440-38-2-D | 0.002 | mg/L | No |
| 6010B | Arsenic, Total | 7440-38-2 | 0.002 | mg/L | Yes |
| 6010B | Barium, Dissolved | 7440-39-3-D | 0.005 | mg/L | No |
| 6010B | Barium, Total | 7440-39-3 | 0.005 | mg/L | Yes |
| 6010B | Beryllium, Dissolved | 7440-41-7-D | 0.0005 | mg/L | No |
| 6010B | Beryllium, Total | 7440-41-7 | 0.0005 | mg/L | Yes |
| 6010B | Boron, Dissolved | 7440-42-8-D | 0.05 | mg/L | No |
| 6010B | Boron, Total | 7440-42-8 | 0.05 | mg/L | No |
| 6010B | Cadmium, Dissolved | 7440-43-9-D | 0.001 | mg/L | No |
| 6010B | Cadmium, Total | 7440-43-9 | 0.001 | mg/L | Yes |
| 6010B | Calcium, Dissolved | 7440-70-2-D | 0.2 | mg/L | No |
| 6010B | Calcium, Total | 7440-70-2 | 0.2 | mg/L | No |
| 6010B | Chromium, Dissolved | 7440-47-3-D | 0.002 | mg/L | No |
| 6010B | Chromium, Total | 7440-47-3 | 0.002 | mg/L | Yes |
| 6010B | Cobalt, Dissolved | 7440-48-4-D | 0.005 | mg/L | No |
| 6010B | Cobalt, Total | 7440-48-4 | 0.005 | mg/L | Yes |
| 6010B | Copper, Dissolved | 7440-50-8-D | 0.002 | mg/L | No |
| 6010B | Copper, Total | 7440-50-8 | 0.002 | mg/L | Yes |
| 6010B | Iron (II) | 7439-89-6 | 0.02 | mg/L | No |
| 6010B | Iron (II), Dissolved | 7439-89-6-D | 0.02 | mg/L | No |
| 6010B | Iron, Dissolved | 7439-89-6-D | 0.2 | mg/L | No |
| 6010B | Iron,Total | 7439-89-6 | 0.2 | mg/L | No |
| 6010B | Lead, Dissolved | 7439-92-1-D | 0.001 | mg/L | No |
| 6010B | Lead, Total | 7439-92-1 | 0.001 | mg/L | Yes |
| 6010B | Lithium, Dissolved | 7439-93-2-D | 0.05 | mg/L | No |
| 6010B | Lithium, Total | 7439-93-2 | 0.05 | mg/L | No |
| 6010B | Magnesium, Dissolved | 7439-95-4-D | 0.1 | mg/L | No |

| Method | Analyte | CAS Number | Reporting Limit | Reporting Limit Units | Appendix IX Constituent |
|---|---|---|---|---|---|
| 6010B | Magnesium, Total | 7439-95-4 | 0.1 | mg/L | No |
| 6010B | Manganese, Dissolved | 7439-96-5-D | 0.005 | mg/L | No |
| 6010B | Manganese, Total | 7439-96-5 | 0.005 | mg/L | No |
| 6010B | Molybdenum, Dissolved | 7439-98-7-D | 0.01 | mg/L | No |
| 6010B | Molybdenum, Total | 7439-98-7 | 0.01 | mg/L | No |
| 6010B | Nickel, Dissolved | 7440-02-0-D | 0.002 | mg/L | No |
| 6010B | Nickel, Total | 7440-02-0 | 0.002 | mg/L | Yes |
| 6010B | Phosphorus, Dissolved | 7723-14-0-D | 0.05 | mg/L | No |
| 6010B | Phosphorus, Total | 7723-14-0 | 0.05 | mg/L | No |
| 6010B | Potassium, Dissolved | 7440-09-7-D | 0.5 | mg/L | No |
| 6010B | Potassium, Total | 7440-09-7 | 0.5 | mg/L | No |
| 6010B | Selenium, Dissolved | 7782-49-2-D | 0.002 | mg/L | No |
| 6010B | Selenium, Total | 7782-49-2 | 0.002 | mg/L | Yes |
| 6010B | Silver, Dissolved | 7440-22-4-D | 0.001 | mg/L | No |
| 6010B | Silver, Total | 7440-22-4 | 0.001 | mg/L | Yes |
| 6010B | Sodium, Dissolved | 7440-23-5-D | 1 | mg/L | No |
| 6010B | Sodium, Total | 7440-23-5 | 1 | mg/L | No |
| 6010B | Strontium, Dissolved | 7440-24-6-D | 0.02 | mg/L | No |
| 6010B | Strontium, Total | 7440-24-6 | 0.02 | mg/L | No |
| 6010B | Thallium, Dissolved | 7440-28-0-D | 0.001 | mg/L | No |
| 6010B | Thallium, Total | 7440-28-0 | 0.001 | mg/L | Yes |
| 6010B | Tin, Total | 7440-31-5 | 0.003 | mg/L | Yes |
| 6010B | Titanium, Dissolved | 7440-32-6-D | 0.005 | mg/L | No |
| 6010B | Titanium, Total | 7440-32-6 | 0.005 | mg/L | No |
| 6010B | Vanadium, Dissolved | 7440-62-2-D | 0.005 | mg/L | No |
| 6010B | Vanadium, Total | 7440-62-2 | 0.005 | mg/L | Yes |
| 6010B | Zinc, Dissolved | 7440-66-6-D | 0.02 | mg/L | No |
| 6010B | Zinc, Total | 7440-66-6 | 0.02 | mg/L | Yes |
| 6010B | Zirconium, Dissolved | 7440-67-7-D | 0.05 | mg/L | No |
| 6010B | Zirconium, Total | 7440-67-7 | 0.05 | mg/L | No |
| 6020 | Aluminum, Dissolved | 7429-90-5-D | 0.05 | mg/L | No |
| 6020 | Aluminum, Total | 7429-90-5 | 0.05 | mg/L | No |
| 6020 | Antimony, Dissolved | 7440-36-0-D | 0.002 | mg/L | No |
| 6020 | Antimony, Total | 7440-36-0 | 0.002 | mg/L | Yes |
| 6020 | Arsenic, Dissolved | 7440-38-2-D | 0.002 | mg/L | No |
| 6020 | Arsenic, Total | 7440-38-2 | 0.002 | mg/L | Yes |
| 6020 | Barium, Dissolved | 7440-39-3-D | 0.005 | mg/L | No |
| 6020 | Barium, Total | 7440-39-3 | 0.005 | mg/L | Yes |
| 6020 | Beryllium, Dissolved | 7440-41-7-D | 0.0005 | mg/L | No |
| 6020 | Beryllium, Total | 7440-41-7 | 0.0005 | mg/L | Yes |
| 6020 | Boron, Dissolved | 7440-42-8-D | 0.05 | mg/L | No |
| 6020 | Boron, Total | 7440-42-8 | 0.05 | mg/L | No |
| 6020 | Cadmium, Dissolved | 7440-43-9-D | 0.001 | mg/L | No |
| 6020 | Cadmium, Total | 7440-43-9 | 0.001 | mg/L | Yes |
| 6020 | Calcium, Dissolved | 7440-70-2-D | 0.2 | mg/L | No |
| 6020 | Calcium, Total | 7440-70-2 | 0.2 | mg/L | No |
| 6020 | Chromium, Dissolved | 7440-47-3-D | 0.002 | mg/L | No |
| 6020 | Chromium, Total | 7440-47-3 | 0.002 | mg/L | Yes |

See last page of table for notes and abbreviations.

| Method | Analyte | CAS Number | Reporting Limit | Reporting Limit Units | Appendix IX Constituent |
|---|---|---|---|---|---|
| 6020 | Cobalt, Dissolved | 7440-48-4-D | 0.005 | mg/L | No |
| 6020 | Cobalt, Total | 7440-48-4 | 0.005 | mg/L | Yes |
| 6020 | Copper, Dissolved | 7440-50-8-D | 0.002 | mg/L | No |
| 6020 | Copper, Total | 7440-50-8 | 0.002 | mg/L | Yes |
| 6020 | Iron (II) | 7439-89-6 | 0.02 | mg/L | No |
| 6020 | Iron (II), Dissolved | 7439-89-6-D | 0.02 | mg/L | No |
| 6020 | Iron, Dissolved | 7439-89-6-D | 0.2 | mg/L | No |
| 6020 | Iron,Total | 7439-89-6 | 0.2 | mg/L | No |
| 6020 | Lead, Dissolved | 7439-92-1-D | 0.001 | mg/L | No |
| 6020 | Lead, Total | 7439-92-1 | 0.001 | mg/L | Yes |
| 6020 | Lithium, Dissolved | 7439-93-2-D | 0.05 | mg/L | No |
| 6020 | Lithium, Total | 7439-93-2 | 0.05 | mg/L | No |
| 6020 | Magnesium, Dissolved | 7439-95-4-D | 0.1 | mg/L | No |
| 6020 | Magnesium, Total | 7439-95-4 | 0.1 | mg/L | No |
| 6020 | Manganese, Dissolved | 7439-96-5-D | 0.005 | mg/L | No |
| 6020 | Manganese, Total | 7439-96-5 | 0.005 | mg/L | No |
| 6020 | Molybdenum, Dissolved | 7439-98-7-D | 0.01 | mg/L | No |
| 6020 | Molybdenum, Total | 7439-98-7 | 0.01 | mg/L | No |
| 6020 | Nickel, Dissolved | 7440-02-0-D | 0.002 | mg/L | No |
| 6020 | Nickel, Total | 7440-02-0 | 0.002 | mg/L | Yes |
| 6020 | Phosphorus, Dissolved | 7723-14-0-D | 0.05 | mg/L | No |
| 6020 | Phosphorus, Total | 7723-14-0 | 0.05 | mg/L | No |
| 6020 | Potassium, Dissolved | 7440-09-7-D | 0.5 | mg/L | No |
| 6020 | Potassium, Total | 7440-09-7 | 0.5 | mg/L | No |
| 6020 | Selenium, Dissolved | 7782-49-2-D | 0.002 | mg/L | No |
| 6020 | Selenium, Total | 7782-49-2 | 0.002 | mg/L | Yes |
| 6020 | Silver, Dissolved | 7440-22-4-D | 0.001 | mg/L | No |
| 6020 | Silver, Total | 7440-22-4 | 0.001 | mg/L | Yes |
| 6020 | Sodium, Dissolved | 7440-23-5-D | 1 | mg/L | No |
| 6020 | Sodium, Total | 7440-23-5 | 1 | mg/L | No |
| 6020 | Strontium, Dissolved | 7440-24-6-D | 0.02 | mg/L | No |
| 6020 | Strontium, Total | 7440-24-6 | 0.02 | mg/L | No |
| 6020 | Thallium, Dissolved | 7440-28-0-D | 0.001 | mg/L | No |
| 6020 | Thallium, Total | 7440-28-0 | 0.001 | mg/L | Yes |
| 6020 | Tin, Total | 7440-31-5 | 0.003 | mg/L | Yes |
| 6020 | Titanium, Dissolved | 7440-32-6-D | 0.005 | mg/L | No |
| 6020 | Titanium, Total | 7440-32-6 | 0.005 | mg/L | No |
| 6020 | Vanadium, Dissolved | 7440-62-2-D | 0.005 | mg/L | No |
| 6020 | Vanadium, Total | 7440-62-2 | 0.005 | mg/L | Yes |
| 6020 | Zinc, Dissolved | 7440-66-6-D | 0.02 | mg/L | No |
| 6020 | Zinc, Total | 7440-66-6 | 0.02 | mg/L | Yes |
| 6020 | Zirconium, Dissolved | 7440-67-7-D | 0.05 | mg/L | No |
| 6020 | Zirconium, Total | 7440-67-7 | 0.05 | mg/L | No |
| 6850 | Perchlorate | 14797-73-0 | 2 | ug/L | No |
| 6860 | Perchlorate | 14797-73-0 | 2 | ug/L | No |
| 7196A | Hexavalent Chromium, Dissolved | 18540-29-9-D | 0.01 | mg/L | No |
| 7196A | Hexavalent Chromium, Total | 18540-29-9 | 0.01 | mg/L | No |
| 7199 | Hexavalent Chromium, Dissolved | 18540-29-9-D | 0.01 | mg/L | No |

| Method | Analyte | CAS Number | Reporting Limit | Reporting Limit Units | Appendix IX Constituent |
|---|---|---|---|---|---|
| 7199 | Hexavalent Chromium, Total | 18540-29-9 | 0.01 | mg/L | No |
| 7470A | Mercury, Dissolved | 7439-97-6-D | 0.0001 | mg/L | No |
| 7470A | Mercury, Total | 7439-97-6 | 0.0001 | mg/L | Yes |
| 8015 | Diesel Range Organics (C12-C14) | EFHD (C12-C14) | 0.47 | mg/L | No |
| 8015 | Diesel Range Organics (C15-C20) | EFHD (C15-C20) | 0.47 | mg/L | No |
| 8015 | Diesel Range Organics (C21-C30) | EFHD (C21-C30) | 0.47 | mg/L | No |
| 8015 | Diesel Range Organics (C8-C11) | EFHD (C8-C11) | 0.47 | mg/L | No |
| 8015 | Diesel Range Organics (C8-C30) | EFHD (C8-C30) | 0.47 | mg/L | No |
| 8015 | Gasoline Range Organics (C4-C12) | GRO C4-C12 | 50 | ug/L | No |
| 8015 | Gasoline Range Organics (C6-C12) | GRO C6-C12 | 50 | ug/L | No |
| 8015B | Diesel Range Organics (C12-C14) | EFHD (C12-C14) | 0.47 | mg/L | No |
| 8015B | Diesel Range Organics (C15-C20) | EFHD (C15-C20) | 0.47 | mg/L | No |
| 8015B | Diesel Range Organics (C21-C30) | EFHD (C21-C30) | 0.47 | mg/L | No |
| 8015B | Diesel Range Organics (C8-C11) | EFHD (C8-C11) | 0.47 | mg/L | No |
| 8015B | Diesel Range Organics (C8-C30) | EFHD (C8-C30) | 0.47 | mg/L | No |
| 8015B | Gasoline Range Organics (C4-C12) | GRO C4-C12 | 50 | ug/L | No |
| 8015B | Gasoline Range Organics (C6-C12) | GRO C6-C12 | 50 | ug/L | No |
| 8015B | Kerosene Fuel (RP-1, JP-1, JP-4; C9-C17) | PHCKC9C17 | 0.5 | mg/L | No |
| 8015B | m-Terphenyl | 92-06-8 | 0.005 | mg/L | No |
| 8015B | o-Terphenyl | 84-15-1 | 0.005 | mg/L | No |
| 8015B | p-Terphenyl | 92-94-4 | 0.005 | mg/L | No |
| 8015C | Diesel Range Organics (C12-C14) | EFHD (C12-C14) | 0.47 | mg/L | No |
| 8015C | Diesel Range Organics (C15-C20) | EFHD (C15-C20) | 0.47 | mg/L | No |
| 8015C | Diesel Range Organics (C21-C30) | EFHD (C21-C30) | 0.47 | mg/L | No |
| 8015C | Diesel Range Organics (C8-C11) | EFHD (C8-C11) | 0.47 | mg/L | No |
| 8015C | Diesel Range Organics (C8-C30) | EFHD (C8-C30) | 0.47 | mg/L | No |
| 8081 | 4,4'-DDD | 72-54-8 | 0.095 | ug/L | Yes |
| 8081 | 4,4'-DDE | 72-55-9 | 0.095 | ug/L | Yes |
| 8081 | 4,4'-DDT | 50-29-3 | 0.095 | ug/L | Yes |
| 8081 | Aldrin | 309-00-2 | 0.05 | ug/L | Yes |
| 8081 | alpha-BHC | 319-84-6 | 0.05 | ug/L | Yes |
| 8081 | beta-BHC | 319-85-7 | 0.05 | ug/L | Yes |
| 8081 | Chlordane | 57-74-9 | 0.5 | ug/L | Yes |
| 8081 | Chlorobenzilate | 510-15-6 | 10 | ug/L | Yes |
| 8081 | delta-BHC | 319-86-8 | 0.19 | ug/L | Yes |
| 8081 | Diallate | 2303-16-4 | 10 | ug/L | Yes |
| 8081 | Dieldrin | 60-57-1 | 0.05 | ug/L | Yes |
| 8081 | Endosulfan I | 959-98-8 | 0.095 | ug/L | Yes |
| 8081 | Endosulfan II | 33213-65-9 | 0.095 | ug/L | Yes |
| 8081 | Endosulfan sulfate | 1031-07-8 | 0.19 | ug/L | Yes |
| 8081 | Endrin | 72-20-8 | 0.095 | ug/L | Yes |
| 8081 | Endrin aldehyde | 7421-93-4 | 0.23 | ug/L | Yes |
| 8081 | Endrin ketone | 53494-70-5 | 0.1 | ug/L | No |
| 8081 | gamma-BHC (Lindane) | 58-89-9 | 0.095 | ug/L | Yes |
| 8081 | Heptachlor | 76-44-8 | 0.05 | ug/L | Yes |
| 8081 | Heptachlor epoxide | 1024-57-3 | 0.05 | ug/L | Yes |
| 8081 | Kepone | 143-50-0 | 50 | ug/L | Yes |
| 8081 | Methoxychlor | 72-43-5 | 0.1 | ug/L | Yes |

| Method | Analyte | CAS Number | Reporting Limit | Reporting Limit Units | Appendix IX Constituent |
|---|---|---|---|---|---|
| 8081 | Mirex (Dechlorane) | 2385-85-5 | 0.2 | ug/L | No |
| 8081 | Toxaphene | 8001-35-2 | 4.8 | ug/L | Yes |
| 8081A | 4,4'-DDD | 72-54-8 | 0.095 | ug/L | Yes |
| 8081A | 4,4'-DDE | 72-55-9 | 0.095 | ug/L | Yes |
| 8081A | 4,4'-DDT | 50-29-3 | 0.095 | ug/L | Yes |
| 8081A | Aldrin | 309-00-2 | 0.05 | ug/L | Yes |
| 8081A | alpha-BHC | 319-84-6 | 0.05 | ug/L | Yes |
| 8081A | beta-BHC | 319-85-7 | 0.05 | ug/L | Yes |
| 8081A | Chlordane | 57-74-9 | 0.5 | ug/L | Yes |
| 8081A | Chlorobenzilate | 510-15-6 | 10 | ug/L | Yes |
| 8081A | delta-BHC | 319-86-8 | 0.19 | ug/L | Yes |
| 8081A | Diallate | 2303-16-4 | 10 | ug/L | Yes |
| 8081A | Dieldrin | 60-57-1 | 0.05 | ug/L | Yes |
| 8081A | Endosulfan I | 959-98-8 | 0.095 | ug/L | Yes |
| 8081A | Endosulfan II | 33213-65-9 | 0.095 | ug/L | Yes |
| 8081A | Endosulfan sulfate | 1031-07-8 | 0.19 | ug/L | Yes |
| 8081A | Endrin | 72-20-8 | 0.095 | ug/L | Yes |
| 8081A | Endrin aldehyde | 7421-93-4 | 0.23 | ug/L | Yes |
| 8081A | Endrin ketone | 53494-70-5 | 0.1 | ug/L | No |
| 8081A | gamma-BHC (Lindane) | 58-89-9 | 0.095 | ug/L | Yes |
| 8081A | Heptachlor | 76-44-8 | 0.05 | ug/L | Yes |
| 8081A | Heptachlor epoxide | 1024-57-3 | 0.05 | ug/L | Yes |
| 8081A | Kepone | 143-50-0 | 50 | ug/L | Yes |
| 8081A | Methoxychlor | 72-43-5 | 0.1 | ug/L | Yes |
| 8081A | Mirex (Dechlorane) | 2385-85-5 | 0.2 | ug/L | No |
| 8081A | Toxaphene | 8001-35-2 | 4.8 | ug/L | Yes |
| 8082 | Aroclor 1016 | 12674-11-2 | 1 | ug/L | Yes |
| 8082 | Aroclor 1221 | 11104-28-2 | 1 | ug/L | Yes |
| 8082 | Aroclor 1232 | 11141-16-5 | 1 | ug/L | Yes |
| 8082 | Aroclor 1242 | 53469-21-9 | 1 | ug/L | Yes |
| 8082 | Aroclor 1248 | 12672-29-6 | 1 | ug/L | Yes |
| 8082 | Aroclor 1254 | 11097-69-1 | 1 | ug/L | Yes |
| 8082 | Aroclor 1260 | 11096-82-5 | 1 | ug/L | Yes |
| 8082 | Aroclor 1262 | 37324-23-5 | 0.5 | ug/L | No |
| 8082 | Aroclor 1268 | 11100-14-4 | 0.5 | ug/L | No |
| 8082 | Aroclor 5432 | 61788-33-8 | 0.5 | ug/L | No |
| 8082 | Aroclor 5442 | 12642-23-8 | 0.5 | ug/L | No |
| 8082 | Aroclor 5460 | 11126-42-4 | 0.5 | ug/L | No |
| 8082 | PCB 101 | 37680-73-2 | 0.01 | ug/L | No |
| 8082 | PCB 105 | 32598-14-4 | 0.01 | ug/L | No |
| 8082 | PCB 110 | 38380-03-9 | 0.01 | ug/L | No |
| 8082 | PCB 114 | 74472-37-0 | 0.01 | ug/L | No |
| 8082 | PCB 118 | 31508-00-6 | 0.01 | ug/L | No |
| 8082 | PCB 119 | 56558-17-9 | 0.01 | ug/L | No |
| 8082 | PCB 123 | 65510-44-3 | 0.01 | ug/L | No |
| 8082 | PCB 126 | 57465-28-8 | 0.01 | ug/L | No |
| 8082 | PCB 128 | 38380-07-3 | 0.01 | ug/L | No |
| 8082 | PCB 132 | 38380-05-1 | 0.01 | ug/L | No |

| Method | Analyte | CAS Number | Reporting Limit | Reporting Limit Units | Appendix IX Constituent |
|---|---|---|---|---|---|
| 8082 | PCB 138 | 35065-28-2 | 0.01 | ug/L | No |
| 8082 | PCB 149 | 38380-04-0 | 0.01 | ug/L | No |
| 8082 | PCB 151 | 52663-63-5 | 0.01 | ug/L | No |
| 8082 | PCB 153 | 35065-27-1 | 0.01 | ug/L | No |
| 8082 | PCB 156 | 38380-08-4 | 0.01 | ug/L | No |
| 8082 | PCB 157 | 69782-90-7 | 0.01 | ug/L | No |
| 8082 | PCB 158 | 74472-42-7 | 0.01 | ug/L | No |
| 8082 | PCB 167 | 52663-72-6 | 0.01 | ug/L | No |
| 8082 | PCB 168 | 59291-65-5 | 0.01 | ug/L | No |
| 8082 | PCB 169 | 32774-16-6 | 0.01 | ug/L | No |
| 8082 | PCB 170 | 35065-30-6 | 0.01 | ug/L | No |
| 8082 | PCB 177 | 52663-70-4 | 0.01 | ug/L | No |
| 8082 | PCB 18 | 37680-65-2 | 0.01 | ug/L | No |
| 8082 | PCB 180 | 35065-29-3 | 0.01 | ug/L | No |
| 8082 | PCB 183 | 52663-69-1 | 0.01 | ug/L | No |
| 8082 | PCB 187 | 52663-68-0 | 0.01 | ug/L | No |
| 8082 | PCB 189 | 39635-31-9 | 0.01 | ug/L | No |
| 8082 | PCB 194 | 35694-08-7 | 0.01 | ug/L | No |
| 8082 | PCB 201 | 40186-71-8 | 0.01 | ug/L | No |
| 8082 | PCB 206 | 40186-72-9 | 0.01 | ug/L | No |
| 8082 | PCB 28 | 7012-37-5 | 0.01 | ug/L | No |
| 8082 | PCB 37 | 38444-90-5 | 0.01 | ug/L | No |
| 8082 | PCB 44 | 41464-39-5 | 0.01 | ug/L | No |
| 8082 | PCB 49 | 41464-40-8 | 0.01 | ug/L | No |
| 8082 | PCB 52 | 35693-99-3 | 0.01 | ug/L | No |
| 8082 | PCB 66 | 32598-10-0 | 0.01 | ug/L | No |
| 8082 | PCB 70 | 32598-11-1 | 0.01 | ug/L | No |
| 8082 | PCB 74 | 32690-93-0 | 0.01 | ug/L | No |
| 8082 | PCB 77 | 32598-13-3 | 0.01 | ug/L | No |
| 8082 | PCB 81 | 70362-50-4 | 0.01 | ug/L | No |
| 8082 | PCB 87 | 38380-02-8 | 0.01 | ug/L | No |
| 8082 | PCB 99 | 38380-01-7 | 0.01 | ug/L | No |
| 8141A | Dimethoate | 60-51-5 | 0.95 | ug/L | Yes |
| 8141A | Disulfoton | 298-04-4 | 1 | ug/L | Yes |
| 8141A | Famphur | 52-85-7 | 10 | ug/L | Yes |
| 8141A | Parathion-ethyl | 56-38-2 | 1 | ug/L | Yes |
| 8141A | Parathion-methyl | 298-00-0 | 0.47 | ug/L | Yes |
| 8141A | Phorate | 298-02-2 | 1.2 | ug/L | Yes |
| 8141A | Sulfotepp | 3689-24-5 | 1.5 | ug/L | Yes |
| 8141A | Thionazin | 297-97-2 | 0.47 | ug/L | Yes |
| 8151A | 2,4,5-T | 93-76-5 | 1 | ug/L | Yes |
| 8151A | 2,4,5-TP (Silvex) | 93-72-1 | 1 | ug/L | Yes |
| 8151A | 2,4-D | 94-75-7 | 1 | ug/L | Yes |
| 8151A | 2,4-DB | 94-82-6 | 4 | ug/L | No |
| 8151A | Dalapon | 75-99-0 | 2 | ug/L | No |
| 8151A | Dicamba | 18-00-9 | 2 | ug/L | No |
| 8151A | Dichloroprop | 120-36-5 | 4 | ug/L | No |
| 8151A | Dinoseb | 88-85-7 | 1 | ug/L | Yes |

| Method | Analyte | CAS Number | Reporting Limit | Reporting Limit Units | Appendix IX Constituent |
|---|---|---|---|---|---|
| 8151A | Hexachlorophene | 70-30-4 | 50 | ug/L | Yes |
| 8151A | MCPA | 94-74-6 | 500 | ug/L | No |
| 8151A | MCPP | 93-65-2 | 500 | ug/L | No |
| 8151A | Pentachlorophenol (PCP) | 87-86-5 | 1 | ug/L | Yes |
| 8260B | 1,1,1,2-Tetrachloroethane | 630-20-6 | 5 | ug/L | Yes |
| 8260B | 1,1,1-Trichloroethane | 71-55-6 | 1 | ug/L | Yes |
| 8260B | 1,1,2,2-Tetrachloroethane | 79-34-5 | 1 | ug/L | Yes |
| 8260B | 1,1,2-Trichloro-1,2,2-trifluoroethane | 76-13-1 | 5 | ug/L | No |
| 8260B | 1,1,2-Trichloroethane | 79-00-5 | 1 | ug/L | Yes |
| 8260B | 1,1-Dichloroethane | 75-34-3 | 1 | ug/L | Yes |
| 8260B | 1,1-Dichloroethene | 75-35-4 | 1 | ug/L | Yes |
| 8260B | 1,1-Dichloropropene | 563-58-6 | 2 | ug/L | No |
| 8260B | 1,2,3-Trichlorobenzene | 87-61-6 | 5 | ug/L | No |
| 8260B | 1,2,3-Trichloropropane (TCP) | 96-18-4 | 0.005 | ug/L | Yes |
| 8260B | 1,2,4-Trichlorobenzene | 120-82-1 | 5 | ug/L | Yes |
| 8260B | 1,2,4-Trimethylbenzene | 95-63-6 | 2 | ug/L | No |
| 8260B | 1,2-Dibromo-3-chloropropane (DBCP) | 96-12-8 | 0.02 | ug/L | Yes |
| 8260B | 1,2-Dibromoethane (EDB) | 106-93-4 | 0.02 | ug/L | Yes |
| 8260B | 1,2-Dichlorobenzene | 95-50-1 | 1 | ug/L | Yes |
| 8260B | 1,2-Dichloroethane | 107-06-2 | 0.5 | ug/L | Yes |
| 8260B | 1,2-Dichloropropane | 78-87-5 | 1 | ug/L | Yes |
| 8260B | 1,3,5-Trimethylbenzene | 108-67-8 | 2 | ug/L | No |
| 8260B | 1,3-Dichlorobenzene | 541-73-1 | 1 | ug/L | Yes |
| 8260B | 1,3-Dichloropropane | 142-28-9 | 2 | ug/L | No |
| 8260B | 1,4-Dichlorobenzene | 106-46-7 | 1 | ug/L | Yes |
| 8260B | 1,4-Dioxane | 123-91-1 | 3 | ug/L | Yes |
| 8260B | 2,2-Dichloropropane | 594-20-7 | 1 | ug/L | No |
| 8260B | 2-Chloro-1,1,1-trifluoroethane | 75-88-7 | 5 | ug/L | No |
| 8260B | 2-Chloroethyl vinyl ether | 110-75-8 | 5 | ug/L | No |
| 8260B | 2-Chlorotoluene | 95-49-8 | 5 | ug/L | No |
| 8260B | 2-Hexanone | 591-78-6 | 10 | ug/L | Yes |
| 8260B | 4-Chlorotoluene | 106-43-4 | 5 | ug/L | No |
| 8260B | Acetone | 67-64-1 | 10 | ug/L | Yes |
| 8260B | Acetonitrile | 75-05-8 | 30 | ug/L | Yes |
| 8260B | Acrolein | 107-02-8 | 20 | ug/L | Yes |
| 8260B | Acrylonitrile | 107-13-1 | 20 | ug/L | Yes |
| 8260B | Allyl chloride | 107-05-1 | 2 | ug/L | Yes |
| 8260B | Benzene | 71-43-2 | 0.5 | ug/L | Yes |
| 8260B | Bromobenzene | 108-86-1 | 5 | ug/L | No |
| 8260B | Bromochloromethane | 74-97-5 | 5 | ug/L | No |
| 8260B | Bromodichloromethane | 75-27-4 | 1 | ug/L | Yes |
| 8260B | Bromoform | 75-25-2 | 1 | ug/L | Yes |
| 8260B | Bromomethane | 74-83-9 | 1 | ug/L | Yes |
| 8260B | Carbon Disulfide | 75-15-0 | 5 | ug/L | Yes |
| 8260B | Carbon Tetrachloride | 56-23-5 | 0.5 | ug/L | Yes |
| 8260B | Chlorobenzene | 108-90-7 | 1 | ug/L | Yes |
| 8260B | Chloroethane | 75-00-3 | 1 | ug/L | Yes |
| 8260B | Chloroform | 67-66-3 | 1 | ug/L | Yes |

See last page of table for notes and abbreviations.

| Method | Analyte | CAS Number | Reporting Limit | Reporting Limit Units | Appendix IX Constituent |
|---|---|---|---|---|---|
| 8260B | Chloromethane | 74-87-3 | 1 | ug/L | Yes |
| 8260B | Chloroprene | 126-99-8 | 1 | ug/L | Yes |
| 8260B | Chlorotrifluoroethylene | 79-38-9 | 5 | ug/L | No |
| 8260B | cis-1,2-Dichloroethene | 156-59-2 | 1 | ug/L | Yes |
| 8260B | cis-1,3-Dichloropropene | 10061-01-5 | 0.5 | ug/L | Yes |
| 8260B | Dibromochloromethane | 124-48-1 | 1 | ug/L | Yes |
| 8260B | Dibromomethane | 74-95-3 | 2 | ug/L | Yes |
| 8260B | Dichlorodifluoromethane | 75-71-8 | 5 | ug/L | Yes |
| 8260B | Ethyl methacrylate | 97-63-2 | 3 | ug/L | Yes |
| 8260B | Ethylbenzene | 100-41-4 | 1 | ug/L | Yes |
| 8260B | Hexachlorobutadiene | 87-68-3 | 5 | ug/L | Yes |
| 8260B | Iodomethane | 74-88-4 | 2 | ug/L | Yes |
| 8260B | Isobutanol | 78-83-1 | 110 | ug/L | Yes |
| 8260B | Isopropanol (isopropyl alcohol, 2-propanol) | 67-63-0 | 100 | ug/L | No |
| 8260B | Isopropylbenzene | 98-82-8 | 2 | ug/L | No |
| 8260B | Methacrylonitrile | 126-98-7 | 10 | ug/L | Yes |
| 8260B | Methyl ethyl ketone | 78-93-3 | 10 | ug/L | Yes |
| 8260B | Methyl isobutyl ketone (MIBK) | 108-10-1 | 10 | ug/L | Yes |
| 8260B | Methyl methacrylate | 80-62-6 | 4 | ug/L | Yes |
| 8260B | Methylene chloride | 75-09-2 | 5 | ug/L | Yes |
| 8260B | Methyl-tert-butyl-Ether (MTBE) | 1634-04-4 | 5 | ug/L | No |
| 8260B | m-Xylene & p-Xylene | 136777-61-2 | 1 | ug/L | Yes |
| 8260B | n-Butylbenzene | 104-51-8 | 5 | ug/L | No |
| 8260B | Nitrobenzene | 98-95-3 | 5 | ug/L | Yes |
| 8260B | n-Propylbenzene | 103-65-1 | 2 | ug/L | No |
| 8260B | o-Xylene | 95-47-6 | 1 | ug/L | Yes |
| 8260B | Pentachloroethane | 76-01-7 | 10 | ug/L | Yes |
| 8260B | p-Isopropyltoluene | 99-87-6 | 2 | ug/L | No |
| 8260B | Propionitrile | 107-12-0 | 20 | ug/L | Yes |
| 8260B | Sec-Butylbenzene | 135-98-8 | 5 | ug/L | No |
| 8260B | Styrene | 100-42-5 | 2 | ug/L | Yes |
| 8260B | Tert-Butylbenzene | 98-06-6 | 5 | ug/L | No |
| 8260B | Tetrachloroethene | 127-18-4 | 1 | ug/L | Yes |
| 8260B | Toluene | 108-88-3 | 1 | ug/L | Yes |
| 8260B | trans-1,2-Dichloroethene | 156-60-5 | 1 | ug/L | Yes |
| 8260B | trans-1,3-Dichloropropene | 10061-02-6 | 0.5 | ug/L | Yes |
| 8260B | trans-1,4-Dichloro-2-butene | 110-57-6 | 10 | ug/L | Yes |
| 8260B | Trichloroethene | 79-01-6 | 1 | ug/L | Yes |
| 8260B | Trichlorofluoromethane (Freon 11) | 75-69-4 | 1 | ug/L | Yes |
| 8260B | Vinyl acetate | 108-05-4 | 5 | ug/L | Yes |
| 8260B | Vinyl chloride | 75-01-4 | 0.5 | ug/L | Yes |
| 8260B SIM | 1,4-Dioxane | 123-91-1 | 3 | ug/L | Yes |
| 8260MSIM | 1,4-Dioxane | 123-91-1 | 3 | ug/L | Yes |
| 8260SIM | 1,2,3-Trichloropropane (TCP) | 96-18-4 | 0.005 | ug/L | Yes |
| 8260SIM | 1,4-Dioxane | 123-91-1 | 3 | ug/L | Yes |
| 8270C | 1,2,4,5-Tetrachlorobenzene | 95-94-3 | 10 | ug/L | Yes |
| 8270C | 1,2,4-Trichlorobenzene | 120-82-1 | 5 | ug/L | Yes |
| 8270C | 1,2-Dichlorobenzene | 95-50-1 | 10 | ug/L | Yes |

| Method | Analyte | CAS Number | Reporting Limit | Reporting Limit Units | Appendix IX Constituent |
|---|---|---|---|---|---|
| 8270C | 1,2-Diphenylhydrazine | 122-66-7 | 5 | ug/L | No |
| 8270C | 1,3,5-Trinitrobenzene | 99-35-4 | 50 | ug/L | Yes |
| 8270C | 1,3-Dichlorobenzene | 541-73-1 | 4 | ug/L | Yes |
| 8270C | 1,3-Dinitrobenzene | 99-65-0 | 10 | ug/L | Yes |
| 8270C | 1,4-Dichlorobenzene | 106-46-7 | 10 | ug/L | Yes |
| 8270C | 1,4-Naphthoquinone | 130-15-4 | 50 | ug/L | Yes |
| 8270C | 1,4-Phenylenediamine | 106-50-3 | 100 | ug/L | Yes |
| 8270C | 1-Methylnaphthalene | 90-12-0 | 10 | ug/L | No |
| 8270C | 1-Naphthylamine | 134-32-7 | 10 | ug/L | Yes |
| 8270C | 2,3,4,6-Tetrachlorophenol | 58-90-2 | 50 | ug/L | Yes |
| 8270C | 2,4,5-Trichlorophenol | 95-95-4 | 10 | ug/L | Yes |
| 8270C | 2,4,6-Trichlorophenol | 88-06-2 | 10 | ug/L | Yes |
| 8270C | 2,4-Dichlorophenol | 120-83-2 | 5 | ug/L | Yes |
| 8270C | 2,4-Dimethylphenol | 105-67-9 | 10 | ug/L | Yes |
| 8270C | 2,4-Dinitrophenol | 51-28-5 | 60 | ug/L | Yes |
| 8270C | 2,4-Dinitrotoluene | 121-14-2 | 5 | ug/L | Yes |
| 8270C | 2,6-Dichlorophenol | 87-65-0 | 10 | ug/L | Yes |
| 8270C | 2,6-Dinitrotoluene | 606-20-2 | 5 | ug/L | Yes |
| 8270C | 2-Acetylaminofluorene | 53-96-3 | 100 | ug/L | Yes |
| 8270C | 2-Chloronaphthalene | 91-58-7 | 5 | ug/L | Yes |
| 8270C | 2-Chlorophenol | 95-57-8 | 5 | ug/L | Yes |
| 8270C | 2-Methylnaphthalene | 91-57-6 | 5 | ug/L | Yes |
| 8270C | 2-Methylphenol | 95-48-7 | 10 | ug/L | Yes |
| 8270C | 2-Naphthylamine | 91-59-8 | 10 | ug/L | Yes |
| 8270C | 2-Nitroaniline | 88-74-4 | 10 | ug/L | Yes |
| 8270C | 2-Nitrophenol | 88-75-5 | 9.6 | ug/L | Yes |
| 8270C | 2-Picoline | 109-06-8 | 20 | ug/L | Yes |
| 8270C | 3,3´-Dichlorobenzidine | 91-94-1 | 5 | ug/L | Yes |
| 8270C | 3,3´-Dimethylbenzidine | 119-93-7 | 20 | ug/L | Yes |
| 8270C | 3,5-Dimethylphenol | 108-68-9 | 20 | ug/L | No |
| 8270C | 3-Methylcholanthrene | 56-49-5 | 20 | ug/L | Yes |
| 8270C | 3-Methylphenol | 108-39-4 | 5 | ug/L | Yes |
| 8270C | 3-Nitroaniline | 99-09-2 | 10 | ug/L | Yes |
| 8270C | 4,6-Dinitro-2-Methylphenol | 534-52-1 | 14 | ug/L | Yes |
| 8270C | 4-Aminobiphenyl | 92-67-1 | 50 | ug/L | Yes |
| 8270C | 4-Bromophenyl phenyl ether | 101-55-3 | 5 | ug/L | Yes |
| 8270C | 4-Chloro-3-methylphenol | 59-50-7 | 10 | ug/L | Yes |
| 8270C | 4-Chloroaniline | 106-47-8 | 10 | ug/L | Yes |
| 8270C | 4-Chlorophenyl phenyl ether | 7005-72-3 | 5 | ug/L | Yes |
| 8270C | 4-Methylphenol | 106-44-5 | 10 | ug/L | Yes |
| 8270C | 4-Nitroaniline | 100-01-6 | 10 | ug/L | Yes |
| 8270C | 4-Nitrophenol | 100-02-7 | 30 | ug/L | Yes |
| 8270C | 4-Nitroquinoline-1-oxide | 56-57-5 | 100 | ug/L | Yes |
| 8270C | 5-Nitro-o-toluidine | 99-55-8 | 20 | ug/L | Yes |
| 8270C | 7,12-Dimethylbenz (a) anthracene | 57-97-6 | 20 | ug/L | Yes |
| 8270C | a,a-Dimethylphenethylamine | 122-09-8 | 50 | ug/L | Yes |
| 8270C | Acenaphthene | 83-32-9 | 5 | ug/L | Yes |
| 8270C | Acenaphthylene | 208-96-8 | 5 | ug/L | Yes |

See last page of table for notes and abbreviations.

| Method | Analyte | CAS Number | Reporting Limit | Reporting Limit Units | Appendix IX Constituent |
|---|---|---|---|---|---|
| 8270C | Acetophenone | 98-86-2 | 10 | ug/L | Yes |
| 8270C | Aniline | 62-53-3 | 10 | ug/L | Yes |
| 8270C | Anthracene | 120-12-7 | 5 | ug/L | Yes |
| 8270C | Aramite | 140-57-8 | 40 | ug/L | Yes |
| 8270C | Benzidine | 92-87-5 | 60 | ug/L | No |
| 8270C | Benzo(a)anthracene | 56-55-3 | 5 | ug/L | Yes |
| 8270C | Benzo(a)pyrene | 50-32-8 | 5 | ug/L | Yes |
| 8270C | Benzo(b)fluoranthene | 205-99-2 | 5 | ug/L | Yes |
| 8270C | Benzo(b+k)fluoranthene(total) | STOTFE | 10 | ug/L | Yes |
| 8270C | Benzo(g,h,i)perylene | 191-24-2 | 5 | ug/L | Yes |
| 8270C | Benzo(k)fluoranthene | 207-08-9 | 5 | ug/L | Yes |
| 8270C | Benzoic acid | 65-85-0 | 20 | ug/L | No |
| 8270C | Benzyl alcohol | 100-51-6 | 10 | ug/L | Yes |
| 8270C | Bis(2-chloroethoxy)methane | 111-91-1 | 5 | ug/L | Yes |
| 8270C | Bis(2-chloroethyl)ether | 111-44-4 | 5 | ug/L | Yes |
| 8270C | Bis(2-chloroisopropyl)ether | 108-60-1 | 5 | ug/L | Yes |
| 8270C | Bis(2-ethylhexyl)phthalate | 117-81-7 | 5 | ug/L | Yes |
| 8270C | Butyl benzyl phthalate | 85-68-7 | 5 | ug/L | Yes |
| 8270C | Carbazole | 86-74-8 | 20 | ug/L | No |
| 8270C | Chlorobenzilate | 510-15-6 | 10 | ug/L | Yes |
| 8270C | Chrysene | 218-01-9 | 5 | ug/L | Yes |
| 8270C | Diallate | 2303-16-4 | 10 | ug/L | Yes |
| 8270C | Dibenz(a,h)anthracene | 53-70-3 | 5 | ug/L | Yes |
| 8270C | Dibenzofuran | 132-64-9 | 5 | ug/L | Yes |
| 8270C | Diethyl phthalate | 84-66-2 | 5 | ug/L | Yes |
| 8270C | Dimethoate | 60-51-5 | 0.95 | ug/L | Yes |
| 8270C | Dimethyl phthalate | 131-11-3 | 5 | ug/L | Yes |
| 8270C | Dimethylaminoazobenzene | 60-11-7 | 20 | ug/L | Yes |
| 8270C | Di-n-butyl phthalate | 84-74-2 | 5 | ug/L | Yes |
| 8270C | Di-n-octyl phthalate | 117-84-0 | 5 | ug/L | Yes |
| 8270C | Diphenylamine | 122-39-4 | 10 | ug/L | Yes |
| 8270C | Disulfoton | 298-04-4 | 1 | ug/L | Yes |
| 8270C | Ethyl methanesulfonate | 62-50-0 | 10 | ug/L | Yes |
| 8270C | Famphur | 52-85-7 | 10 | ug/L | Yes |
| 8270C | Fluoranthene | 206-44-0 | 5 | ug/L | Yes |
| 8270C | Fluorene | 86-73-7 | 5 | ug/L | Yes |
| 8270C | Hexachlorobenzene | 118-74-1 | 5 | ug/L | Yes |
| 8270C | Hexachlorobutadiene | 87-68-3 | 5 | ug/L | Yes |
| 8270C | Hexachlorocyclopentadiene | 77-47-4 | 50 | ug/L | Yes |
| 8270C | Hexachloroethane | 67-72-1 | 5 | ug/L | Yes |
| 8270C | Hexachlorophene | 70-30-4 | 50 | ug/L | Yes |
| 8270C | Hexachloropropene | 1888-71-7 | 100 | ug/L | Yes |
| 8270C | Indeno(1,2,3-cd)pyrene | 193-39-5 | 5 | ug/L | Yes |
| 8270C | Isodrin | 465-73-6 | 10 | ug/L | Yes |
| 8270C | Isophorone | 78-59-1 | 5 | ug/L | Yes |
| 8270C | Isosafrole | 120-58-1 | 20 | ug/L | Yes |
| 8270C | Kepone | 143-50-0 | 50 | ug/L | Yes |
| 8270C | Methapyrilene | 91-80-5 | 50 | ug/L | Yes |

See last page of table for notes and abbreviations.

| Method | Analyte | CAS Number | Reporting Limit | Reporting Limit Units | Appendix IX Constituent |
|---|---|---|---|---|---|
| 8270C | Methyl methanesulfonate | 66-27-3 | 10 | ug/L | Yes |
| 8270C | Naphthalene | 91-20-3 | 5 | ug/L | Yes |
| 8270C | Nitrobenzene | 98-95-3 | 5 | ug/L | Yes |
| 8270C | n-Nitrosodiethylamine (NDEA) | 55-18-5 | 10 | ug/L | Yes |
| 8270C | n-Nitrosodimethylamine (NDMA) | 62-75-9 | 20 | ug/L | Yes |
| 8270C | n-Nitrosodi-n-butylamine | 924-16-3 | 10 | ug/L | Yes |
| 8270C | n-Nitrosodi-n-propylamine (NDPA) | 621-64-7 | 5 | ug/L | Yes |
| 8270C | n-Nitrosodiphenylamine | 86-30-6 | 5 | ug/L | Yes |
| 8270C | n-Nitrosomethylethylamine | 10595-95-6 | 10 | ug/L | Yes |
| 8270C | n-Nitrosomorpholine | 59-89-2 | 10 | ug/L | Yes |
| 8270C | n-Nitrosopiperidine | 100-75-4 | 10 | ug/L | Yes |
| 8270C | n-Nitrosopyrrolidine | 930-55-2 | 10 | ug/L | Yes |
| 8270C | O,O,O-Triethyl phosphorothioate | 126-68-1 | 50 | ug/L | Yes |
| 8270C | o-Toluidine | 95-53-4 | 10 | ug/L | Yes |
| 8270C | Parathion-ethyl | 56-38-2 | 1 | ug/L | Yes |
| 8270C | Parathion-methyl | 298-00-0 | 0.47 | ug/L | Yes |
| 8270C | Pentachlorobenzene | 608-93-5 | 10 | ug/L | Yes |
| 8270C | Pentachloroethane | 76-01-7 | 10 | ug/L | Yes |
| 8270C | Pentachloronitrobenzene | 82-68-8 | 50 | ug/L | Yes |
| 8270C | Pentachlorophenol (PCP) | 87-86-5 | 15 | ug/L | Yes |
| 8270C | Phenacetin | 62-44-2 | 20 | ug/L | Yes |
| 8270C | Phenanthrene | 85-01-8 | 5 | ug/L | Yes |
| 8270C | Phenol | 108-95-2 | 5 | ug/L | Yes |
| 8270C | Phorate | 298-02-2 | 1.2 | ug/L | Yes |
| 8270C | Pronamide | 23950-58-5 | 20 | ug/L | Yes |
| 8270C | Pyrene | 129-00-0 | 10 | ug/L | Yes |
| 8270C | Pyridine | 110-86-1 | 20 | ug/L | Yes |
| 8270C | Safrole | 94-59-7 | 20 | ug/L | Yes |
| 8270C | Sulfotepp | 3689-24-5 | 1.5 | ug/L | Yes |
| 8270C | Thionazin | 297-97-2 | 0.47 | ug/L | Yes |
| 8270CSIM | 1-Methylnaphthalene | 90-12-0 | 10 | ug/L | No |
| 8270CSIM | 2-Methylnaphthalene | 91-57-6 | 10 | ug/L | Yes |
| 8270CSIM | Acenaphthene | 83-32-9 | 10 | ug/L | Yes |
| 8270CSIM | Acenaphthylene | 208-96-8 | 10 | ug/L | Yes |
| 8270CSIM | Anthracene | 120-12-7 | 10 | ug/L | Yes |
| 8270CSIM | Benzo(a)anthracene | 56-55-3 | 10 | ug/L | Yes |
| 8270CSIM | Benzo(a)pyrene | 50-32-8 | 10 | ug/L | Yes |
| 8270CSIM | Benzo(b)fluoranthene | 205-99-2 | 10 | ug/L | Yes |
| 8270CSIM | Benzo(g,h,i)perylene | 191-24-2 | 10 | ug/L | Yes |
| 8270CSIM | Benzo(k)fluoranthene | 207-08-9 | 10 | ug/L | Yes |
| 8270CSIM | Bis(2-ethylhexyl)phthalate | 117-81-7 | 10 | ug/L | Yes |
| 8270CSIM | Butyl benzyl phthalate | 85-68-7 | 10 | ug/L | Yes |
| 8270CSIM | Chrysene | 218-01-9 | 10 | ug/L | Yes |
| 8270CSIM | Dibenz(a,h)anthracene | 53-70-3 | 10 | ug/L | Yes |
| 8270CSIM | Diethyl phthalate | 84-66-2 | 10 | ug/L | Yes |
| 8270CSIM | Dimethyl phthalate | 131-11-3 | 10 | ug/L | Yes |
| 8270CSIM | Di-n-butyl phthalate | 84-74-2 | 10 | ug/L | Yes |
| 8270CSIM | Di-n-octyl phthalate | 117-84-0 | 10 | ug/L | Yes |

See last page of table for notes and abbreviations.

| Method | Analyte | CAS Number | Reporting Limit | Reporting Limit Units | Appendix IX Constituent |
|---|---|---|---|---|---|
| 8270CSIM | Fluoranthene | 206-44-0 | 10 | ug/L | Yes |
| 8270CSIM | Fluorene | 86-73-7 | 10 | ug/L | Yes |
| 8270CSIM | Indeno(1,2,3-cd)pyrene | 193-39-5 | 10 | ug/L | Yes |
| 8270CSIM | Naphthalene | 91-20-3 | 10 | ug/L | Yes |
| 8270CSIM | n-Nitrosodimethylamine (NDMA) | 62-75-9 | 10 | ug/L | Yes |
| 8270CSIM | Phenanthrene | 85-01-8 | 10 | ug/L | Yes |
| 8270CSIM | Pyrene | 129-00-0 | 10 | ug/L | Yes |
| 8270SIM | n-Nitrosodimethylamine (NDMA) | 62-75-9 | 20 | ug/L | Yes |
| 8270SIM | Pentachlorophenol (PCP) | 87-86-5 | 1 | ug/L | Yes |
| 8290 | 1,2,3,4,6,7,8-HpCDD | 35822-46-9 | 24.8 | pg/L | Yes |
| 8290 | 1,2,3,4,6,7,8-HpCDF | 67562-39-4 | 24.8 | pg/L | Yes |
| 8290 | 1,2,3,4,7,8,9-HpCDF | 55673-89-7 | 24.8 | pg/L | Yes |
| 8290 | 1,2,3,4,7,8-HxCDD | 39227-28-6 | 24.8 | pg/L | Yes |
| 8290 | 1,2,3,4,7,8-HxCDF | 70648-26-9 | 24.8 | pg/L | Yes |
| 8290 | 1,2,3,6,7,8-HxCDD | 57653-85-7 | 24.8 | pg/L | Yes |
| 8290 | 1,2,3,6,7,8-HxCDF | 57117-44-9 | 24.8 | pg/L | Yes |
| 8290 | 1,2,3,7,8,9-HxCDD | 19408-74-3 | 24.8 | pg/L | Yes |
| 8290 | 1,2,3,7,8,9-HxCDF | 72918-21-9 | 24.8 | pg/L | Yes |
| 8290 | 1,2,3,7,8-PeCDD | 40321-76-4 | 24.8 | pg/L | Yes |
| 8290 | 1,2,3,7,8-PeCDF | 57117-41-6 | 24.8 | pg/L | Yes |
| 8290 | 2,3,4,6,7,8-HxCDF | 60851-34-5 | 24.8 | pg/L | Yes |
| 8290 | 2,3,4,7,8-PeCDF | 57117-31-4 | 24.8 | pg/L | Yes |
| 8290 | 2,3,7,8-TCDD | 1746-01-6 | 4.97 | pg/L | Yes |
| 8290 | 2,3,7,8-TCDF | 51207-31-9 | 4.97 | pg/L | Yes |
| 8290 | OCDD | 3268-87-9 | 24.8 | pg/L | Yes |
| 8290 | OCDF | 39001-02-0 | 24.8 | pg/L | Yes |
| 8315 | Formaldehyde | 50-00-0 | 50 | ug/L | No |
| DV-WC-0077* | 1,1-Dimethylhydrazine (unsymmetrical dimethylhydrazine, UDMH) | 57-14-7 | 5 | ug/L | No |
| DV-WC-0077* | Hydrazine | 302-01-2 | 1 | ug/L | No |
| DV-WC-0077* | Monomethylhydrazine (MMH) | 50-00-0 | 50 | ug/L | No |
| 8315A | 1,1-Dimethylhydrazine (unsymmetrical dimethylhydrazine, UDMH) | 57-14-7 | 5 | ug/L | No |
| 8315A | Formaldehyde | 50-00-0 | 50 | ug/L | No |
| 8315A | Hydrazine | 302-01-2 | 1 | ug/L | No |
| 8315A | Monomethylhydrazine (MMH) | 60-34-4 | 5 | ug/L | No |
| 8315M | 1,1-Dimethylhydrazine (unsymmetrical dimethylhydrazine, UDMH) | 57-14-7 | 5 | ug/L | No |
| 8315M | Hydrazine | 302-01-2 | 1 | ug/L | No |
| 8315M | Monomethylhydrazine (MMH) | 60-34-4 | 5 | ug/L | No |
| 8321 | Perchlorate | 14797-73-0 | 2 | ug/L | No |
| 8321A | 1,3-Dinitrobenzene | 99-65-0 | 10 | ug/L | Yes |
| 8321A | Hexachlorophene | 70-30-4 | 50 | ug/L | Yes |
| 8321A | Pentachlorophenol (PCP) | 87-86-5 | 1 | ug/L | Yes |
| 8321A | Perchlorate | 14797-73-0 | 2 | ug/L | No |
| 8330 | 1,3,5-Trinitrobenzene | 99-35-4 | 0.5 | ug/L | Yes |
| 8330 | 1,3-Dinitrobenzene | 99-65-0 | 10 | ug/L | Yes |
| 8330 | 2,4,6-Trinitrotoluene | 118-96-7 | 0.5 | ug/L | No |

| Method | Analyte | CAS Number | Reporting Limit | Reporting Limit Units | Appendix IX Constituent |
|---|---|---|---|---|---|
| 8330 | 2,4-Diamino-6-nitrotoluene | 6629-29-4 | 5 | ug/L | No |
| 8330 | 2,4-Dinitrotoluene | 121-14-2 | 0.5 | ug/L | Yes |
| 8330 | 2,6-Diamino-4-Nitrotoluene | 59229-75-3 | 5 | ug/L | No |
| 8330 | 2,6-Dinitrotoluene | 606-20-2 | 0.5 | ug/L | Yes |
| 8330 | 2-Amino-4,6-dinitrotoluene | 35572-78-2 | 0.5 | ug/L | No |
| 8330 | 2-Nitrotoluene | 88-72-2 | 0.5 | ug/L | No |
| 8330 | 3-Nitrotoluene | 99-08-1 | 0.5 | ug/L | No |
| 8330 | 4-Amino-2,6-dinitrotoluene | 19406-51-0 | 0.5 | ug/L | No |
| 8330 | 4-Nitrotoluene | 99-99-0 | 0.5 | ug/L | No |
| 8330 | HMX | 2691-41-0 | 0.5 | ug/L | No |
| 8330 | Nitrobenzene | 98-95-3 | 0.5 | ug/L | Yes |
| 8330 | Nitroglycerin | 55-63-0 | 2 | ug/L | No |
| 8330 | PETN | 78-11-5 | 2 | ug/L | No |
| 8330 | RDX | 121-82-4 | 0.5 | ug/L | No |
| 8330 | Tetryl | 479-45-8 | 1.5 | ug/L | No |
| 8330A | 1,3,5-Trinitrobenzene | 99-35-4 | 0.5 | ug/L | Yes |
| 8330A | 1,3-Dinitrobenzene | 99-65-0 | 10 | ug/L | Yes |
| 8330A | 2,4,6-Trinitrotoluene | 118-96-7 | 0.5 | ug/L | No |
| 8330A | 2,4-Diamino-6-nitrotoluene | 6629-29-4 | 5 | ug/L | No |
| 8330A | 2,4-Dinitrotoluene | 121-14-2 | 0.5 | ug/L | Yes |
| 8330A | 2,6-Diamino-4-Nitrotoluene | 59229-75-3 | 5 | ug/L | No |
| 8330A | 2,6-Dinitrotoluene | 606-20-2 | 0.5 | ug/L | Yes |
| 8330A | 2-Amino-4,6-dinitrotoluene | 35572-78-2 | 0.5 | ug/L | No |
| 8330A | 2-Nitrotoluene | 88-72-2 | 0.5 | ug/L | No |
| 8330A | 3-Nitrotoluene | 99-08-1 | 0.5 | ug/L | No |
| 8330A | 4-Amino-2,6-dinitrotoluene | 19406-51-0 | 0.5 | ug/L | No |
| 8330A | 4-Nitrotoluene | 99-99-0 | 0.5 | ug/L | No |
| 8330A | HMX | 2691-41-0 | 0.5 | ug/L | No |
| 8330A | Nitrobenzene | 98-95-3 | 0.5 | ug/L | Yes |
| 8330A | Nitroglycerin | 55-63-0 | 2 | ug/L | No |
| 8330A | PETN | 78-11-5 | 2 | ug/L | No |
| 8330A | RDX | 121-82-4 | 0.5 | ug/L | No |
| 8330A | Tetryl | 479-45-8 | 1.5 | ug/L | No |
| 900.0 | Gross alpha, Dissolved | 12587-46-1 | 3 | pCi/L | No |
| 900.0 | Gross alpha, Total | 12587-46-1 | 3 | pCi/L | No |
| 900.0 | Gross beta, Dissolved | 12587-47-2 | 4 | pCi/L | No |
| 900.0 | Gross beta, Total | 12587-47-2 | 4 | pCi/L | No |
| 9012 | Total Cyanide | 57-12-5 | 0.025 | mg/L | Yes |
| 9012A | Total Cyanide | 57-12-5 | 0.025 | mg/L | Yes |
| 9012B | Total Cyanide | 57-12-5 | 0.025 | mg/L | Yes |
| 901.1 | Actinium-228 (Ac-228), Dissolved | 14331-83-0-D | 20 | pCi/L | No |
| 901.1 | Actinium-228 (Ac-228), Total | 14331-83-0 | 20 | pCi/L | No |
| 901.1 | Americium-241 (Am-241), Dissolved | 86954-36-1-D | 3 | pCi/L | No |
| 901.1 | Americium-241 (Am-241), Total | 86954-36-1 | 3 | pCi/L | No |
| 901.1 | Antimony-125 (Sb-125), Dissolved | 14234-35-6-D | 30 | pCi/L | No |
| 901.1 | Antimony-125 (Sb-125), Total | 14234-35-6 | 30 | pCi/L | No |
| 901.1 | Barium-133 (Ba-133), Dissolved | 13981-41-4-D | 20 | pCi/L | No |
| 901.1 | Barium-133 (Ba-133), Total | 13981-41-4 | 20 | pCi/L | No |

| Method | Analyte | CAS Number | Reporting Limit | Reporting Limit Units | Appendix IX Constituent |
|---|---|---|---|---|---|
| 901.1 | Cesium-134 (Cs-134), Dissolved | 13967-70-9-D | 20 | pCi/L | No |
| 901.1 | Cesium-134 (Cs-134), Total | 13967-70-9 | 20 | pCi/L | No |
| 901.1 | Cesium-137 (Cs-137), Dissolved | 10045-97-3-D | 20 | pCi/L | No |
| 901.1 | Cesium-137 (Cs-137), Total | 10045-97-3 | 20 | pCi/L | No |
| 901.1 | Cobalt-57 (Co-57), Dissolved | 13981-50-5-D | 100 | pCi/L | No |
| 901.1 | Cobalt-57 (Co-57), Total | 13981-50-5 | 100 | pCi/L | No |
| 901.1 | Cobalt-60 (Co-60), Dissolved | 10198-40-0-D | 10 | pCi/L | No |
| 901.1 | Cobalt-60 (Co-60), Total | 10198-40-0 | 10 | pCi/L | No |
| 901.1 | Europium-152 (Eu-152), Dissolved | 14683-23-9-D | 6 | pCi/L | No |
| 901.1 | Europium-152 (Eu-152), Total | 14683-23-9 | 6 | pCi/L | No |
| 901.1 | Europium-154 (Eu-154), Dissolved | 15585-10-1-D | 20 | pCi/L | No |
| 901.1 | Europium-154 (Eu-154), Total | 15585-10-1 | 20 | pCi/L | No |
| 901.1 | Europium-155 (Eu-155), Dissolved | 14391-16-3-D | 60 | pCi/L | No |
| 901.1 | Europium-155 (Eu-155), Total | 14391-16-3 | 60 | pCi/L | No |
| 901.1 | Manganese-54 (Mn-54), Dissolved | 13966-31-9-D | 30 | pCi/L | No |
| 901.1 | Manganese-54 (Mn-54), Total | 13966-31-9 | 30 | pCi/L | No |
| 901.1 | Potassium-40 (K-40), Dissolved | 13966-00-2-D | 25 | pCi/L | No |
| 901.1 | Potassium-40 (K-40), Total | 13966-00-2 | 25 | pCi/L | No |
| 901.1 | Sodium-22 (Na-22), Dissolved | 13966-32-0-D | 40 | pCi/L | No |
| 901.1 | Sodium-22 (Na-22), Total | 13966-32-0 | 40 | pCi/L | No |
| 9014 | Total Cyanide | 57-12-5 | 0.025 | mg/L | Yes |
| 902.0 | Iodine-129 (I-129), Dissolved | 15046-84-1-D | 0.5 | pCi/L | No |
| 902.0 | Iodine-129 (I-129), Total | 15046-84-1 | 0.5 | pCi/L | No |
| 903.1 | Radium-226 (Ra-226), Dissolved | 13982-63-3-D | 1 | pCi/L | No |
| 903.1 | Radium-226 (Ra-226), Total | 13982-63-3 | 1 | pCi/L | No |
| 904.0 | Radium-228 (Ra-228), Dissolved | 7440-14-4-D | 1 | pCi/L | No |
| 904.0 | Radium-228 (Ra-228), Total | 7440-14-4 | 1 | pCi/L | No |
| 9040B | pH | E-10139 | 0.01 | pH Units | No |
| 905.0 | Strontium-90 (Sr-90), Dissolved | 10098-97-2-D | 2 | pCi/L | No |
| 905.0 | Strontium-90 (Sr-90), Total | 10098-97-2 | 2 | pCi/L | No |
| 9056A | Nitrite-NO2 | 14797-65-0 | 0.1 | mg/L | No |
| 9056A | Orthophosphate-PO4 | 14265-44-2 | 0.2 | mg/L | No |
| 9056M | 1,1-Dimethylhydrazine (unsymmetrical dimethylhydrazine, UDMH) | 57-14-7 | 5 | ug/L | No |
| 9056M | Hydrazine | 302-01-2 | 1 | ug/L | No |
| 9056M | Monomethylhydrazine (MMH) | 60-34-4 | 5 | ug/L | No |
| 906.0 | Tritium, Total | 10028-17-8 | 200 | pCi/L | No |
| 9060.0 | Total Organic Carbon | 1-01-2 | 10 | mg/L | No |
| 907.0 | Thorium-228 (Th-228), Dissolved | 14274-82-9-D | 3 | pCi/L | No |
| 907.0 | Thorium-228 (Th-228), Total | 14274-82-9 | 3 | pCi/L | No |
| 907.0 | Thorium-230 (Th-230), Dissolved | 14269-63-7-D | 3 | pCi/L | No |
| 907.0 | Thorium-230 (Th-230), Total | 14269-63-7 | 3 | pCi/L | No |
| 907.0 | Thorium-232 (Th-232), Dissolved | 7440-29-1-D | 3 | pCi/L | No |
| 907.0 | Thorium-232 (Th-232), Total | 7440-29-1 | 3 | pCi/L | No |
| 908.0 | Uranium-233/234 (U-233/U-234), Dissolved | E-13230-D | 2 | pCi/L | No |
| 908.0 | Uranium-233/234 (U-233/U-234), Total | E-13230 | 2 | pCi/L | No |
| 908.0 | Uranium-234 (U-234), Dissolved | 13966-29-5-D | 2 | pCi/L | No |
| 908.0 | Uranium-234 (U-234), Total | 13966-29-5 | 2 | pCi/L | No |

| Method | Analyte | CAS Number | Reporting Limit | Reporting Limit Units | Appendix IX Constituent |
|---|---|---|---|---|---|
| 908.0 | Uranium-235 (U-235), Dissolved | 15117-96-1-D | 2 | pCi/L | No |
| 908.0 | Uranium-235 (U-235), Total | 15117-96-1 | 2 | pCi/L | No |
| 908.0 | Uranium-238 (U-238), Dissolved | 7440-61-1-D | 2 | pCi/L | No |
| 908.0 | Uranium-238 (U-238), Total | 7440-61-1 | 2 | pCi/L | No |
| CF-IRMS | Deuterium | 7782-39-0 | 2 | per mil | No |
| CF-IRMS | Oxygen-18 | O18 | 0.15 | per mil | No |
| DOE RESL Fe-1, Fe-55 | Iron-55 (Fe-55), Dissolved | 14681-59-5-D | 200 | pCi/L | No |
| DOE RESL Fe-1, Fe-55 | Iron-55 (Fe-55), Total | 14681-59-5 | 200 | pCi/L | No |
| DOE RESL | Nickel-59 (Ni-59), Dissolved | 14336-70-0-D | 30 | pCi/L | No |
| DOE RESL | Nickel-59 (Ni-59), Total | 14336-70-0 | 30 | pCi/L | No |
| DOE RESL Ni-1, Ni-59 | Nickel-59 (Ni-59), Dissolved | 14336-70-0-D | 30 | pCi/L | No |
| DOE RESL Ni-1, Ni-59 | Nickel-59 (Ni-59), Total | 14336-70-0 | 30 | pCi/L | No |
| DOE RESL | Nickel-63 (Ni-63), Dissolved | 13981-37-8-D | 5 | pCi/L | No |
| DOE RESL | Nickel-63 (Ni-63), Total | 13981-37-8 | 5 | pCi/L | No |
| DOE RESL Ni-1, Ni-63 | Nickel-63 (Ni-63), Dissolved | 13981-37-8-D | 5 | pCi/L | No |
| DOE RESL Ni-1, Ni-63 | Nickel-63 (Ni-63), Total | 13981-37-8 | 5 | pCi/L | No |
| EPA EERF C-01 | Carbon-14 (C-14), Dissolved | 14762-75-5-D | 200 | pCi/L | No |
| EPA EERF C-01 | Carbon-14 (C-14), Total | 14762-75-5 | 200 | pCi/L | No |
| Hach #8146 SM3500 | Iron (II) | 7439-89-6 | 0.02 | mg/L | No |
| Hach #8146 SM3500 | Iron (II), Dissolved | 7439-89-6-D | 0.02 | mg/L | No |
| HASL 300 I-01 Mod | Iodine-129 (I-129), Dissolved | 15046-84-1-D | 0.5 | pCi/L | No |
| HASL 300 I-01 Mod | Iodine-129 (I-129), Total | 15046-84-1 | 0.5 | pCi/L | No |
| HASL 300 Th-01-RC | Thorium-228 (Th-228), Dissolved | 14274-82-9-D | 3 | pCi/L | No |
| HASL 300 Th-01-RC | Thorium-228 (Th-228), Total | 14274-82-9 | 3 | pCi/L | No |
| HASL 300 Th-01-RC | Thorium-230 (Th-230), Dissolved | 14269-63-7-D | 3 | pCi/L | No |
| HASL 300 Th-01-RC | Thorium-230 (Th-230), Total | 14269-63-7 | 3 | pCi/L | No |
| HASL 300 Th-01-RC | Thorium-232 (Th-232), Dissolved | 7440-29-1-D | 3 | pCi/L | No |
| HASL 300 Th-01-RC | Thorium-232 (Th-232), Total | 7440-29-1 | 3 | pCi/L | No |
| HASL 300 U-02-RC | Uranium-233/234 (U-233/U-234), Dissolved | E-13230-D | 2 | pCi/L | No |
| HASL 300 U-02-RC | Uranium-233/234 (U-233/U-234), Dissolved | E-13230 | 2 | pCi/L | No |
| HASL 300 U-02-RC | Uranium-234 (U-234), Dissolved | 23966-29-5-D | 2 | pCi/L | No |
| HASL 300 U-02-RC | Uranium-234 (U-234), Total | 23966-29-5 | 2 | pCi/L | No |
| HASL 300 U-02-RC | Uranium-235 (U-235), Dissolved | 15117-96-1-D | 2 | pCi/L | No |
| HASL 300 U-02-RC | Uranium-235 (U-235), Total | 15117-96-1 | 2 | pCi/L | No |
| HASL 300 U-02-RC | Uranium-238 (U-238), Dissolved | 7440-61-1-D | 2 | pCi/L | No |
| HASL 300 U-02-RC | Uranium-238 (U-238), Total | 7440-61-1 | 2 | pCi/L | No |
| HASL-300 | Curium-243 (Cm-243), Dissolved | 15757-87-6-D | 3 | pCi/L | No |
| HASL-300 | Curium-243 (Cm-243), Total | 15757-87-6 | 3 | pCi/L | No |
| HASL-300 | Plutonium-238 (Pu-238), Dissolved | 13981-16-3-D | 3 | pCi/L | No |
| HASL-300 | Plutonium-238 (Pu-238), Total | 13981-16-3 | 3 | pCi/L | No |
| HASL-300 | Plutonium-239 (Pu-239), Dissolved | 15117-48-3-D | 3 | pCi/L | No |
| HASL-300 | Plutonium-239 (Pu-239), Total | 15117-48-3 | 3 | pCi/L | No |
| HASL-300 | Pu-239/Pu-240, Dissolved | E-13207-D | 3 | pCi/L | No |
| HASL-300 | Pu-239/Pu-240, Total | E-13207 | 3 | pCi/L | No |
| HASL-300 | Plutonium-240 (Pu-240), Dissolved | 14119-33-6-D | 3 | pCi/L | No |
| HASL-300 | Plutonium-240 (Pu-240), Total | 14119-33-6 | 3 | pCi/L | No |
| HASL-300 | Plutonium-241 (Pu-241), Dissolved | 14119-32-5-D | 20 | pCi/L | No |
| HASL-300 | Plutonium-241 (Pu-241), Total | 14119-32-5 | 20 | pCi/L | No |

| Method | Analyte | CAS Number | Reporting Limit | Reporting Limit Units | Appendix IX Constituent |
|---|---|---|---|---|---|
| HASL-300 | Plutonium-242 (Pu-242), Dissolved | 13982-10-0-D | 3 | pCi/L | No |
| HASL-300 | Plutonium-242 (Pu-242), Total | 13982-10-0 | 3 | pCi/L | No |
| HASL-300 | Technetium-99 (Tc-99), Dissolved | 14133-76-7-D | 90 | pCi/L | No |
| HASL-300 | Technetium-99 (Tc-99), Total | 14133-76-7 | 90 | pCi/L | No |
| HASL-300 | Lead-210 (Pb-210), Dissolved | 14255-04-0-D | 20 | pCi/L | No |
| HASL-300 | Lead-210 (Pb-210), Total | 14255-04-0 | 20 | pCi/L | No |
| HASL-300 | Neptunium-237 (Np-237), Dissolved | 13994-20-2-D | 3 | pCi/L | No |
| HASL-300 | Neptunium-237 (Np-237), Total | 13994-20-2 | 3 | pCi/L | No |
| Microseeps | Hydrogen | 1333-74-0 | 0.03 | nM | No |
| RSK-175 | Ethane | 74-84-0 | 2 | ug/L | No |
| RSK-175 | Ethene | 74-85-1 | 3 | ug/L | No |
| RSK-175 | Methane | 74-82-8 | 1 | ug/L | No |
| SM2130B | Turbidity | E-10607 | 0.3 | NTU | No |
| SM2320B | Alkalinity | TAlk | 2 | mg/L | No |
| SM2320B | Alkalinity as CaCO3 | TAlk | 2 | mg/L | No |
| SM2320B | Bicarbonate | 71-52-3 | 2.4 | mg/L | No |
| SM2320B | Carbonate | 3812-32-6 | 2 | mg/L | No |
| SM2510B | Specific Conductance | E-10184 | 5 | umhos/cm | No |
| SM2540C | Total Dissolved Solids | E-10173 | 30 | mg/L | No |
| SM4500-NH3 | Ammonia | 7664-41-7 | 0.5 | mg/L | No |
| SM4500-NH3 | Ammonia-N | 7664-41-7 | 0.5 | mg/L | No |
| SM4500-H | pH | E-10139 | 0.01 | pH Units | No |
| SM4500 SD | Sulfide | 18496-25-8 | 0.1 | mg/L | Yes |
| SRL 524M | 1,2,3-Trichloropropane (TCP) | 96-18-4 | 0.005 | ug/L | Yes |

**NOTES AND ABBREVIATIONS**

1. umhos/cm = Micromhos per centimeter.
2. mg/L = Milligrams per liter.
3. NTU = Nephelometric Turbidity Units.
4. pg/L = Picograms per liter.
5. ug/L = Micrograms per liter.
6. CAS = Chemical Abstract Service
7. pCi/L = PicoCuries per liter.
8. * = TestAmerica Laboratories internal method.
9. For additional methods requested, see the Quality Assurance Project Plan SSFL RCRA Facility Investigation Surficial Media Operable Unit (March 2009, Revision 4).

| Matrix | Analytical Parameter | Method | Container | Sample Volume or Weight[(a)] | Preservative | Holding Time |
|---|---|---|---|---|---|---|
| Water | 1,2-dibromo-3-chloroprane (DBCP)<br>1,2-dibromoethane (EDB) | EPA 504.1, SW-846 8260B | G | 3 x 40 mL | Na2S2O3 | 14 days |
| Water | 1,2,3-Trichloropropane (TCP) | SRL 524M, EPA 504.1, SW 846 8260SIM, 8260B | G | 3 x 40 mL | Cool to 4°C | 14 days |
| Water | 1,4-Dioxane | SW 846 8260SIM, 8260MSIM, 8260B | G | 3 x 40 mL | Cool to 4°C<br>HCl | 7 days |
| Water | Alkalinity, Alkalinity as CaCO3 | SM2320B,<br>EPA 310.1, 310.2 | P, G | 200 mL | Cool to 4°C | 14 days |
| Water | Ammonia, Ammonia-N | EPA 350.1, 350.2, 350.3, SM4500-NH3 | P, G | 100 mL | Cool to 4°C H2SO4 to pH < 2 | 28 days |
| Water | Bicarbonate, Carbonate | SM2320B | P, G | 200 mL | Cool to 4°C | 14 days |
| Water | Bromide | EPA 300.0 | P, G | 50 mL | Cool to 4°C | 28 days |
| Water | Carbon-14 (C-14) | EPA EERF C-01 | P | 1 L | $HNO_3$ to pH<2 | 6 months |
| Water | Chloride | EPA 300.0 | P, G | 50 mL | Cool to 4°C | 28 days |
| Water | Chloro-phenoxy acetic acid Herbicides | SW-846 8151A | G (amber) | 1 L | Cool to 4°C | 7/40 days |
| Water | Cyanide | SW-846 9012, 9012A, 9012B, 9014 | P | 250 mL | NaOH | 14 days |
| Water | Deuterium,<br>Oxygen-18 | CF-IRMS | G | 3 x 40 mL | Cool to 4°C | None |

| Matrix | Analytical Parameter | Method | Container | Sample Volume or Weight[(a)] | Preservative | Holding Time |
|---|---|---|---|---|---|---|
| Water | Diesel Range Organics (DRO) | SW-846 8015C, 8015B, 8015 | G (amber) | 2 x 1 L | Cool to 4°C | 7/40 days |
| Water | Dioxins and Furans | SW-846 8290, 1613 | G (amber) | 2 x 1 L | Cool to 4°C | 30/45 days |
| Water | Dissolved Oxygen (DO) | EPA 360.1 | G | 300 mL BOD Bottle | None | Immediate |
| Water | Dissolved Organic Carbon (DOC) | EPA 415.1 | P,G | 125 mL | pH < 2 $H_2SO_4$<br>Cool to 4°C | 28 Days |
| Water | Energetics | SW-846 8330, 8330A | G | 1 L | Cool to 4°C | 7 days for extraction and 40 days for analysis |
| Water | Fluoride | EPA 300.0, 340.2 | P, G | 50 mL | Cool to 4°C | 28 days |
| Water | Formaldehyde | SW-846 8315A, 8315 | G | 2 x 100 mL | Cool to 4°C | 72 hours for extraction and derivation<br>72 hours for analysis (3/3 days) |
| Water | Gamma-emitting radionuclides | EPA Method 901.1, HASL-300 | P | 1 L | $HNO_3$ to pH<2 | 6 months |
| Water | Gasoline Range Organics (GRO) | SW-846 8015, 8015B | G | 3 x 40 mL | HCl or $H_2SO_4$ pH <2 | 14 days |
| Water | Gross Alpha, Gross Beta | EPA Method 900.0 | P | 1 L | $HNO_3$ to pH<2 | 6 months |
| Water | Hexachlorophene | SW-846 8321A, 8151A, 8270C | G | 3 x 40 mL | Cool to 4°C | 7 days |
| Water | Hexavalent Chromium | SW-846 7196A, 7199 | P, G | 1 L | Cool to 4°C | 24 hours |
| Water | Hydrazines | SW-846 8315M, 8315A, 9056M, DV-WC-0077 | G (amber) | 500 mL | Cool to 4°C | 72 hours for water matrix/72 hours for extract |

| Matrix | Analytical Parameter | Method | Container | Sample Volume or Weight[(a)] | Preservative | Holding Time |
|---|---|---|---|---|---|---|
| Water | Hydrogen | Microseeps | G | 40 mL | Cool to 4°C | 24 hours |
| Water | Iodine-129 (I-129) | 902, HASL 300 I-01 Mod | P | 1 L | None | 6 months |
| Water | Iron (II) | Hach #8146<br><br>SM3500, 6010B, 6020 | P,G | 125 mL | Cool to 4°C<br><br>Filtered $HNO_3$ to pH<2 | Immediate<br><br>6 months |
| Water | Iron-55 (Fe-55) | DOE RESL Fe-1, Fe-55 | P | 1 L | $HNO_3$ to pH<2 | 6 months |
| Water | Kerosene fuel (RP-1, JP-1, JP-4)[(b)] | SW-846 8015B | G (amber) | 2 x 1 L | Cool to 4°C | 7/40 days |
| Water | Metals | SW-846 6010B, 6020,7470A | P | 500 mL - 1 L | $HNO_3$ to pH<2, Cool to 4°C | 6 months for 6010B/6020; 28 days for 7470A |
| Water | Methane, Ethane, and Ethene | RSK-175 (Robert S. Kerr Laboratory Method) | G | 40 mL | Cool to 4º C | 7 days |
| Water | Nickel-59 (Ni-59), Nickel-63 (Ni-63) | DOE RESL Ni-1, Ni-59; DOE RESL Ni-1, Ni-63; DOE RESL | P | 1 L | $HNO_3$ to pH<2 | 6 months |
| Water | Nitrate, Nitrate-N, Nitrate-NO3 | EPA 300.0, 353.2 | P, G | 50 mL | Cool to 4°C | 48 hours |
| Water | Nitrite-NO2 | EPA 300.0, 9056A | P, G | 50 mL | Cool to 4°C | 48 hours |
| Water | n-Nitrosodimethylamine (NDMA) | EPA 1625M, 1625C, 521, SW-846 8270C, 8270SIM | G (amber) | 4 x 500 mL | Cool to 4°C | 7/40 days, or 14/28 days depending on method |
| Water | Organophosphorus Pesticides | SW-846 8141A, 8270C | G (amber) | 1 L | Cool to 4°C | 7/40 days |
| Water | Orthophosphate-PO4 | EPA 300.0, 9056A | P, G | 50 mL | Cool to 4°C | 48 hours |
| Water | Pentachlorophenol (PCP) | SW-846 8270C, 8151A, 8321A, 8270SIM | G (amber) | 2 x 1000 mL | Cool to 4°C | 7/40 days |

| Matrix | Analytical Parameter | Method | Container | Sample Volume or Weight[(a)] | Preservative | Holding Time |
|---|---|---|---|---|---|---|
| Water | Perchlorate | EPA 314.0, 332.0, 331.0, SW-846 6850, 6860, 8321A, 8321 | P, G | 100 mL | Cool to 4°C | 28 days |
| Water | Pesticides | SW-846 8081A, 8081, 8270C | G (amber) | 1 L | Cool to 4°C | 7/40 days |
| Water | pH | SW-846 9040B, EPA 150.1, SM4500-H | P, G | 50 mL | Cool to 4°C | Immediate |
| Water | Polychlorinated Biphenyls (PCBs) | SW-846 8082, EPA 1668 | G (amber) | 2 x 1000 mL | Cool to 4°C | 7/40 days |
| Water | Polycyclic Aromatic Hydrocarbons (PAHs) | SW-846 8270CSIM, 8270C | G (amber) | 1 L | Cool to 4°C | 7/40 days |
| Water | Radium-226 (Ra-226) | EPA Method 903.1 | P | 1 L | $HNO_3$ to pH<2 | 6 months |
| Water | Radium-228 (Ra-228) | EPA Method 904.0 | P | 1 L | $HNO_3$ to pH<2 | 6 months |
| Water | Semi-Volatile Organic Compounds (SVOCs)<br><br>Alternative methods:<br><br>Pentachloroethane (8260B)<br><br>Famphur (8141A) | SW-846 8270C, 8330, 8321A | G (amber) | 2 x 1000 mL | Cool to 4°C | 7/40 days |
| Water | Specific Conductance | EPA 120.1, SM2510B | P, G | 100 mL | Cool to 4°C | 28 Days |
| Water | Strontium-90 (Sr-90) | EPA Method 905.0 | P | 1 L | $HNO_3$ to pH<2 | 6 months |
| Water | Sulfate | EPA 300.0, EPA 375.4 | P, G | 50 mL | Cool to 4°C | 28 days |
| Water | Sulfide | EPA 376.2, EPA SM4500 SD | P | 250 mL | Zinc Acetate/ NaOH | 7 days |
| Water | Sulfite | EPA 377.1 | P | 500 mL | Cool to 4°C | 24 Hours |

| Matrix | Analytical Parameter | Method | Container | Sample Volume or Weight[(a)] | Preservative | Holding Time |
|---|---|---|---|---|---|---|
| Water | Temperature | 170.1 | P, G | 125 mL | None | Immediate |
| Water | Terphenyls | SW-846 8015B | G | 1 L | Cool to 4°C | 7/40 days |
| Water | Thorium-228 (Th-228), Thorium-230 (Th-230), Thorium-232 (Th-232) | EPA Method 907.0, HASL 300 Th-01-RC | P | 1 L | $HNO_3$ to pH<2 | 6 months |
| Water | Total Dissolved Solids | EPA 160.1, SM2540C | P, G | 500 mL | Cool to 4°C | 7 days |
| Water | Total Organic Carbon | SW-846 9060 | P,G | 125 mL | pH < 2 $H_2SO_4$<br>Cool to 4°C | 28 Days |
| Water | Total Petroleum Hydrocarbons (TPH)[(b)] | SW-846 8015B | G (amber) | 2 x 1 L | HCl or $H_2SO_4$<br>pH <2 | 14 days |
| Water | Tritium | EPA Method 906.0 | G | 2 x 8 oz | None | 6 months |
| Water | Turbidity | EPA 180.1, SM2130B | P | 250 mL | Cool to 4°C | 48 hours |
| Water | Uranium-234 (U-234), Uranium-235 (U-235), Uranium-233/234 (U-233/234), Uranium-238 (U-238), | EPA Method 908.0, HASL 300 U-02-RC | P | 1 L | $HNO_3$ to pH<2 | 6 months |
| Water | Volatile Organic Compounds (VOCs)<br>Alternative methods:<br>Pentachloroethane (8270C) | SW-846 8260B | G | 3 x 40 mL | pH < 2 HCl<br>Cool to 4°C | 14 days preserved; 7 days unpreserved |

NOTES AND ABBREVIATIONS:

(a) Each analytical laboratory may specify a larger or smaller volume at each stage of the project. The volume listed above is a recommended minimum.

(b) Project defined hydrocarbon ranges.

G = Glass

P = Polyethylene

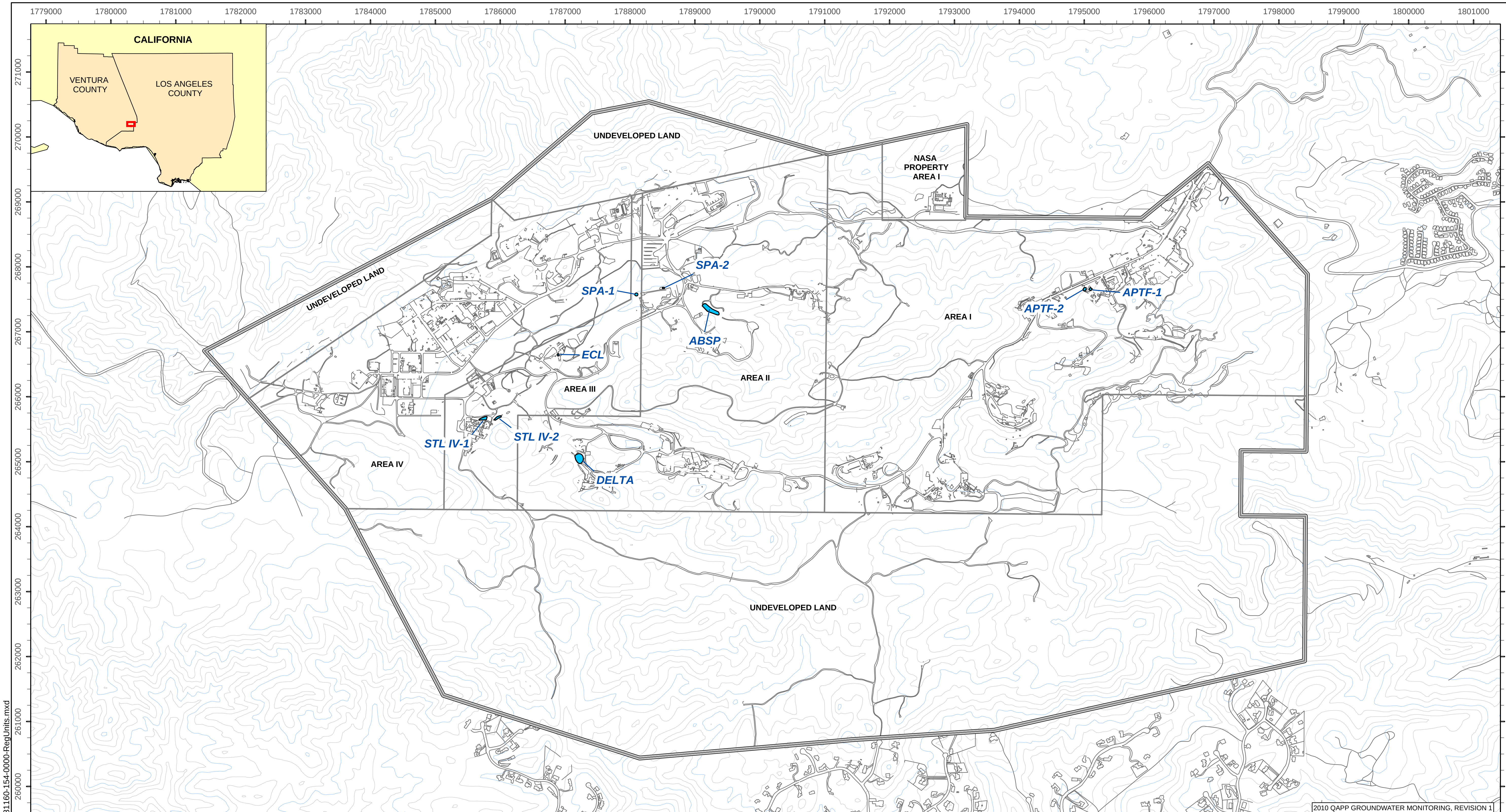
SIM = Selected Ion Monitoring

For additional methods requested, see the Quality Assurance Project Plan SSFL RCRA Facility Investigation Surficial Media Operable Unit (March 2009, Revision 4).

| Quality Control Sample | DQI | Frequency | Method QC Acceptance Limits | Project Acceptance Criteria | Corrective Action |
|---|---|---|---|---|---|
| **Field QA/QC** | | | | | |
| Field Duplicate | Precision | 1 per 20 Samples | NA | RPD <35% | Qualify or resample |
| Equipment Rinse Blank | Accuracy | 1 per method per day at locations without dedicated or disposable sampling equipment | NA | <CRQL | |
| Field Blank | Accuracy | 1 per Event | NA | <CRQL | |
| Split | Comparability | Variable* | NA | RPD<35% | |
| Trip Blank | Accuracy | 1 per cooler for VOCs and GRO | NA | <CRQL | |
| **Laboratory QA/QC** | | | | | |
| Laboratory Duplicate | Precision | 1/Batch of 20 Samples | RPD < 20% for analytes >5 x CRQL | RPD < 20% for analytes >5 x CRQL | Re-analyze or qualify in lab report |
| Method Blank | Accuracy | 1/Batch of 20 Samples | [analyte] <½CRQL or sample [analyte] 10 x [Blank] | [analyte] <½CRQL or sample [analyte] 10 x [Blank] | Re-prep and re-analyze blank and all associated samples |
| Laboratory Control Sample / Laboratory Control Sample Duplicate (LCS/LCSD) | Precision and Accuracy | 1/Batch of 20 Samples | %R = 70-130% True Value | %R = 70-130% True Value | Re-analyze, confirm or qualify |
| Matrix Spike/ Matrix Spike Duplicate Sample (MS/MSD) | Precision and Accuracy | 1/Batch of 20 Samples | Method Specific Criteria | %R = 50-150% True Value | Re-prep and re-analyze, if confirmed, qualify data in report |

**Notes and Abbreviations:**

CRQL = Contract Required Quantitation Limit
DQI = Data Quality Indicator
NA = Not Applicable
QA/QC = Quality Assurance/Quality Control
RPD = Replicate Percent Difference
[ ] = Concentration
%R = Percent Recovery
* = Split samples are collected at least once per year, when the primary analytical laboratory changes, and/or when verification sampling is needed.




## LEGEND

UNIT NAME

REGULATED UNIT

SSFL PROPERTY BOUNDARY

Map Coordinates: CA State Plane, NAD 27, Zone V, US Survey FT

**SPA** = STORABLE PROPELLANT AREA
**ABSP** = ALFA BRAVO SKIM POND
**ECL** = ENGINEERING CHEMISTRY LAB
**STL IV** = SYSTEMS TEST LABORATORY IV
**APTF** = ADVANCED PROPULSION TEST FACILITY

N
W E
S

0 1500 3000
SCALE IN FEET

HALEY & ALDRICH

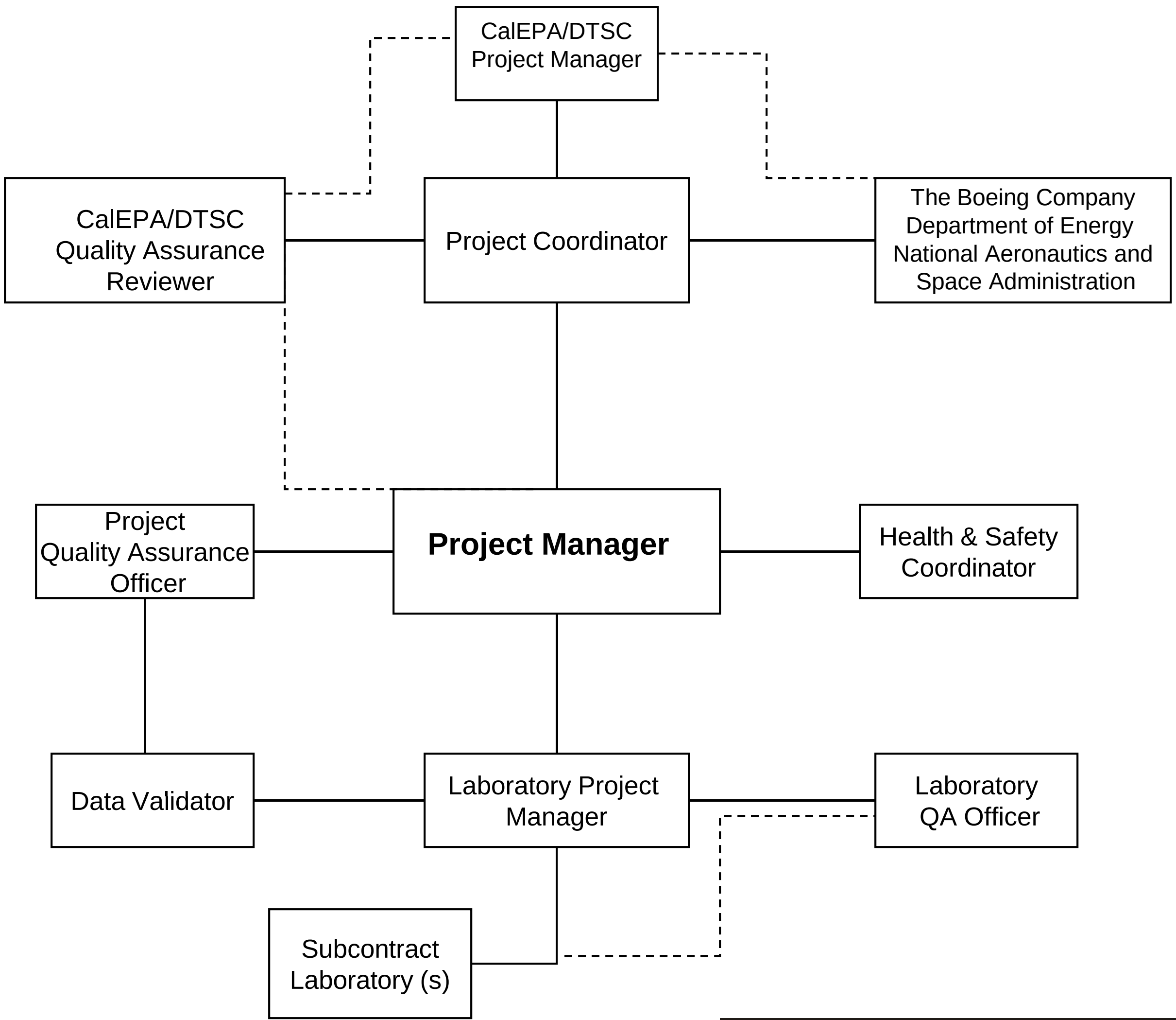
SANTA SUSANA FIELD LABORATORY
VENTURA COUNTY, CALIFORNIA

SITE MAP

SCALE: AS SHOWN
DECEMBER 2010

FIGURE B-1

G:\Graphics\Projects\26472 - Boeing\QAPP\31160-154-0000-RegUnits.mxd




**Notes:**

- - - - - - - - **Line of Communication**

———— **Direct Reporting**

HALEY & ALDRICH

THE BOEING COMPANY
SANTA SUSANA FIELD LABORATORY
VENTURA COUNTY, CALIFORNIA

**PROJECT QUALITY ASSURANCE TEAM ORGANIZATION CHART**

DECEMBER 2010

FIGURE B-2

**TABLE B-I**
SUMMARY OF FIELD
STANDARD OPERATING PROCEDURES (SOPs)
SANTA SUSANA FIELD LABORATORY
VENTURA COUNTY, CALIFORNIA

| **Title** | **Use** | **Source** |
|---|---|---|
| Equipment Decontamination | Pre/Post Sampling | Refer to Appendix A, SSFL Field Sampling Plan in Water Quality Sampling and Analysis Plans for the Regulated Units and the Site-Wide groundwater monitoring programs, Haley & Aldrich, Inc., (2010a, 2010b, 2010c) for current Field Measurement SOPs. |
| Groundwater Sampling | Sample Collection | |
| Manual Water Level Measurement | | |
| Low-Flow Purge | | |
| FLUTe Multilevel System | | |
| Westbay Multilevel System | | |
| Sample Management | Post Sampling | |

| Method | Analyte | CAS Number | Reporting Limit | Reporting Limit Units | Appendix IX Constituent |
|---|---|---|---|---|---|
| 120.1 | Specific Conductance | E-10184 | 5 | umhos/cm | No |
| 150.1 | pH | E-10139 | 0.01 | pH Units | No |
| 160.1 | Total Dissolved Solids | E-10173 | 30 | mg/L | No |
| 1613 | 1,2,3,4,6,7,8-HpCDD | 35822-46-9 | 24.8 | pg/L | Yes |
| 1613 | 1,2,3,4,6,7,8-HpCDF | 67562-39-4 | 24.8 | pg/L | Yes |
| 1613 | 1,2,3,4,7,8,9-HpCDF | 55673-89-7 | 24.8 | pg/L | Yes |
| 1613 | 1,2,3,4,7,8-HxCDD | 39227-28-6 | 24.8 | pg/L | Yes |
| 1613 | 1,2,3,4,7,8-HxCDF | 70648-26-9 | 24.8 | pg/L | Yes |
| 1613 | 1,2,3,6,7,8-HxCDD | 57653-85-7 | 24.8 | pg/L | Yes |
| 1613 | 1,2,3,6,7,8-HxCDF | 57117-44-9 | 24.8 | pg/L | Yes |
| 1613 | 1,2,3,7,8,9-HxCDD | 19408-74-3 | 24.8 | pg/L | Yes |
| 1613 | 1,2,3,7,8,9-HxCDF | 72918-21-9 | 24.8 | pg/L | Yes |
| 1613 | 1,2,3,7,8-PeCDD | 40321-76-4 | 24.8 | pg/L | Yes |
| 1613 | 1,2,3,7,8-PeCDF | 57117-41-6 | 24.8 | pg/L | Yes |
| 1613 | 2,3,4,6,7,8-HxCDF | 60851-34-5 | 24.8 | pg/L | Yes |
| 1613 | 2,3,4,7,8-PeCDF | 57117-31-4 | 24.8 | pg/L | Yes |
| 1613 | 2,3,7,8-TCDD | 1746-01-6 | 4.97 | pg/L | Yes |
| 1613 | 2,3,7,8-TCDF | 51207-31-9 | 4.97 | pg/L | Yes |
| 1613 | OCDD | 3268-87-9 | 24.8 | pg/L | Yes |
| 1613 | OCDF | 39001-02-0 | 24.8 | pg/L | Yes |
| 1625C | n-Nitrosodimethylamine (NDMA) | 62-75-9 | 20 | ug/L | Yes |
| 1625M | n-Nitrosodimethylamine (NDMA) | 62-75-9 | 0.005 | ug/L | Yes |
| 1668 | Aroclor 1016 | 12674-11-2 | 1 | ug/L | Yes |
| 1668 | Aroclor 1221 | 11104-28-2 | 1 | ug/L | Yes |
| 1668 | Aroclor 1232 | 11141-16-5 | 1 | ug/L | Yes |
| 1668 | Aroclor 1242 | 53469-21-9 | 1 | ug/L | Yes |
| 1668 | Aroclor 1248 | 12672-29-6 | 1 | ug/L | Yes |
| 1668 | Aroclor 1254 | 11097-69-1 | 1 | ug/L | Yes |
| 1668 | Aroclor 1260 | 11096-82-5 | 1 | ug/L | Yes |
| 1668 | Aroclor 1262 | 37324-23-5 | 0.5 | ug/L | No |
| 1668 | Aroclor 1268 | 11100-14-4 | 0.5 | ug/L | No |
| 1668 | Aroclor 5432 | 61788-33-8 | 0.5 | ug/L | No |
| 1668 | Aroclor 5442 | 12642-23-8 | 0.5 | ug/L | No |
| 1668 | Aroclor 5460 | 11126-42-4 | 0.5 | ug/L | No |
| 1668 | PCB 101 | 37680-73-2 | 0.01 | ug/L | No |
| 1668 | PCB 105 | 32598-14-4 | 0.01 | ug/L | No |
| 1668 | PCB 110 | 38380-03-9 | 0.01 | ug/L | No |
| 1668 | PCB 114 | 74472-37-0 | 0.01 | ug/L | No |
| 1668 | PCB 118 | 31508-00-6 | 0.01 | ug/L | No |
| 1668 | PCB 119 | 56558-17-9 | 0.01 | ug/L | No |
| 1668 | PCB 123 | 65510-44-3 | 0.01 | ug/L | No |
| 1668 | PCB 126 | 57465-28-8 | 0.01 | ug/L | No |
| 1668 | PCB 128 | 38380-07-3 | 0.01 | ug/L | No |
| 1668 | PCB 132 | 38380-05-1 | 0.01 | ug/L | No |
| 1668 | PCB 138 | 35065-28-2 | 0.01 | ug/L | No |
| 1668 | PCB 149 | 38380-04-0 | 0.01 | ug/L | No |
| 1668 | PCB 151 | 52663-63-5 | 0.01 | ug/L | No |
| 1668 | PCB 153 | 35065-27-1 | 0.01 | ug/L | No |

See last page of table for notes and abbreviations.

| Method | Analyte | CAS Number | Reporting Limit | Reporting Limit Units | Appendix IX Constituent |
|---|---|---|---|---|---|
| 1668 | PCB 156 | 38380-08-4 | 0.01 | ug/L | No |
| 1668 | PCB 157 | 69782-90-7 | 0.01 | ug/L | No |
| 1668 | PCB 158 | 74472-42-7 | 0.01 | ug/L | No |
| 1668 | PCB 167 | 52663-72-6 | 0.01 | ug/L | No |
| 1668 | PCB 168 | 59291-65-5 | 0.01 | ug/L | No |
| 1668 | PCB 169 | 32774-16-6 | 0.01 | ug/L | No |
| 1668 | PCB 170 | 35065-30-6 | 0.01 | ug/L | No |
| 1668 | PCB 177 | 52663-70-4 | 0.01 | ug/L | No |
| 1668 | PCB 18 | 37680-65-2 | 0.01 | ug/L | No |
| 1668 | PCB 180 | 35065-29-3 | 0.01 | ug/L | No |
| 1668 | PCB 183 | 52663-69-1 | 0.01 | ug/L | No |
| 1668 | PCB 187 | 52663-68-0 | 0.01 | ug/L | No |
| 1668 | PCB 189 | 39635-31-9 | 0.01 | ug/L | No |
| 1668 | PCB 194 | 35694-08-7 | 0.01 | ug/L | No |
| 1668 | PCB 201 | 40186-71-8 | 0.01 | ug/L | No |
| 1668 | PCB 206 | 40186-72-9 | 0.01 | ug/L | No |
| 1668 | PCB 28 | 7012-37-5 | 0.01 | ug/L | No |
| 1668 | PCB 37 | 38444-90-5 | 0.01 | ug/L | No |
| 1668 | PCB 44 | 41464-39-5 | 0.01 | ug/L | No |
| 1668 | PCB 49 | 41464-40-8 | 0.01 | ug/L | No |
| 1668 | PCB 52 | 35693-99-3 | 0.01 | ug/L | No |
| 1668 | PCB 66 | 32598-10-0 | 0.01 | ug/L | No |
| 1668 | PCB 70 | 32598-11-1 | 0.01 | ug/L | No |
| 1668 | PCB 74 | 32690-93-0 | 0.01 | ug/L | No |
| 1668 | PCB 77 | 32598-13-3 | 0.01 | ug/L | No |
| 1668 | PCB 81 | 70362-50-4 | 0.01 | ug/L | No |
| 1668 | PCB 87 | 38380-02-8 | 0.01 | ug/L | No |
| 1668 | PCB 99 | 38380-01-7 | 0.01 | ug/L | No |
| 170.1 | Temperature | TEMP | 0.1 | Celsius | No |
| 180.1 | Turbidity | E-10607 | 0.3 | NTU | No |
| 300.0 | Bromide | 24959-67-9 | 0.5 | mg/L | No |
| 300.0 | Chloride | 16887-00-6 | 0.5 | mg/L | No |
| 300.0 | Fluoride | 16984-48-8 | 0.5 | mg/L | No |
| 300.0 | Nitrate | NO3N | 0.5 | mg/L | No |
| 300.0 | Nitrate-N | NO3N | 0.5 | mg/L | No |
| 300.0 | Nitrate-NO3 | NO3N | 0.5 | mg/L | No |
| 300.0 | Nitrite-NO2 | 14797-65-0 | 0.1 | mg/L | No |
| 300.0 | Orthophosphate-PO4 | 14265-44-2 | 0.2 | mg/L | No |
| 300.0 | Sulfate | 14808-79-8 | 1 | mg/L | No |
| 310.1 | Alkalinity | TAlk | 2 | mg/L | No |
| 310.1 | Alkalinity as CaCO3 | TAlk | 2 | mg/L | No |
| 310.2 | Alkalinity | TAlk | 2 | mg/L | No |
| 310.2 | Alkalinity as CaCO3 | TAlk | 2 | mg/L | No |
| 314.0 | Perchlorate | 14797-73-0 | 2 | ug/L | No |
| 331.0 | Perchlorate | 14797-73-0 | 2 | ug/L | No |
| 332.0 | Perchlorate | 14797-73-0 | 2 | ug/L | No |
| 340.2 | Fluoride | 16984-48-8 | 0.5 | mg/L | No |
| 350.1 | Ammonia | 7664-41-7 | 0.5 | mg/L | No |

See last page of table for notes and abbreviations.

| Method | Analyte | CAS Number | Reporting Limit | Reporting Limit Units | Appendix IX Constituent |
|---|---|---|---|---|---|
| 350.1 | Ammonia-N | 7664-41-7 | 0.5 | mg/L | No |
| 350.2 | Ammonia | 7664-41-7 | 0.5 | mg/L | No |
| 350.2 | Ammonia-N | 7664-41-7 | 0.5 | mg/L | No |
| 350.3 | Ammonia | 7664-41-7 | 0.5 | mg/L | No |
| 350.3 | Ammonia-N | 7664-41-7 | 0.5 | mg/L | No |
| 353.2 | Nitrate | NO3N | 0.5 | mg/L | No |
| 353.2 | Nitrate-N | NO3N | 0.5 | mg/L | No |
| 353.2 | Nitrate-NO3 | NO3N | 0.5 | mg/L | No |
| 360.1 | Dissolved Oxygen (DO) | E-14539 | 1 | mg/L | No |
| 375.4 | Sulfate | 14808-79-8 | 1 | mg/L | No |
| 376.2 | Sulfide | 18496-25-8 | 0.1 | mg/L | Yes |
| 377.1 | Sulfite | 14265-45-3 | 0.05 | mg/L | No |
| 415.1 | Organic Carbon, Dissolved | E-10094 | 1 | mg/L | No |
| 504.1 | 1,2,3-Trichloropropane (TCP) | 96-18-4 | 0.005 | ug/L | Yes |
| 504.1 | 1,2-Dibromo-3-chloropropane (DBCP) | 96-12-8 | 0.02 | ug/L | Yes |
| 504.1 | 1,2-Dibromoethane (EDB) | 106-93-4 | 0.02 | ug/L | Yes |
| 521 | n-Nitrosodimethylamine (NDMA) | 62-75-9 | 20 | ug/L | Yes |
| 6010B | Aluminum, Dissolved | 7429-90-5-D | 0.05 | mg/L | No |
| 6010B | Aluminum, Total | 7429-90-5 | 0.05 | mg/L | No |
| 6010B | Antimony, Dissolved | 7440-36-0-D | 0.002 | mg/L | No |
| 6010B | Antimony, Total | 7440-36-0 | 0.002 | mg/L | Yes |
| 6010B | Arsenic, Dissolved | 7440-38-2-D | 0.002 | mg/L | No |
| 6010B | Arsenic, Total | 7440-38-2 | 0.002 | mg/L | Yes |
| 6010B | Barium, Dissolved | 7440-39-3-D | 0.005 | mg/L | No |
| 6010B | Barium, Total | 7440-39-3 | 0.005 | mg/L | Yes |
| 6010B | Beryllium, Dissolved | 7440-41-7-D | 0.0005 | mg/L | No |
| 6010B | Beryllium, Total | 7440-41-7 | 0.0005 | mg/L | Yes |
| 6010B | Boron, Dissolved | 7440-42-8-D | 0.05 | mg/L | No |
| 6010B | Boron, Total | 7440-42-8 | 0.05 | mg/L | No |
| 6010B | Cadmium, Dissolved | 7440-43-9-D | 0.001 | mg/L | No |
| 6010B | Cadmium, Total | 7440-43-9 | 0.001 | mg/L | Yes |
| 6010B | Calcium, Dissolved | 7440-70-2-D | 0.2 | mg/L | No |
| 6010B | Calcium, Total | 7440-70-2 | 0.2 | mg/L | No |
| 6010B | Chromium, Dissolved | 7440-47-3-D | 0.002 | mg/L | No |
| 6010B | Chromium, Total | 7440-47-3 | 0.002 | mg/L | Yes |
| 6010B | Cobalt, Dissolved | 7440-48-4-D | 0.005 | mg/L | No |
| 6010B | Cobalt, Total | 7440-48-4 | 0.005 | mg/L | Yes |
| 6010B | Copper, Dissolved | 7440-50-8-D | 0.002 | mg/L | No |
| 6010B | Copper, Total | 7440-50-8 | 0.002 | mg/L | Yes |
| 6010B | Iron (II) | 7439-89-6 | 0.02 | mg/L | No |
| 6010B | Iron (II), Dissolved | 7439-89-6-D | 0.02 | mg/L | No |
| 6010B | Iron, Dissolved | 7439-89-6-D | 0.2 | mg/L | No |
| 6010B | Iron,Total | 7439-89-6 | 0.2 | mg/L | No |
| 6010B | Lead, Dissolved | 7439-92-1-D | 0.001 | mg/L | No |
| 6010B | Lead, Total | 7439-92-1 | 0.001 | mg/L | Yes |
| 6010B | Lithium, Dissolved | 7439-93-2-D | 0.05 | mg/L | No |
| 6010B | Lithium, Total | 7439-93-2 | 0.05 | mg/L | No |
| 6010B | Magnesium, Dissolved | 7439-95-4-D | 0.1 | mg/L | No |

| Method | Analyte | CAS Number | Reporting Limit | Reporting Limit Units | Appendix IX Constituent |
|---|---|---|---|---|---|
| 6010B | Magnesium, Total | 7439-95-4 | 0.1 | mg/L | No |
| 6010B | Manganese, Dissolved | 7439-96-5-D | 0.005 | mg/L | No |
| 6010B | Manganese, Total | 7439-96-5 | 0.005 | mg/L | No |
| 6010B | Molybdenum, Dissolved | 7439-98-7-D | 0.01 | mg/L | No |
| 6010B | Molybdenum, Total | 7439-98-7 | 0.01 | mg/L | No |
| 6010B | Nickel, Dissolved | 7440-02-0-D | 0.002 | mg/L | No |
| 6010B | Nickel, Total | 7440-02-0 | 0.002 | mg/L | Yes |
| 6010B | Phosphorus, Dissolved | 7723-14-0-D | 0.05 | mg/L | No |
| 6010B | Phosphorus, Total | 7723-14-0 | 0.05 | mg/L | No |
| 6010B | Potassium, Dissolved | 7440-09-7-D | 0.5 | mg/L | No |
| 6010B | Potassium, Total | 7440-09-7 | 0.5 | mg/L | No |
| 6010B | Selenium, Dissolved | 7782-49-2-D | 0.002 | mg/L | No |
| 6010B | Selenium, Total | 7782-49-2 | 0.002 | mg/L | Yes |
| 6010B | Silver, Dissolved | 7440-22-4-D | 0.001 | mg/L | No |
| 6010B | Silver, Total | 7440-22-4 | 0.001 | mg/L | Yes |
| 6010B | Sodium, Dissolved | 7440-23-5-D | 1 | mg/L | No |
| 6010B | Sodium, Total | 7440-23-5 | 1 | mg/L | No |
| 6010B | Strontium, Dissolved | 7440-24-6-D | 0.02 | mg/L | No |
| 6010B | Strontium, Total | 7440-24-6 | 0.02 | mg/L | No |
| 6010B | Thallium, Dissolved | 7440-28-0-D | 0.001 | mg/L | No |
| 6010B | Thallium, Total | 7440-28-0 | 0.001 | mg/L | Yes |
| 6010B | Tin, Total | 7440-31-5 | 0.003 | mg/L | Yes |
| 6010B | Titanium, Dissolved | 7440-32-6-D | 0.005 | mg/L | No |
| 6010B | Titanium, Total | 7440-32-6 | 0.005 | mg/L | No |
| 6010B | Vanadium, Dissolved | 7440-62-2-D | 0.005 | mg/L | No |
| 6010B | Vanadium, Total | 7440-62-2 | 0.005 | mg/L | Yes |
| 6010B | Zinc, Dissolved | 7440-66-6-D | 0.02 | mg/L | No |
| 6010B | Zinc, Total | 7440-66-6 | 0.02 | mg/L | Yes |
| 6010B | Zirconium, Dissolved | 7440-67-7-D | 0.05 | mg/L | No |
| 6010B | Zirconium, Total | 7440-67-7 | 0.05 | mg/L | No |
| 6020 | Aluminum, Dissolved | 7429-90-5-D | 0.05 | mg/L | No |
| 6020 | Aluminum, Total | 7429-90-5 | 0.05 | mg/L | No |
| 6020 | Antimony, Dissolved | 7440-36-0-D | 0.002 | mg/L | No |
| 6020 | Antimony, Total | 7440-36-0 | 0.002 | mg/L | Yes |
| 6020 | Arsenic, Dissolved | 7440-38-2-D | 0.002 | mg/L | No |
| 6020 | Arsenic, Total | 7440-38-2 | 0.002 | mg/L | Yes |
| 6020 | Barium, Dissolved | 7440-39-3-D | 0.005 | mg/L | No |
| 6020 | Barium, Total | 7440-39-3 | 0.005 | mg/L | Yes |
| 6020 | Beryllium, Dissolved | 7440-41-7-D | 0.0005 | mg/L | No |
| 6020 | Beryllium, Total | 7440-41-7 | 0.0005 | mg/L | Yes |
| 6020 | Boron, Dissolved | 7440-42-8-D | 0.05 | mg/L | No |
| 6020 | Boron, Total | 7440-42-8 | 0.05 | mg/L | No |
| 6020 | Cadmium, Dissolved | 7440-43-9-D | 0.001 | mg/L | No |
| 6020 | Cadmium, Total | 7440-43-9 | 0.001 | mg/L | Yes |
| 6020 | Calcium, Dissolved | 7440-70-2-D | 0.2 | mg/L | No |
| 6020 | Calcium, Total | 7440-70-2 | 0.2 | mg/L | No |
| 6020 | Chromium, Dissolved | 7440-47-3-D | 0.002 | mg/L | No |
| 6020 | Chromium, Total | 7440-47-3 | 0.002 | mg/L | Yes |

See last page of table for notes and abbreviations.

| Method | Analyte | CAS Number | Reporting Limit | Reporting Limit Units | Appendix IX Constituent |
|---|---|---|---|---|---|
| 6020 | Cobalt, Dissolved | 7440-48-4-D | 0.005 | mg/L | No |
| 6020 | Cobalt, Total | 7440-48-4 | 0.005 | mg/L | Yes |
| 6020 | Copper, Dissolved | 7440-50-8-D | 0.002 | mg/L | No |
| 6020 | Copper, Total | 7440-50-8 | 0.002 | mg/L | Yes |
| 6020 | Iron (II) | 7439-89-6 | 0.02 | mg/L | No |
| 6020 | Iron (II), Dissolved | 7439-89-6-D | 0.02 | mg/L | No |
| 6020 | Iron, Dissolved | 7439-89-6-D | 0.2 | mg/L | No |
| 6020 | Iron,Total | 7439-89-6 | 0.2 | mg/L | No |
| 6020 | Lead, Dissolved | 7439-92-1-D | 0.001 | mg/L | No |
| 6020 | Lead, Total | 7439-92-1 | 0.001 | mg/L | Yes |
| 6020 | Lithium, Dissolved | 7439-93-2-D | 0.05 | mg/L | No |
| 6020 | Lithium, Total | 7439-93-2 | 0.05 | mg/L | No |
| 6020 | Magnesium, Dissolved | 7439-95-4-D | 0.1 | mg/L | No |
| 6020 | Magnesium, Total | 7439-95-4 | 0.1 | mg/L | No |
| 6020 | Manganese, Dissolved | 7439-96-5-D | 0.005 | mg/L | No |
| 6020 | Manganese, Total | 7439-96-5 | 0.005 | mg/L | No |
| 6020 | Molybdenum, Dissolved | 7439-98-7-D | 0.01 | mg/L | No |
| 6020 | Molybdenum, Total | 7439-98-7 | 0.01 | mg/L | No |
| 6020 | Nickel, Dissolved | 7440-02-0-D | 0.002 | mg/L | No |
| 6020 | Nickel, Total | 7440-02-0 | 0.002 | mg/L | Yes |
| 6020 | Phosphorus, Dissolved | 7723-14-0-D | 0.05 | mg/L | No |
| 6020 | Phosphorus, Total | 7723-14-0 | 0.05 | mg/L | No |
| 6020 | Potassium, Dissolved | 7440-09-7-D | 0.5 | mg/L | No |
| 6020 | Potassium, Total | 7440-09-7 | 0.5 | mg/L | No |
| 6020 | Selenium, Dissolved | 7782-49-2-D | 0.002 | mg/L | No |
| 6020 | Selenium, Total | 7782-49-2 | 0.002 | mg/L | Yes |
| 6020 | Silver, Dissolved | 7440-22-4-D | 0.001 | mg/L | No |
| 6020 | Silver, Total | 7440-22-4 | 0.001 | mg/L | Yes |
| 6020 | Sodium, Dissolved | 7440-23-5-D | 1 | mg/L | No |
| 6020 | Sodium, Total | 7440-23-5 | 1 | mg/L | No |
| 6020 | Strontium, Dissolved | 7440-24-6-D | 0.02 | mg/L | No |
| 6020 | Strontium, Total | 7440-24-6 | 0.02 | mg/L | No |
| 6020 | Thallium, Dissolved | 7440-28-0-D | 0.001 | mg/L | No |
| 6020 | Thallium, Total | 7440-28-0 | 0.001 | mg/L | Yes |
| 6020 | Tin, Total | 7440-31-5 | 0.003 | mg/L | Yes |
| 6020 | Titanium, Dissolved | 7440-32-6-D | 0.005 | mg/L | No |
| 6020 | Titanium, Total | 7440-32-6 | 0.005 | mg/L | No |
| 6020 | Vanadium, Dissolved | 7440-62-2-D | 0.005 | mg/L | No |
| 6020 | Vanadium, Total | 7440-62-2 | 0.005 | mg/L | Yes |
| 6020 | Zinc, Dissolved | 7440-66-6-D | 0.02 | mg/L | No |
| 6020 | Zinc, Total | 7440-66-6 | 0.02 | mg/L | Yes |
| 6020 | Zirconium, Dissolved | 7440-67-7-D | 0.05 | mg/L | No |
| 6020 | Zirconium, Total | 7440-67-7 | 0.05 | mg/L | No |
| 6850 | Perchlorate | 14797-73-0 | 2 | ug/L | No |
| 6860 | Perchlorate | 14797-73-0 | 2 | ug/L | No |
| 7196A | Hexavalent Chromium, Dissolved | 18540-29-9-D | 0.01 | mg/L | No |
| 7196A | Hexavalent Chromium, Total | 18540-29-9 | 0.01 | mg/L | No |
| 7199 | Hexavalent Chromium, Dissolved | 18540-29-9-D | 0.01 | mg/L | No |

| Method | Analyte | CAS Number | Reporting Limit | Reporting Limit Units | Appendix IX Constituent |
|---|---|---|---|---|---|
| 7199 | Hexavalent Chromium, Total | 18540-29-9 | 0.01 | mg/L | No |
| 7470A | Mercury, Dissolved | 7439-97-6-D | 0.0001 | mg/L | No |
| 7470A | Mercury, Total | 7439-97-6 | 0.0001 | mg/L | Yes |
| 8015 | Diesel Range Organics (C12-C14) | EFHD (C12-C14) | 0.47 | mg/L | No |
| 8015 | Diesel Range Organics (C15-C20) | EFHD (C15-C20) | 0.47 | mg/L | No |
| 8015 | Diesel Range Organics (C21-C30) | EFHD (C21-C30) | 0.47 | mg/L | No |
| 8015 | Diesel Range Organics (C8-C11) | EFHD (C8-C11) | 0.47 | mg/L | No |
| 8015 | Diesel Range Organics (C8-C30) | EFHD (C8-C30) | 0.47 | mg/L | No |
| 8015 | Gasoline Range Organics (C4-C12) | GRO C4-C12 | 50 | ug/L | No |
| 8015 | Gasoline Range Organics (C6-C12) | GRO C6-C12 | 50 | ug/L | No |
| 8015B | Diesel Range Organics (C12-C14) | EFHD (C12-C14) | 0.47 | mg/L | No |
| 8015B | Diesel Range Organics (C15-C20) | EFHD (C15-C20) | 0.47 | mg/L | No |
| 8015B | Diesel Range Organics (C21-C30) | EFHD (C21-C30) | 0.47 | mg/L | No |
| 8015B | Diesel Range Organics (C8-C11) | EFHD (C8-C11) | 0.47 | mg/L | No |
| 8015B | Diesel Range Organics (C8-C30) | EFHD (C8-C30) | 0.47 | mg/L | No |
| 8015B | Gasoline Range Organics (C4-C12) | GRO C4-C12 | 50 | ug/L | No |
| 8015B | Gasoline Range Organics (C6-C12) | GRO C6-C12 | 50 | ug/L | No |
| 8015B | Kerosene Fuel (RP-1, JP-1, JP-4; C9-C17) | PHCKC9C17 | 0.5 | mg/L | No |
| 8015B | m-Terphenyl | 92-06-8 | 0.005 | mg/L | No |
| 8015B | o-Terphenyl | 84-15-1 | 0.005 | mg/L | No |
| 8015B | p-Terphenyl | 92-94-4 | 0.005 | mg/L | No |
| 8015C | Diesel Range Organics (C12-C14) | EFHD (C12-C14) | 0.47 | mg/L | No |
| 8015C | Diesel Range Organics (C15-C20) | EFHD (C15-C20) | 0.47 | mg/L | No |
| 8015C | Diesel Range Organics (C21-C30) | EFHD (C21-C30) | 0.47 | mg/L | No |
| 8015C | Diesel Range Organics (C8-C11) | EFHD (C8-C11) | 0.47 | mg/L | No |
| 8015C | Diesel Range Organics (C8-C30) | EFHD (C8-C30) | 0.47 | mg/L | No |
| 8081 | 4,4'-DDD | 72-54-8 | 0.095 | ug/L | Yes |
| 8081 | 4,4'-DDE | 72-55-9 | 0.095 | ug/L | Yes |
| 8081 | 4,4'-DDT | 50-29-3 | 0.095 | ug/L | Yes |
| 8081 | Aldrin | 309-00-2 | 0.05 | ug/L | Yes |
| 8081 | alpha-BHC | 319-84-6 | 0.05 | ug/L | Yes |
| 8081 | beta-BHC | 319-85-7 | 0.05 | ug/L | Yes |
| 8081 | Chlordane | 57-74-9 | 0.5 | ug/L | Yes |
| 8081 | Chlorobenzilate | 510-15-6 | 10 | ug/L | Yes |
| 8081 | delta-BHC | 319-86-8 | 0.19 | ug/L | Yes |
| 8081 | Diallate | 2303-16-4 | 10 | ug/L | Yes |
| 8081 | Dieldrin | 60-57-1 | 0.05 | ug/L | Yes |
| 8081 | Endosulfan I | 959-98-8 | 0.095 | ug/L | Yes |
| 8081 | Endosulfan II | 33213-65-9 | 0.095 | ug/L | Yes |
| 8081 | Endosulfan sulfate | 1031-07-8 | 0.19 | ug/L | Yes |
| 8081 | Endrin | 72-20-8 | 0.095 | ug/L | Yes |
| 8081 | Endrin aldehyde | 7421-93-4 | 0.23 | ug/L | Yes |
| 8081 | Endrin ketone | 53494-70-5 | 0.1 | ug/L | No |
| 8081 | gamma-BHC (Lindane) | 58-89-9 | 0.095 | ug/L | Yes |
| 8081 | Heptachlor | 76-44-8 | 0.05 | ug/L | Yes |
| 8081 | Heptachlor epoxide | 1024-57-3 | 0.05 | ug/L | Yes |
| 8081 | Kepone | 143-50-0 | 50 | ug/L | Yes |
| 8081 | Methoxychlor | 72-43-5 | 0.1 | ug/L | Yes |

| Method | Analyte | CAS Number | Reporting Limit | Reporting Limit Units | Appendix IX Constituent |
|---|---|---|---|---|---|
| 8081 | Mirex (Dechlorane) | 2385-85-5 | 0.2 | ug/L | No |
| 8081 | Toxaphene | 8001-35-2 | 4.8 | ug/L | Yes |
| 8081A | 4,4'-DDD | 72-54-8 | 0.095 | ug/L | Yes |
| 8081A | 4,4'-DDE | 72-55-9 | 0.095 | ug/L | Yes |
| 8081A | 4,4'-DDT | 50-29-3 | 0.095 | ug/L | Yes |
| 8081A | Aldrin | 309-00-2 | 0.05 | ug/L | Yes |
| 8081A | alpha-BHC | 319-84-6 | 0.05 | ug/L | Yes |
| 8081A | beta-BHC | 319-85-7 | 0.05 | ug/L | Yes |
| 8081A | Chlordane | 57-74-9 | 0.5 | ug/L | Yes |
| 8081A | Chlorobenzilate | 510-15-6 | 10 | ug/L | Yes |
| 8081A | delta-BHC | 319-86-8 | 0.19 | ug/L | Yes |
| 8081A | Diallate | 2303-16-4 | 10 | ug/L | Yes |
| 8081A | Dieldrin | 60-57-1 | 0.05 | ug/L | Yes |
| 8081A | Endosulfan I | 959-98-8 | 0.095 | ug/L | Yes |
| 8081A | Endosulfan II | 33213-65-9 | 0.095 | ug/L | Yes |
| 8081A | Endosulfan sulfate | 1031-07-8 | 0.19 | ug/L | Yes |
| 8081A | Endrin | 72-20-8 | 0.095 | ug/L | Yes |
| 8081A | Endrin aldehyde | 7421-93-4 | 0.23 | ug/L | Yes |
| 8081A | Endrin ketone | 53494-70-5 | 0.1 | ug/L | No |
| 8081A | gamma-BHC (Lindane) | 58-89-9 | 0.095 | ug/L | Yes |
| 8081A | Heptachlor | 76-44-8 | 0.05 | ug/L | Yes |
| 8081A | Heptachlor epoxide | 1024-57-3 | 0.05 | ug/L | Yes |
| 8081A | Kepone | 143-50-0 | 50 | ug/L | Yes |
| 8081A | Methoxychlor | 72-43-5 | 0.1 | ug/L | Yes |
| 8081A | Mirex (Dechlorane) | 2385-85-5 | 0.2 | ug/L | No |
| 8081A | Toxaphene | 8001-35-2 | 4.8 | ug/L | Yes |
| 8082 | Aroclor 1016 | 12674-11-2 | 1 | ug/L | Yes |
| 8082 | Aroclor 1221 | 11104-28-2 | 1 | ug/L | Yes |
| 8082 | Aroclor 1232 | 11141-16-5 | 1 | ug/L | Yes |
| 8082 | Aroclor 1242 | 53469-21-9 | 1 | ug/L | Yes |
| 8082 | Aroclor 1248 | 12672-29-6 | 1 | ug/L | Yes |
| 8082 | Aroclor 1254 | 11097-69-1 | 1 | ug/L | Yes |
| 8082 | Aroclor 1260 | 11096-82-5 | 1 | ug/L | Yes |
| 8082 | Aroclor 1262 | 37324-23-5 | 0.5 | ug/L | No |
| 8082 | Aroclor 1268 | 11100-14-4 | 0.5 | ug/L | No |
| 8082 | Aroclor 5432 | 61788-33-8 | 0.5 | ug/L | No |
| 8082 | Aroclor 5442 | 12642-23-8 | 0.5 | ug/L | No |
| 8082 | Aroclor 5460 | 11126-42-4 | 0.5 | ug/L | No |
| 8082 | PCB 101 | 37680-73-2 | 0.01 | ug/L | No |
| 8082 | PCB 105 | 32598-14-4 | 0.01 | ug/L | No |
| 8082 | PCB 110 | 38380-03-9 | 0.01 | ug/L | No |
| 8082 | PCB 114 | 74472-37-0 | 0.01 | ug/L | No |
| 8082 | PCB 118 | 31508-00-6 | 0.01 | ug/L | No |
| 8082 | PCB 119 | 56558-17-9 | 0.01 | ug/L | No |
| 8082 | PCB 123 | 65510-44-3 | 0.01 | ug/L | No |
| 8082 | PCB 126 | 57465-28-8 | 0.01 | ug/L | No |
| 8082 | PCB 128 | 38380-07-3 | 0.01 | ug/L | No |
| 8082 | PCB 132 | 38380-05-1 | 0.01 | ug/L | No |

See last page of table for notes and abbreviations.

| Method | Analyte | CAS Number | Reporting Limit | Reporting Limit Units | Appendix IX Constituent |
|---|---|---|---|---|---|
| 8082 | PCB 138 | 35065-28-2 | 0.01 | ug/L | No |
| 8082 | PCB 149 | 38380-04-0 | 0.01 | ug/L | No |
| 8082 | PCB 151 | 52663-63-5 | 0.01 | ug/L | No |
| 8082 | PCB 153 | 35065-27-1 | 0.01 | ug/L | No |
| 8082 | PCB 156 | 38380-08-4 | 0.01 | ug/L | No |
| 8082 | PCB 157 | 69782-90-7 | 0.01 | ug/L | No |
| 8082 | PCB 158 | 74472-42-7 | 0.01 | ug/L | No |
| 8082 | PCB 167 | 52663-72-6 | 0.01 | ug/L | No |
| 8082 | PCB 168 | 59291-65-5 | 0.01 | ug/L | No |
| 8082 | PCB 169 | 32774-16-6 | 0.01 | ug/L | No |
| 8082 | PCB 170 | 35065-30-6 | 0.01 | ug/L | No |
| 8082 | PCB 177 | 52663-70-4 | 0.01 | ug/L | No |
| 8082 | PCB 18 | 37680-65-2 | 0.01 | ug/L | No |
| 8082 | PCB 180 | 35065-29-3 | 0.01 | ug/L | No |
| 8082 | PCB 183 | 52663-69-1 | 0.01 | ug/L | No |
| 8082 | PCB 187 | 52663-68-0 | 0.01 | ug/L | No |
| 8082 | PCB 189 | 39635-31-9 | 0.01 | ug/L | No |
| 8082 | PCB 194 | 35694-08-7 | 0.01 | ug/L | No |
| 8082 | PCB 201 | 40186-71-8 | 0.01 | ug/L | No |
| 8082 | PCB 206 | 40186-72-9 | 0.01 | ug/L | No |
| 8082 | PCB 28 | 7012-37-5 | 0.01 | ug/L | No |
| 8082 | PCB 37 | 38444-90-5 | 0.01 | ug/L | No |
| 8082 | PCB 44 | 41464-39-5 | 0.01 | ug/L | No |
| 8082 | PCB 49 | 41464-40-8 | 0.01 | ug/L | No |
| 8082 | PCB 52 | 35693-99-3 | 0.01 | ug/L | No |
| 8082 | PCB 66 | 32598-10-0 | 0.01 | ug/L | No |
| 8082 | PCB 70 | 32598-11-1 | 0.01 | ug/L | No |
| 8082 | PCB 74 | 32690-93-0 | 0.01 | ug/L | No |
| 8082 | PCB 77 | 32598-13-3 | 0.01 | ug/L | No |
| 8082 | PCB 81 | 70362-50-4 | 0.01 | ug/L | No |
| 8082 | PCB 87 | 38380-02-8 | 0.01 | ug/L | No |
| 8082 | PCB 99 | 38380-01-7 | 0.01 | ug/L | No |
| 8141A | Dimethoate | 60-51-5 | 0.95 | ug/L | Yes |
| 8141A | Disulfoton | 298-04-4 | 1 | ug/L | Yes |
| 8141A | Famphur | 52-85-7 | 10 | ug/L | Yes |
| 8141A | Parathion-ethyl | 56-38-2 | 1 | ug/L | Yes |
| 8141A | Parathion-methyl | 298-00-0 | 0.47 | ug/L | Yes |
| 8141A | Phorate | 298-02-2 | 1.2 | ug/L | Yes |
| 8141A | Sulfotepp | 3689-24-5 | 1.5 | ug/L | Yes |
| 8141A | Thionazin | 297-97-2 | 0.47 | ug/L | Yes |
| 8151A | 2,4,5-T | 93-76-5 | 1 | ug/L | Yes |
| 8151A | 2,4,5-TP (Silvex) | 93-72-1 | 1 | ug/L | Yes |
| 8151A | 2,4-D | 94-75-7 | 1 | ug/L | Yes |
| 8151A | 2,4-DB | 94-82-6 | 4 | ug/L | No |
| 8151A | Dalapon | 75-99-0 | 2 | ug/L | No |
| 8151A | Dicamba | 18-00-9 | 2 | ug/L | No |
| 8151A | Dichloroprop | 120-36-5 | 4 | ug/L | No |
| 8151A | Dinoseb | 88-85-7 | 1 | ug/L | Yes |

See last page of table for notes and abbreviations.

| Method | Analyte | CAS Number | Reporting Limit | Reporting Limit Units | Appendix IX Constituent |
|---|---|---|---|---|---|
| 8151A | Hexachlorophene | 70-30-4 | 50 | ug/L | Yes |
| 8151A | MCPA | 94-74-6 | 500 | ug/L | No |
| 8151A | MCPP | 93-65-2 | 500 | ug/L | No |
| 8151A | Pentachlorophenol (PCP) | 87-86-5 | 1 | ug/L | Yes |
| 8260B | 1,1,1,2-Tetrachloroethane | 630-20-6 | 5 | ug/L | Yes |
| 8260B | 1,1,1-Trichloroethane | 71-55-6 | 1 | ug/L | Yes |
| 8260B | 1,1,2,2-Tetrachloroethane | 79-34-5 | 1 | ug/L | Yes |
| 8260B | 1,1,2-Trichloro-1,2,2-trifluoroethane | 76-13-1 | 5 | ug/L | No |
| 8260B | 1,1,2-Trichloroethane | 79-00-5 | 1 | ug/L | Yes |
| 8260B | 1,1-Dichloroethane | 75-34-3 | 1 | ug/L | Yes |
| 8260B | 1,1-Dichloroethene | 75-35-4 | 1 | ug/L | Yes |
| 8260B | 1,1-Dichloropropene | 563-58-6 | 2 | ug/L | No |
| 8260B | 1,2,3-Trichlorobenzene | 87-61-6 | 5 | ug/L | No |
| 8260B | 1,2,3-Trichloropropane (TCP) | 96-18-4 | 0.005 | ug/L | Yes |
| 8260B | 1,2,4-Trichlorobenzene | 120-82-1 | 5 | ug/L | Yes |
| 8260B | 1,2,4-Trimethylbenzene | 95-63-6 | 2 | ug/L | No |
| 8260B | 1,2-Dibromo-3-chloropropane (DBCP) | 96-12-8 | 0.02 | ug/L | Yes |
| 8260B | 1,2-Dibromoethane (EDB) | 106-93-4 | 0.02 | ug/L | Yes |
| 8260B | 1,2-Dichlorobenzene | 95-50-1 | 1 | ug/L | Yes |
| 8260B | 1,2-Dichloroethane | 107-06-2 | 0.5 | ug/L | Yes |
| 8260B | 1,2-Dichloropropane | 78-87-5 | 1 | ug/L | Yes |
| 8260B | 1,3,5-Trimethylbenzene | 108-67-8 | 2 | ug/L | No |
| 8260B | 1,3-Dichlorobenzene | 541-73-1 | 1 | ug/L | Yes |
| 8260B | 1,3-Dichloropropane | 142-28-9 | 2 | ug/L | No |
| 8260B | 1,4-Dichlorobenzene | 106-46-7 | 1 | ug/L | Yes |
| 8260B | 1,4-Dioxane | 123-91-1 | 3 | ug/L | Yes |
| 8260B | 2,2-Dichloropropane | 594-20-7 | 1 | ug/L | No |
| 8260B | 2-Chloro-1,1,1-trifluoroethane | 75-88-7 | 5 | ug/L | No |
| 8260B | 2-Chloroethyl vinyl ether | 110-75-8 | 5 | ug/L | No |
| 8260B | 2-Chlorotoluene | 95-49-8 | 5 | ug/L | No |
| 8260B | 2-Hexanone | 591-78-6 | 10 | ug/L | Yes |
| 8260B | 4-Chlorotoluene | 106-43-4 | 5 | ug/L | No |
| 8260B | Acetone | 67-64-1 | 10 | ug/L | Yes |
| 8260B | Acetonitrile | 75-05-8 | 30 | ug/L | Yes |
| 8260B | Acrolein | 107-02-8 | 20 | ug/L | Yes |
| 8260B | Acrylonitrile | 107-13-1 | 20 | ug/L | Yes |
| 8260B | Allyl chloride | 107-05-1 | 2 | ug/L | Yes |
| 8260B | Benzene | 71-43-2 | 0.5 | ug/L | Yes |
| 8260B | Bromobenzene | 108-86-1 | 5 | ug/L | No |
| 8260B | Bromochloromethane | 74-97-5 | 5 | ug/L | No |
| 8260B | Bromodichloromethane | 75-27-4 | 1 | ug/L | Yes |
| 8260B | Bromoform | 75-25-2 | 1 | ug/L | Yes |
| 8260B | Bromomethane | 74-83-9 | 1 | ug/L | Yes |
| 8260B | Carbon Disulfide | 75-15-0 | 5 | ug/L | Yes |
| 8260B | Carbon Tetrachloride | 56-23-5 | 0.5 | ug/L | Yes |
| 8260B | Chlorobenzene | 108-90-7 | 1 | ug/L | Yes |
| 8260B | Chloroethane | 75-00-3 | 1 | ug/L | Yes |
| 8260B | Chloroform | 67-66-3 | 1 | ug/L | Yes |

| Method | Analyte | CAS Number | Reporting Limit | Reporting Limit Units | Appendix IX Constituent |
|---|---|---|---|---|---|
| 8260B | Chloromethane | 74-87-3 | 1 | ug/L | Yes |
| 8260B | Chloroprene | 126-99-8 | 1 | ug/L | Yes |
| 8260B | Chlorotrifluoroethylene | 79-38-9 | 5 | ug/L | No |
| 8260B | cis-1,2-Dichloroethene | 156-59-2 | 1 | ug/L | Yes |
| 8260B | cis-1,3-Dichloropropene | 10061-01-5 | 0.5 | ug/L | Yes |
| 8260B | Dibromochloromethane | 124-48-1 | 1 | ug/L | Yes |
| 8260B | Dibromomethane | 74-95-3 | 2 | ug/L | Yes |
| 8260B | Dichlorodifluoromethane | 75-71-8 | 5 | ug/L | Yes |
| 8260B | Ethyl methacrylate | 97-63-2 | 3 | ug/L | Yes |
| 8260B | Ethylbenzene | 100-41-4 | 1 | ug/L | Yes |
| 8260B | Hexachlorobutadiene | 87-68-3 | 5 | ug/L | Yes |
| 8260B | Iodomethane | 74-88-4 | 2 | ug/L | Yes |
| 8260B | Isobutanol | 78-83-1 | 110 | ug/L | Yes |
| 8260B | Isopropanol (isopropyl alcohol, 2-propanol) | 67-63-0 | 100 | ug/L | No |
| 8260B | Isopropylbenzene | 98-82-8 | 2 | ug/L | No |
| 8260B | Methacrylonitrile | 126-98-7 | 10 | ug/L | Yes |
| 8260B | Methyl ethyl ketone | 78-93-3 | 10 | ug/L | Yes |
| 8260B | Methyl isobutyl ketone (MIBK) | 108-10-1 | 10 | ug/L | Yes |
| 8260B | Methyl methacrylate | 80-62-6 | 4 | ug/L | Yes |
| 8260B | Methylene chloride | 75-09-2 | 5 | ug/L | Yes |
| 8260B | Methyl-tert-butyl-Ether (MTBE) | 1634-04-4 | 5 | ug/L | No |
| 8260B | m-Xylene & p-Xylene | 136777-61-2 | 1 | ug/L | Yes |
| 8260B | n-Butylbenzene | 104-51-8 | 5 | ug/L | No |
| 8260B | Nitrobenzene | 98-95-3 | 5 | ug/L | Yes |
| 8260B | n-Propylbenzene | 103-65-1 | 2 | ug/L | No |
| 8260B | o-Xylene | 95-47-6 | 1 | ug/L | Yes |
| 8260B | Pentachloroethane | 76-01-7 | 10 | ug/L | Yes |
| 8260B | p-Isopropyltoluene | 99-87-6 | 2 | ug/L | No |
| 8260B | Propionitrile | 107-12-0 | 20 | ug/L | Yes |
| 8260B | Sec-Butylbenzene | 135-98-8 | 5 | ug/L | No |
| 8260B | Styrene | 100-42-5 | 2 | ug/L | Yes |
| 8260B | Tert-Butylbenzene | 98-06-6 | 5 | ug/L | No |
| 8260B | Tetrachloroethene | 127-18-4 | 1 | ug/L | Yes |
| 8260B | Toluene | 108-88-3 | 1 | ug/L | Yes |
| 8260B | trans-1,2-Dichloroethene | 156-60-5 | 1 | ug/L | Yes |
| 8260B | trans-1,3-Dichloropropene | 10061-02-6 | 0.5 | ug/L | Yes |
| 8260B | trans-1,4-Dichloro-2-butene | 110-57-6 | 10 | ug/L | Yes |
| 8260B | Trichloroethene | 79-01-6 | 1 | ug/L | Yes |
| 8260B | Trichlorofluoromethane (Freon 11) | 75-69-4 | 1 | ug/L | Yes |
| 8260B | Vinyl acetate | 108-05-4 | 5 | ug/L | Yes |
| 8260B | Vinyl chloride | 75-01-4 | 0.5 | ug/L | Yes |
| 8260B SIM | 1,4-Dioxane | 123-91-1 | 3 | ug/L | Yes |
| 8260MSIM | 1,4-Dioxane | 123-91-1 | 3 | ug/L | Yes |
| 8260SIM | 1,2,3-Trichloropropane (TCP) | 96-18-4 | 0.005 | ug/L | Yes |
| 8260SIM | 1,4-Dioxane | 123-91-1 | 3 | ug/L | Yes |
| 8270C | 1,2,4,5-Tetrachlorobenzene | 95-94-3 | 10 | ug/L | Yes |
| 8270C | 1,2,4-Trichlorobenzene | 120-82-1 | 5 | ug/L | Yes |
| 8270C | 1,2-Dichlorobenzene | 95-50-1 | 10 | ug/L | Yes |

| Method | Analyte | CAS Number | Reporting Limit | Reporting Limit Units | Appendix IX Constituent |
|---|---|---|---|---|---|
| 8270C | 1,2-Diphenylhydrazine | 122-66-7 | 5 | ug/L | No |
| 8270C | 1,3,5-Trinitrobenzene | 99-35-4 | 50 | ug/L | Yes |
| 8270C | 1,3-Dichlorobenzene | 541-73-1 | 4 | ug/L | Yes |
| 8270C | 1,3-Dinitrobenzene | 99-65-0 | 10 | ug/L | Yes |
| 8270C | 1,4-Dichlorobenzene | 106-46-7 | 10 | ug/L | Yes |
| 8270C | 1,4-Naphthoquinone | 130-15-4 | 50 | ug/L | Yes |
| 8270C | 1,4-Phenylenediamine | 106-50-3 | 100 | ug/L | Yes |
| 8270C | 1-Methylnaphthalene | 90-12-0 | 10 | ug/L | No |
| 8270C | 1-Naphthylamine | 134-32-7 | 10 | ug/L | Yes |
| 8270C | 2,3,4,6-Tetrachlorophenol | 58-90-2 | 50 | ug/L | Yes |
| 8270C | 2,4,5-Trichlorophenol | 95-95-4 | 10 | ug/L | Yes |
| 8270C | 2,4,6-Trichlorophenol | 88-06-2 | 10 | ug/L | Yes |
| 8270C | 2,4-Dichlorophenol | 120-83-2 | 5 | ug/L | Yes |
| 8270C | 2,4-Dimethylphenol | 105-67-9 | 10 | ug/L | Yes |
| 8270C | 2,4-Dinitrophenol | 51-28-5 | 60 | ug/L | Yes |
| 8270C | 2,4-Dinitrotoluene | 121-14-2 | 5 | ug/L | Yes |
| 8270C | 2,6-Dichlorophenol | 87-65-0 | 10 | ug/L | Yes |
| 8270C | 2,6-Dinitrotoluene | 606-20-2 | 5 | ug/L | Yes |
| 8270C | 2-Acetylaminofluorene | 53-96-3 | 100 | ug/L | Yes |
| 8270C | 2-Chloronaphthalene | 91-58-7 | 5 | ug/L | Yes |
| 8270C | 2-Chlorophenol | 95-57-8 | 5 | ug/L | Yes |
| 8270C | 2-Methylnaphthalene | 91-57-6 | 5 | ug/L | Yes |
| 8270C | 2-Methylphenol | 95-48-7 | 10 | ug/L | Yes |
| 8270C | 2-Naphthylamine | 91-59-8 | 10 | ug/L | Yes |
| 8270C | 2-Nitroaniline | 88-74-4 | 10 | ug/L | Yes |
| 8270C | 2-Nitrophenol | 88-75-5 | 9.6 | ug/L | Yes |
| 8270C | 2-Picoline | 109-06-8 | 20 | ug/L | Yes |
| 8270C | 3,3´-Dichlorobenzidine | 91-94-1 | 5 | ug/L | Yes |
| 8270C | 3,3´-Dimethylbenzidine | 119-93-7 | 20 | ug/L | Yes |
| 8270C | 3,5-Dimethylphenol | 108-68-9 | 20 | ug/L | No |
| 8270C | 3-Methylcholanthrene | 56-49-5 | 20 | ug/L | Yes |
| 8270C | 3-Methylphenol | 108-39-4 | 5 | ug/L | Yes |
| 8270C | 3-Nitroaniline | 99-09-2 | 10 | ug/L | Yes |
| 8270C | 4,6-Dinitro-2-Methylphenol | 534-52-1 | 14 | ug/L | Yes |
| 8270C | 4-Aminobiphenyl | 92-67-1 | 50 | ug/L | Yes |
| 8270C | 4-Bromophenyl phenyl ether | 101-55-3 | 5 | ug/L | Yes |
| 8270C | 4-Chloro-3-methylphenol | 59-50-7 | 10 | ug/L | Yes |
| 8270C | 4-Chloroaniline | 106-47-8 | 10 | ug/L | Yes |
| 8270C | 4-Chlorophenyl phenyl ether | 7005-72-3 | 5 | ug/L | Yes |
| 8270C | 4-Methylphenol | 106-44-5 | 10 | ug/L | Yes |
| 8270C | 4-Nitroaniline | 100-01-6 | 10 | ug/L | Yes |
| 8270C | 4-Nitrophenol | 100-02-7 | 30 | ug/L | Yes |
| 8270C | 4-Nitroquinoline-1-oxide | 56-57-5 | 100 | ug/L | Yes |
| 8270C | 5-Nitro-o-toluidine | 99-55-8 | 20 | ug/L | Yes |
| 8270C | 7,12-Dimethylbenz (a) anthracene | 57-97-6 | 20 | ug/L | Yes |
| 8270C | a,a-Dimethylphenethylamine | 122-09-8 | 50 | ug/L | Yes |
| 8270C | Acenaphthene | 83-32-9 | 5 | ug/L | Yes |
| 8270C | Acenaphthylene | 208-96-8 | 5 | ug/L | Yes |

| Method | Analyte | CAS Number | Reporting Limit | Reporting Limit Units | Appendix IX Constituent |
|---|---|---|---|---|---|
| 8270C | Acetophenone | 98-86-2 | 10 | ug/L | Yes |
| 8270C | Aniline | 62-53-3 | 10 | ug/L | Yes |
| 8270C | Anthracene | 120-12-7 | 5 | ug/L | Yes |
| 8270C | Aramite | 140-57-8 | 40 | ug/L | Yes |
| 8270C | Benzidine | 92-87-5 | 60 | ug/L | No |
| 8270C | Benzo(a)anthracene | 56-55-3 | 5 | ug/L | Yes |
| 8270C | Benzo(a)pyrene | 50-32-8 | 5 | ug/L | Yes |
| 8270C | Benzo(b)fluoranthene | 205-99-2 | 5 | ug/L | Yes |
| 8270C | Benzo(b+k)fluoranthene(total) | STOTFE | 10 | ug/L | Yes |
| 8270C | Benzo(g,h,i)perylene | 191-24-2 | 5 | ug/L | Yes |
| 8270C | Benzo(k)fluoranthene | 207-08-9 | 5 | ug/L | Yes |
| 8270C | Benzoic acid | 65-85-0 | 20 | ug/L | No |
| 8270C | Benzyl alcohol | 100-51-6 | 10 | ug/L | Yes |
| 8270C | Bis(2-chloroethoxy)methane | 111-91-1 | 5 | ug/L | Yes |
| 8270C | Bis(2-chloroethyl)ether | 111-44-4 | 5 | ug/L | Yes |
| 8270C | Bis(2-chloroisopropyl)ether | 108-60-1 | 5 | ug/L | Yes |
| 8270C | Bis(2-ethylhexyl)phthalate | 117-81-7 | 5 | ug/L | Yes |
| 8270C | Butyl benzyl phthalate | 85-68-7 | 5 | ug/L | Yes |
| 8270C | Carbazole | 86-74-8 | 20 | ug/L | No |
| 8270C | Chlorobenzilate | 510-15-6 | 10 | ug/L | Yes |
| 8270C | Chrysene | 218-01-9 | 5 | ug/L | Yes |
| 8270C | Diallate | 2303-16-4 | 10 | ug/L | Yes |
| 8270C | Dibenz(a,h)anthracene | 53-70-3 | 5 | ug/L | Yes |
| 8270C | Dibenzofuran | 132-64-9 | 5 | ug/L | Yes |
| 8270C | Diethyl phthalate | 84-66-2 | 5 | ug/L | Yes |
| 8270C | Dimethoate | 60-51-5 | 0.95 | ug/L | Yes |
| 8270C | Dimethyl phthalate | 131-11-3 | 5 | ug/L | Yes |
| 8270C | Dimethylaminoazobenzene | 60-11-7 | 20 | ug/L | Yes |
| 8270C | Di-n-butyl phthalate | 84-74-2 | 5 | ug/L | Yes |
| 8270C | Di-n-octyl phthalate | 117-84-0 | 5 | ug/L | Yes |
| 8270C | Diphenylamine | 122-39-4 | 10 | ug/L | Yes |
| 8270C | Disulfoton | 298-04-4 | 1 | ug/L | Yes |
| 8270C | Ethyl methanesulfonate | 62-50-0 | 10 | ug/L | Yes |
| 8270C | Famphur | 52-85-7 | 10 | ug/L | Yes |
| 8270C | Fluoranthene | 206-44-0 | 5 | ug/L | Yes |
| 8270C | Fluorene | 86-73-7 | 5 | ug/L | Yes |
| 8270C | Hexachlorobenzene | 118-74-1 | 5 | ug/L | Yes |
| 8270C | Hexachlorobutadiene | 87-68-3 | 5 | ug/L | Yes |
| 8270C | Hexachlorocyclopentadiene | 77-47-4 | 50 | ug/L | Yes |
| 8270C | Hexachloroethane | 67-72-1 | 5 | ug/L | Yes |
| 8270C | Hexachlorophene | 70-30-4 | 50 | ug/L | Yes |
| 8270C | Hexachloropropene | 1888-71-7 | 100 | ug/L | Yes |
| 8270C | Indeno(1,2,3-cd)pyrene | 193-39-5 | 5 | ug/L | Yes |
| 8270C | Isodrin | 465-73-6 | 10 | ug/L | Yes |
| 8270C | Isophorone | 78-59-1 | 5 | ug/L | Yes |
| 8270C | Isosafrole | 120-58-1 | 20 | ug/L | Yes |
| 8270C | Kepone | 143-50-0 | 50 | ug/L | Yes |
| 8270C | Methapyrilene | 91-80-5 | 50 | ug/L | Yes |

See last page of table for notes and abbreviations.

| Method | Analyte | CAS Number | Reporting Limit | Reporting Limit Units | Appendix IX Constituent |
|---|---|---|---|---|---|
| 8270C | Methyl methanesulfonate | 66-27-3 | 10 | ug/L | Yes |
| 8270C | Naphthalene | 91-20-3 | 5 | ug/L | Yes |
| 8270C | Nitrobenzene | 98-95-3 | 5 | ug/L | Yes |
| 8270C | n-Nitrosodiethylamine (NDEA) | 55-18-5 | 10 | ug/L | Yes |
| 8270C | n-Nitrosodimethylamine (NDMA) | 62-75-9 | 20 | ug/L | Yes |
| 8270C | n-Nitrosodi-n-butylamine | 924-16-3 | 10 | ug/L | Yes |
| 8270C | n-Nitrosodi-n-propylamine (NDPA) | 621-64-7 | 5 | ug/L | Yes |
| 8270C | n-Nitrosodiphenylamine | 86-30-6 | 5 | ug/L | Yes |
| 8270C | n-Nitrosomethylethylamine | 10595-95-6 | 10 | ug/L | Yes |
| 8270C | n-Nitrosomorpholine | 59-89-2 | 10 | ug/L | Yes |
| 8270C | n-Nitrosopiperidine | 100-75-4 | 10 | ug/L | Yes |
| 8270C | n-Nitrosopyrrolidine | 930-55-2 | 10 | ug/L | Yes |
| 8270C | O,O,O-Triethyl phosphorothioate | 126-68-1 | 50 | ug/L | Yes |
| 8270C | o-Toluidine | 95-53-4 | 10 | ug/L | Yes |
| 8270C | Parathion-ethyl | 56-38-2 | 1 | ug/L | Yes |
| 8270C | Parathion-methyl | 298-00-0 | 0.47 | ug/L | Yes |
| 8270C | Pentachlorobenzene | 608-93-5 | 10 | ug/L | Yes |
| 8270C | Pentachloroethane | 76-01-7 | 10 | ug/L | Yes |
| 8270C | Pentachloronitrobenzene | 82-68-8 | 50 | ug/L | Yes |
| 8270C | Pentachlorophenol (PCP) | 87-86-5 | 15 | ug/L | Yes |
| 8270C | Phenacetin | 62-44-2 | 20 | ug/L | Yes |
| 8270C | Phenanthrene | 85-01-8 | 5 | ug/L | Yes |
| 8270C | Phenol | 108-95-2 | 5 | ug/L | Yes |
| 8270C | Phorate | 298-02-2 | 1.2 | ug/L | Yes |
| 8270C | Pronamide | 23950-58-5 | 20 | ug/L | Yes |
| 8270C | Pyrene | 129-00-0 | 10 | ug/L | Yes |
| 8270C | Pyridine | 110-86-1 | 20 | ug/L | Yes |
| 8270C | Safrole | 94-59-7 | 20 | ug/L | Yes |
| 8270C | Sulfotepp | 3689-24-5 | 1.5 | ug/L | Yes |
| 8270C | Thionazin | 297-97-2 | 0.47 | ug/L | Yes |
| 8270CSIM | 1-Methylnaphthalene | 90-12-0 | 10 | ug/L | No |
| 8270CSIM | 2-Methylnaphthalene | 91-57-6 | 10 | ug/L | Yes |
| 8270CSIM | Acenaphthene | 83-32-9 | 10 | ug/L | Yes |
| 8270CSIM | Acenaphthylene | 208-96-8 | 10 | ug/L | Yes |
| 8270CSIM | Anthracene | 120-12-7 | 10 | ug/L | Yes |
| 8270CSIM | Benzo(a)anthracene | 56-55-3 | 10 | ug/L | Yes |
| 8270CSIM | Benzo(a)pyrene | 50-32-8 | 10 | ug/L | Yes |
| 8270CSIM | Benzo(b)fluoranthene | 205-99-2 | 10 | ug/L | Yes |
| 8270CSIM | Benzo(g,h,i)perylene | 191-24-2 | 10 | ug/L | Yes |
| 8270CSIM | Benzo(k)fluoranthene | 207-08-9 | 10 | ug/L | Yes |
| 8270CSIM | Bis(2-ethylhexyl)phthalate | 117-81-7 | 10 | ug/L | Yes |
| 8270CSIM | Butyl benzyl phthalate | 85-68-7 | 10 | ug/L | Yes |
| 8270CSIM | Chrysene | 218-01-9 | 10 | ug/L | Yes |
| 8270CSIM | Dibenz(a,h)anthracene | 53-70-3 | 10 | ug/L | Yes |
| 8270CSIM | Diethyl phthalate | 84-66-2 | 10 | ug/L | Yes |
| 8270CSIM | Dimethyl phthalate | 131-11-3 | 10 | ug/L | Yes |
| 8270CSIM | Di-n-butyl phthalate | 84-74-2 | 10 | ug/L | Yes |
| 8270CSIM | Di-n-octyl phthalate | 117-84-0 | 10 | ug/L | Yes |

See last page of table for notes and abbreviations.

| Method | Analyte | CAS Number | Reporting Limit | Reporting Limit Units | Appendix IX Constituent |
|---|---|---|---|---|---|
| 8270CSIM | Fluoranthene | 206-44-0 | 10 | ug/L | Yes |
| 8270CSIM | Fluorene | 86-73-7 | 10 | ug/L | Yes |
| 8270CSIM | Indeno(1,2,3-cd)pyrene | 193-39-5 | 10 | ug/L | Yes |
| 8270CSIM | Naphthalene | 91-20-3 | 10 | ug/L | Yes |
| 8270CSIM | n-Nitrosodimethylamine (NDMA) | 62-75-9 | 10 | ug/L | Yes |
| 8270CSIM | Phenanthrene | 85-01-8 | 10 | ug/L | Yes |
| 8270CSIM | Pyrene | 129-00-0 | 10 | ug/L | Yes |
| 8270SIM | n-Nitrosodimethylamine (NDMA) | 62-75-9 | 20 | ug/L | Yes |
| 8270SIM | Pentachlorophenol (PCP) | 87-86-5 | 1 | ug/L | Yes |
| 8290 | 1,2,3,4,6,7,8-HpCDD | 35822-46-9 | 24.8 | pg/L | Yes |
| 8290 | 1,2,3,4,6,7,8-HpCDF | 67562-39-4 | 24.8 | pg/L | Yes |
| 8290 | 1,2,3,4,7,8,9-HpCDF | 55673-89-7 | 24.8 | pg/L | Yes |
| 8290 | 1,2,3,4,7,8-HxCDD | 39227-28-6 | 24.8 | pg/L | Yes |
| 8290 | 1,2,3,4,7,8-HxCDF | 70648-26-9 | 24.8 | pg/L | Yes |
| 8290 | 1,2,3,6,7,8-HxCDD | 57653-85-7 | 24.8 | pg/L | Yes |
| 8290 | 1,2,3,6,7,8-HxCDF | 57117-44-9 | 24.8 | pg/L | Yes |
| 8290 | 1,2,3,7,8,9-HxCDD | 19408-74-3 | 24.8 | pg/L | Yes |
| 8290 | 1,2,3,7,8,9-HxCDF | 72918-21-9 | 24.8 | pg/L | Yes |
| 8290 | 1,2,3,7,8-PeCDD | 40321-76-4 | 24.8 | pg/L | Yes |
| 8290 | 1,2,3,7,8-PeCDF | 57117-41-6 | 24.8 | pg/L | Yes |
| 8290 | 2,3,4,6,7,8-HxCDF | 60851-34-5 | 24.8 | pg/L | Yes |
| 8290 | 2,3,4,7,8-PeCDF | 57117-31-4 | 24.8 | pg/L | Yes |
| 8290 | 2,3,7,8-TCDD | 1746-01-6 | 4.97 | pg/L | Yes |
| 8290 | 2,3,7,8-TCDF | 51207-31-9 | 4.97 | pg/L | Yes |
| 8290 | OCDD | 3268-87-9 | 24.8 | pg/L | Yes |
| 8290 | OCDF | 39001-02-0 | 24.8 | pg/L | Yes |
| 8315 | Formaldehyde | 50-00-0 | 50 | ug/L | No |
| DV-WC-0077* | 1,1-Dimethylhydrazine (unsymmetrical dimethylhydrazine, UDMH) | 57-14-7 | 5 | ug/L | No |
| DV-WC-0077* | Hydrazine | 302-01-2 | 1 | ug/L | No |
| DV-WC-0077* | Monomethylhydrazine (MMH) | 50-00-0 | 50 | ug/L | No |
| 8315A | 1,1-Dimethylhydrazine (unsymmetrical dimethylhydrazine, UDMH) | 57-14-7 | 5 | ug/L | No |
| 8315A | Formaldehyde | 50-00-0 | 50 | ug/L | No |
| 8315A | Hydrazine | 302-01-2 | 1 | ug/L | No |
| 8315A | Monomethylhydrazine (MMH) | 60-34-4 | 5 | ug/L | No |
| 8315M | 1,1-Dimethylhydrazine (unsymmetrical dimethylhydrazine, UDMH) | 57-14-7 | 5 | ug/L | No |
| 8315M | Hydrazine | 302-01-2 | 1 | ug/L | No |
| 8315M | Monomethylhydrazine (MMH) | 60-34-4 | 5 | ug/L | No |
| 8321 | Perchlorate | 14797-73-0 | 2 | ug/L | No |
| 8321A | 1,3-Dinitrobenzene | 99-65-0 | 10 | ug/L | Yes |
| 8321A | Hexachlorophene | 70-30-4 | 50 | ug/L | Yes |
| 8321A | Pentachlorophenol (PCP) | 87-86-5 | 1 | ug/L | Yes |
| 8321A | Perchlorate | 14797-73-0 | 2 | ug/L | No |
| 8330 | 1,3,5-Trinitrobenzene | 99-35-4 | 0.5 | ug/L | Yes |
| 8330 | 1,3-Dinitrobenzene | 99-65-0 | 10 | ug/L | Yes |
| 8330 | 2,4,6-Trinitrotoluene | 118-96-7 | 0.5 | ug/L | No |

See last page of table for notes and abbreviations.

| Method | Analyte | CAS Number | Reporting Limit | Reporting Limit Units | Appendix IX Constituent |
|---|---|---|---|---|---|
| 8330 | 2,4-Diamino-6-nitrotoluene | 6629-29-4 | 5 | ug/L | No |
| 8330 | 2,4-Dinitrotoluene | 121-14-2 | 0.5 | ug/L | Yes |
| 8330 | 2,6-Diamino-4-Nitrotoluene | 59229-75-3 | 5 | ug/L | No |
| 8330 | 2,6-Dinitrotoluene | 606-20-2 | 0.5 | ug/L | Yes |
| 8330 | 2-Amino-4,6-dinitrotoluene | 35572-78-2 | 0.5 | ug/L | No |
| 8330 | 2-Nitrotoluene | 88-72-2 | 0.5 | ug/L | No |
| 8330 | 3-Nitrotoluene | 99-08-1 | 0.5 | ug/L | No |
| 8330 | 4-Amino-2,6-dinitrotoluene | 19406-51-0 | 0.5 | ug/L | No |
| 8330 | 4-Nitrotoluene | 99-99-0 | 0.5 | ug/L | No |
| 8330 | HMX | 2691-41-0 | 0.5 | ug/L | No |
| 8330 | Nitrobenzene | 98-95-3 | 0.5 | ug/L | Yes |
| 8330 | Nitroglycerin | 55-63-0 | 2 | ug/L | No |
| 8330 | PETN | 78-11-5 | 2 | ug/L | No |
| 8330 | RDX | 121-82-4 | 0.5 | ug/L | No |
| 8330 | Tetryl | 479-45-8 | 1.5 | ug/L | No |
| 8330A | 1,3,5-Trinitrobenzene | 99-35-4 | 0.5 | ug/L | Yes |
| 8330A | 1,3-Dinitrobenzene | 99-65-0 | 10 | ug/L | Yes |
| 8330A | 2,4,6-Trinitrotoluene | 118-96-7 | 0.5 | ug/L | No |
| 8330A | 2,4-Diamino-6-nitrotoluene | 6629-29-4 | 5 | ug/L | No |
| 8330A | 2,4-Dinitrotoluene | 121-14-2 | 0.5 | ug/L | Yes |
| 8330A | 2,6-Diamino-4-Nitrotoluene | 59229-75-3 | 5 | ug/L | No |
| 8330A | 2,6-Dinitrotoluene | 606-20-2 | 0.5 | ug/L | Yes |
| 8330A | 2-Amino-4,6-dinitrotoluene | 35572-78-2 | 0.5 | ug/L | No |
| 8330A | 2-Nitrotoluene | 88-72-2 | 0.5 | ug/L | No |
| 8330A | 3-Nitrotoluene | 99-08-1 | 0.5 | ug/L | No |
| 8330A | 4-Amino-2,6-dinitrotoluene | 19406-51-0 | 0.5 | ug/L | No |
| 8330A | 4-Nitrotoluene | 99-99-0 | 0.5 | ug/L | No |
| 8330A | HMX | 2691-41-0 | 0.5 | ug/L | No |
| 8330A | Nitrobenzene | 98-95-3 | 0.5 | ug/L | Yes |
| 8330A | Nitroglycerin | 55-63-0 | 2 | ug/L | No |
| 8330A | PETN | 78-11-5 | 2 | ug/L | No |
| 8330A | RDX | 121-82-4 | 0.5 | ug/L | No |
| 8330A | Tetryl | 479-45-8 | 1.5 | ug/L | No |
| 900.0 | Gross alpha, Dissolved | 12587-46-1 | 3 | pCi/L | No |
| 900.0 | Gross alpha, Total | 12587-46-1 | 3 | pCi/L | No |
| 900.0 | Gross beta, Dissolved | 12587-47-2 | 4 | pCi/L | No |
| 900.0 | Gross beta, Total | 12587-47-2 | 4 | pCi/L | No |
| 9012 | Total Cyanide | 57-12-5 | 0.025 | mg/L | Yes |
| 9012A | Total Cyanide | 57-12-5 | 0.025 | mg/L | Yes |
| 9012B | Total Cyanide | 57-12-5 | 0.025 | mg/L | Yes |
| 901.1 | Actinium-228 (Ac-228), Dissolved | 14331-83-0-D | 20 | pCi/L | No |
| 901.1 | Actinium-228 (Ac-228), Total | 14331-83-0 | 20 | pCi/L | No |
| 901.1 | Americium-241 (Am-241), Dissolved | 86954-36-1-D | 3 | pCi/L | No |
| 901.1 | Americium-241 (Am-241), Total | 86954-36-1 | 3 | pCi/L | No |
| 901.1 | Antimony-125 (Sb-125), Dissolved | 14234-35-6-D | 30 | pCi/L | No |
| 901.1 | Antimony-125 (Sb-125), Total | 14234-35-6 | 30 | pCi/L | No |
| 901.1 | Barium-133 (Ba-133), Dissolved | 13981-41-4-D | 20 | pCi/L | No |
| 901.1 | Barium-133 (Ba-133), Total | 13981-41-4 | 20 | pCi/L | No |

| Method | Analyte | CAS Number | Reporting Limit | Reporting Limit Units | Appendix IX Constituent |
|---|---|---|---|---|---|
| 901.1 | Cesium-134 (Cs-134), Dissolved | 13967-70-9-D | 20 | pCi/L | No |
| 901.1 | Cesium-134 (Cs-134), Total | 13967-70-9 | 20 | pCi/L | No |
| 901.1 | Cesium-137 (Cs-137), Dissolved | 10045-97-3-D | 20 | pCi/L | No |
| 901.1 | Cesium-137 (Cs-137), Total | 10045-97-3 | 20 | pCi/L | No |
| 901.1 | Cobalt-57 (Co-57), Dissolved | 13981-50-5-D | 100 | pCi/L | No |
| 901.1 | Cobalt-57 (Co-57), Total | 13981-50-5 | 100 | pCi/L | No |
| 901.1 | Cobalt-60 (Co-60), Dissolved | 10198-40-0-D | 10 | pCi/L | No |
| 901.1 | Cobalt-60 (Co-60), Total | 10198-40-0 | 10 | pCi/L | No |
| 901.1 | Europium-152 (Eu-152), Dissolved | 14683-23-9-D | 6 | pCi/L | No |
| 901.1 | Europium-152 (Eu-152), Total | 14683-23-9 | 6 | pCi/L | No |
| 901.1 | Europium-154 (Eu-154), Dissolved | 15585-10-1-D | 20 | pCi/L | No |
| 901.1 | Europium-154 (Eu-154), Total | 15585-10-1 | 20 | pCi/L | No |
| 901.1 | Europium-155 (Eu-155), Dissolved | 14391-16-3-D | 60 | pCi/L | No |
| 901.1 | Europium-155 (Eu-155), Total | 14391-16-3 | 60 | pCi/L | No |
| 901.1 | Manganese-54 (Mn-54), Dissolved | 13966-31-9-D | 30 | pCi/L | No |
| 901.1 | Manganese-54 (Mn-54), Total | 13966-31-9 | 30 | pCi/L | No |
| 901.1 | Potassium-40 (K-40), Dissolved | 13966-00-2-D | 25 | pCi/L | No |
| 901.1 | Potassium-40 (K-40), Total | 13966-00-2 | 25 | pCi/L | No |
| 901.1 | Sodium-22 (Na-22), Dissolved | 13966-32-0-D | 40 | pCi/L | No |
| 901.1 | Sodium-22 (Na-22), Total | 13966-32-0 | 40 | pCi/L | No |
| 9014 | Total Cyanide | 57-12-5 | 0.025 | mg/L | Yes |
| 902.0 | Iodine-129 (I-129), Dissolved | 15046-84-1-D | 0.5 | pCi/L | No |
| 902.0 | Iodine-129 (I-129), Total | 15046-84-1 | 0.5 | pCi/L | No |
| 903.1 | Radium-226 (Ra-226), Dissolved | 13982-63-3-D | 1 | pCi/L | No |
| 903.1 | Radium-226 (Ra-226), Total | 13982-63-3 | 1 | pCi/L | No |
| 904.0 | Radium-228 (Ra-228), Dissolved | 7440-14-4-D | 1 | pCi/L | No |
| 904.0 | Radium-228 (Ra-228), Total | 7440-14-4 | 1 | pCi/L | No |
| 9040B | pH | E-10139 | 0.01 | pH Units | No |
| 905.0 | Strontium-90 (Sr-90), Dissolved | 10098-97-2-D | 2 | pCi/L | No |
| 905.0 | Strontium-90 (Sr-90), Total | 10098-97-2 | 2 | pCi/L | No |
| 9056A | Nitrite-NO2 | 14797-65-0 | 0.1 | mg/L | No |
| 9056A | Orthophosphate-PO4 | 14265-44-2 | 0.2 | mg/L | No |
| 9056M | 1,1-Dimethylhydrazine (unsymmetrical dimethylhydrazine, UDMH) | 57-14-7 | 5 | ug/L | No |
| 9056M | Hydrazine | 302-01-2 | 1 | ug/L | No |
| 9056M | Monomethylhydrazine (MMH) | 60-34-4 | 5 | ug/L | No |
| 906.0 | Tritium, Total | 10028-17-8 | 200 | pCi/L | No |
| 9060.0 | Total Organic Carbon | 1-01-2 | 10 | mg/L | No |
| 907.0 | Thorium-228 (Th-228), Dissolved | 14274-82-9-D | 3 | pCi/L | No |
| 907.0 | Thorium-228 (Th-228), Total | 14274-82-9 | 3 | pCi/L | No |
| 907.0 | Thorium-230 (Th-230), Dissolved | 14269-63-7-D | 3 | pCi/L | No |
| 907.0 | Thorium-230 (Th-230), Total | 14269-63-7 | 3 | pCi/L | No |
| 907.0 | Thorium-232 (Th-232), Dissolved | 7440-29-1-D | 3 | pCi/L | No |
| 907.0 | Thorium-232 (Th-232), Total | 7440-29-1 | 3 | pCi/L | No |
| 908.0 | Uranium-233/234 (U-233/U-234), Dissolved | E-13230-D | 2 | pCi/L | No |
| 908.0 | Uranium-233/234 (U-233/U-234), Total | E-13230 | 2 | pCi/L | No |
| 908.0 | Uranium-234 (U-234), Dissolved | 13966-29-5-D | 2 | pCi/L | No |
| 908.0 | Uranium-234 (U-234), Total | 13966-29-5 | 2 | pCi/L | No |

See last page of table for notes and abbreviations.

| Method | Analyte | CAS Number | Reporting Limit | Reporting Limit Units | Appendix IX Constituent |
|---|---|---|---|---|---|
| 908.0 | Uranium-235 (U-235), Dissolved | 15117-96-1-D | 2 | pCi/L | No |
| 908.0 | Uranium-235 (U-235), Total | 15117-96-1 | 2 | pCi/L | No |
| 908.0 | Uranium-238 (U-238), Dissolved | 7440-61-1-D | 2 | pCi/L | No |
| 908.0 | Uranium-238 (U-238), Total | 7440-61-1 | 2 | pCi/L | No |
| CF-IRMS | Deuterium | 7782-39-0 | 2 | per mil | No |
| CF-IRMS | Oxygen-18 | O18 | 0.15 | per mil | No |
| DOE RESL Fe-1, Fe-55 | Iron-55 (Fe-55), Dissolved | 14681-59-5-D | 200 | pCi/L | No |
| DOE RESL Fe-1, Fe-55 | Iron-55 (Fe-55), Total | 14681-59-5 | 200 | pCi/L | No |
| DOE RESL | Nickel-59 (Ni-59), Dissolved | 14336-70-0-D | 30 | pCi/L | No |
| DOE RESL | Nickel-59 (Ni-59), Total | 14336-70-0 | 30 | pCi/L | No |
| DOE RESL Ni-1, Ni-59 | Nickel-59 (Ni-59), Dissolved | 14336-70-0-D | 30 | pCi/L | No |
| DOE RESL Ni-1, Ni-59 | Nickel-59 (Ni-59), Total | 14336-70-0 | 30 | pCi/L | No |
| DOE RESL | Nickel-63 (Ni-63), Dissolved | 13981-37-8-D | 5 | pCi/L | No |
| DOE RESL | Nickel-63 (Ni-63), Total | 13981-37-8 | 5 | pCi/L | No |
| DOE RESL Ni-1, Ni-63 | Nickel-63 (Ni-63), Dissolved | 13981-37-8-D | 5 | pCi/L | No |
| DOE RESL Ni-1, Ni-63 | Nickel-63 (Ni-63), Total | 13981-37-8 | 5 | pCi/L | No |
| EPA EERF C-01 | Carbon-14 (C-14), Dissolved | 14762-75-5-D | 200 | pCi/L | No |
| EPA EERF C-01 | Carbon-14 (C-14), Total | 14762-75-5 | 200 | pCi/L | No |
| Hach #8146 SM3500 | Iron (II) | 7439-89-6 | 0.02 | mg/L | No |
| Hach #8146 SM3500 | Iron (II), Dissolved | 7439-89-6-D | 0.02 | mg/L | No |
| HASL 300 I-01 Mod | Iodine-129 (I-129), Dissolved | 15046-84-1-D | 0.5 | pCi/L | No |
| HASL 300 I-01 Mod | Iodine-129 (I-129), Total | 15046-84-1 | 0.5 | pCi/L | No |
| HASL 300 Th-01-RC | Thorium-228 (Th-228), Dissolved | 14274-82-9-D | 3 | pCi/L | No |
| HASL 300 Th-01-RC | Thorium-228 (Th-228), Total | 14274-82-9 | 3 | pCi/L | No |
| HASL 300 Th-01-RC | Thorium-230 (Th-230), Dissolved | 14269-63-7-D | 3 | pCi/L | No |
| HASL 300 Th-01-RC | Thorium-230 (Th-230), Total | 14269-63-7 | 3 | pCi/L | No |
| HASL 300 Th-01-RC | Thorium-232 (Th-232), Dissolved | 7440-29-1-D | 3 | pCi/L | No |
| HASL 300 Th-01-RC | Thorium-232 (Th-232), Total | 7440-29-1 | 3 | pCi/L | No |
| HASL 300 U-02-RC | Uranium-233/234 (U-233/U-234), Dissolved | E-13230-D | 2 | pCi/L | No |
| HASL 300 U-02-RC | Uranium-233/234 (U-233/U-234), Dissolved | E-13230 | 2 | pCi/L | No |
| HASL 300 U-02-RC | Uranium-234 (U-234), Dissolved | 23966-29-5-D | 2 | pCi/L | No |
| HASL 300 U-02-RC | Uranium-234 (U-234), Total | 23966-29-5 | 2 | pCi/L | No |
| HASL 300 U-02-RC | Uranium-235 (U-235), Dissolved | 15117-96-1-D | 2 | pCi/L | No |
| HASL 300 U-02-RC | Uranium-235 (U-235), Total | 15117-96-1 | 2 | pCi/L | No |
| HASL 300 U-02-RC | Uranium-238 (U-238), Dissolved | 7440-61-1-D | 2 | pCi/L | No |
| HASL 300 U-02-RC | Uranium-238 (U-238), Total | 7440-61-1 | 2 | pCi/L | No |
| HASL-300 | Curium-243 (Cm-243), Dissolved | 15757-87-6-D | 3 | pCi/L | No |
| HASL-300 | Curium-243 (Cm-243), Total | 15757-87-6 | 3 | pCi/L | No |
| HASL-300 | Plutonium-238 (Pu-238), Dissolved | 13981-16-3-D | 3 | pCi/L | No |
| HASL-300 | Plutonium-238 (Pu-238), Total | 13981-16-3 | 3 | pCi/L | No |
| HASL-300 | Plutonium-239 (Pu-239), Dissolved | 15117-48-3-D | 3 | pCi/L | No |
| HASL-300 | Plutonium-239 (Pu-239), Total | 15117-48-3 | 3 | pCi/L | No |
| HASL-300 | Pu-239/Pu-240, Dissolved | E-13207-D | 3 | pCi/L | No |
| HASL-300 | Pu-239/Pu-240, Total | E-13207 | 3 | pCi/L | No |
| HASL-300 | Plutonium-240 (Pu-240), Dissolved | 14119-33-6-D | 3 | pCi/L | No |
| HASL-300 | Plutonium-240 (Pu-240), Total | 14119-33-6 | 3 | pCi/L | No |
| HASL-300 | Plutonium-241 (Pu-241), Dissolved | 14119-32-5-D | 20 | pCi/L | No |
| HASL-300 | Plutonium-241 (Pu-241), Total | 14119-32-5 | 20 | pCi/L | No |

| Method | Analyte | CAS Number | Reporting Limit | Reporting Limit Units | Appendix IX Constituent |
|---|---|---|---|---|---|
| HASL-300 | Plutonium-242 (Pu-242), Dissolved | 13982-10-0-D | 3 | pCi/L | No |
| HASL-300 | Plutonium-242 (Pu-242), Total | 13982-10-0 | 3 | pCi/L | No |
| HASL-300 | Technetium-99 (Tc-99), Dissolved | 14133-76-7-D | 90 | pCi/L | No |
| HASL-300 | Technetium-99 (Tc-99), Total | 14133-76-7 | 90 | pCi/L | No |
| HASL-300 | Lead-210 (Pb-210), Dissolved | 14255-04-0-D | 20 | pCi/L | No |
| HASL-300 | Lead-210 (Pb-210), Total | 14255-04-0 | 20 | pCi/L | No |
| HASL-300 | Neptunium-237 (Np-237), Dissolved | 13994-20-2-D | 3 | pCi/L | No |
| HASL-300 | Neptunium-237 (Np-237), Total | 13994-20-2 | 3 | pCi/L | No |
| Microseeps | Hydrogen | 1333-74-0 | 0.03 | nM | No |
| RSK-175 | Ethane | 74-84-0 | 2 | ug/L | No |
| RSK-175 | Ethene | 74-85-1 | 3 | ug/L | No |
| RSK-175 | Methane | 74-82-8 | 1 | ug/L | No |
| SM2130B | Turbidity | E-10607 | 0.3 | NTU | No |
| SM2320B | Alkalinity | TAlk | 2 | mg/L | No |
| SM2320B | Alkalinity as CaCO3 | TAlk | 2 | mg/L | No |
| SM2320B | Bicarbonate | 71-52-3 | 2.4 | mg/L | No |
| SM2320B | Carbonate | 3812-32-6 | 2 | mg/L | No |
| SM2510B | Specific Conductance | E-10184 | 5 | umhos/cm | No |
| SM2540C | Total Dissolved Solids | E-10173 | 30 | mg/L | No |
| SM4500-NH3 | Ammonia | 7664-41-7 | 0.5 | mg/L | No |
| SM4500-NH3 | Ammonia-N | 7664-41-7 | 0.5 | mg/L | No |
| SM4500-H | pH | E-10139 | 0.01 | pH Units | No |
| SM4500 SD | Sulfide | 18496-25-8 | 0.1 | mg/L | Yes |
| SRL 524M | 1,2,3-Trichloropropane (TCP) | 96-18-4 | 0.005 | ug/L | Yes |

**NOTES AND ABBREVIATIONS**

1. umhos/cm = Micromhos per centimeter.
2. mg/L = Milligrams per liter.
3. NTU = Nephelometric Turbidity Units.
4. pg/L = Picograms per liter.
5. ug/L = Micrograms per liter.
6. CAS = Chemical Abstract Service
7. pCi/L = PicoCuries per liter.
8. * = TestAmerica Laboratories internal method.
9. For additional methods requested, see the Quality Assurance Project Plan SSFL RCRA Facility Investigation Surficial Media Operable Unit (March 2009, Revision 4).

| Matrix | Analytical Parameter | Method | Container | Sample Volume or Weight[(a)] | Preservative | Holding Time |
|---|---|---|---|---|---|---|
| Water | 1,2-dibromo-3-chloroprane (DBCP)<br>1,2-dibromoethane (EDB) | EPA 504.1, SW-846 8260B | G | 3 x 40 mL | Na2S2O3 | 14 days |
| Water | 1,2,3-Trichloropropane (TCP) | SRL 524M, EPA 504.1, SW 846 8260SIM, 8260B | G | 3 x 40 mL | Cool to 4°C | 14 days |
| Water | 1,4-Dioxane | SW 846 8260SIM, 8260MSIM, 8260B | G | 3 x 40 mL | Cool to 4°C<br>HCl | 7 days |
| Water | Alkalinity, Alkalinity as CaCO3 | SM2320B,<br>EPA 310.1, 310.2 | P, G | 200 mL | Cool to 4°C | 14 days |
| Water | Ammonia, Ammonia-N | EPA 350.1, 350.2, 350.3, SM4500-NH3 | P, G | 100 mL | Cool to 4°C H2SO4 to pH < 2 | 28 days |
| Water | Bicarbonate, Carbonate | SM2320B | P, G | 200 mL | Cool to 4°C | 14 days |
| Water | Bromide | EPA 300.0 | P, G | 50 mL | Cool to 4°C | 28 days |
| Water | Carbon-14 (C-14) | EPA EERF C-01 | P | 1 L | $HNO_3$ to pH<2 | 6 months |
| Water | Chloride | EPA 300.0 | P, G | 50 mL | Cool to 4°C | 28 days |
| Water | Chloro-phenoxy acetic acid Herbicides | SW-846 8151A | G (amber) | 1 L | Cool to 4°C | 7/40 days |
| Water | Cyanide | SW-846 9012, 9012A, 9012B, 9014 | P | 250 mL | NaOH | 14 days |
| Water | Deuterium,<br>Oxygen-18 | CF-IRMS | G | 3 x 40 mL | Cool to 4°C | None |

| Matrix | Analytical Parameter | Method | Container | Sample Volume or Weight[(a)] | Preservative | Holding Time |
|---|---|---|---|---|---|---|
| Water | Diesel Range Organics (DRO) | SW-846 8015C, 8015B, 8015 | G (amber) | 2 x 1 L | Cool to 4°C | 7/40 days |
| Water | Dioxins and Furans | SW-846 8290, 1613 | G (amber) | 2 x 1 L | Cool to 4°C | 30/45 days |
| Water | Dissolved Oxygen (DO) | EPA 360.1 | G | 300 mL BOD Bottle | None | Immediate |
| Water | Dissolved Organic Carbon (DOC) | EPA 415.1 | P,G | 125 mL | pH < 2 $H_2SO_4$<br>Cool to 4°C | 28 Days |
| Water | Energetics | SW-846 8330, 8330A | G | 1 L | Cool to 4°C | 7 days for extraction and 40 days for analysis |
| Water | Fluoride | EPA 300.0, 340.2 | P, G | 50 mL | Cool to 4°C | 28 days |
| Water | Formaldehyde | SW-846 8315A, 8315 | G | 2 x 100 mL | Cool to 4°C | 72 hours for extraction and derivation<br>72 hours for analysis (3/3 days) |
| Water | Gamma-emitting radionuclides | EPA Method 901.1, HASL-300 | P | 1 L | $HNO_3$ to pH<2 | 6 months |
| Water | Gasoline Range Organics (GRO) | SW-846 8015, 8015B | G | 3 x 40 mL | HCl or $H_2SO_4$ pH <2 | 14 days |
| Water | Gross Alpha, Gross Beta | EPA Method 900.0 | P | 1 L | $HNO_3$ to pH<2 | 6 months |
| Water | Hexachlorophene | SW-846 8321A, 8151A, 8270C | G | 3 x 40 mL | Cool to 4°C | 7 days |
| Water | Hexavalent Chromium | SW-846 7196A, 7199 | P, G | 1 L | Cool to 4°C | 24 hours |
| Water | Hydrazines | SW-846 8315M, 8315A, 9056M, DV-WC-0077 | G (amber) | 500 mL | Cool to 4°C | 72 hours for water matrix/72 hours for extract |

| Matrix | Analytical Parameter | Method | Container | Sample Volume or Weight[a] | Preservative | Holding Time |
|---|---|---|---|---|---|---|
| Water | Hydrogen | Microseeps | G | 40 mL | Cool to 4°C | 24 hours |
| Water | Iodine-129 (I-129) | 902, HASL 300 I-01 Mod | P | 1 L | None | 6 months |
| Water | Iron (II) | Hach #8146<br><br>SM3500, 6010B, 6020 | P,G | 125 mL | Cool to 4°C<br><br>Filtered $HNO_3$ to pH<2 | Immediate<br><br>6 months |
| Water | Iron-55 (Fe-55) | DOE RESL Fe-1, Fe-55 | P | 1 L | $HNO_3$ to pH<2 | 6 months |
| Water | Kerosene fuel (RP-1, JP-1, JP-4)[b] | SW-846 8015B | G (amber) | 2 x 1 L | Cool to 4°C | 7/40 days |
| Water | Metals | SW-846 6010B, 6020,7470A | P | 500 mL - 1 L | $HNO_3$ to pH<2, Cool to 4°C | 6 months for 6010B/6020; 28 days for 7470A |
| Water | Methane, Ethane, and Ethene | RSK-175 (Robert S. Kerr Laboratory Method) | G | 40 mL | Cool to 4º C | 7 days |
| Water | Nickel-59 (Ni-59), Nickel-63 (Ni-63) | DOE RESL Ni-1, Ni-59; DOE RESL Ni-1, Ni-63; DOE RESL | P | 1 L | $HNO_3$ to pH<2 | 6 months |
| Water | Nitrate, Nitrate-N, Nitrate-NO3 | EPA 300.0, 353.2 | P, G | 50 mL | Cool to 4°C | 48 hours |
| Water | Nitrite-NO2 | EPA 300.0, 9056A | P, G | 50 mL | Cool to 4°C | 48 hours |
| Water | n-Nitrosodimethylamine (NDMA) | EPA 1625M, 1625C, 521, SW-846 8270C, 8270SIM | G (amber) | 4 x 500 mL | Cool to 4°C | 7/40 days, or 14/28 days depending on method |
| Water | Organophosphorus Pesticides | SW-846 8141A, 8270C | G (amber) | 1 L | Cool to 4°C | 7/40 days |
| Water | Orthophosphate-PO4 | EPA 300.0, 9056A | P, G | 50 mL | Cool to 4°C | 48 hours |
| Water | Pentachlorophenol (PCP) | SW-846 8270C, 8151A, 8321A, 8270SIM | G (amber) | 2 x 1000 mL | Cool to 4°C | 7/40 days |

| Matrix | Analytical Parameter | Method | Container | Sample Volume or Weight[(a)] | Preservative | Holding Time |
|---|---|---|---|---|---|---|
| Water | Perchlorate | EPA 314.0, 332.0, 331.0, SW-846 6850, 6860, 8321A, 8321 | P, G | 100 mL | Cool to 4°C | 28 days |
| Water | Pesticides | SW-846 8081A, 8081, 8270C | G (amber) | 1 L | Cool to 4°C | 7/40 days |
| Water | pH | SW-846 9040B, EPA 150.1, SM4500-H | P, G | 50 mL | Cool to 4°C | Immediate |
| Water | Polychlorinated Biphenyls (PCBs) | SW-846 8082, EPA 1668 | G (amber) | 2 x 1000 mL | Cool to 4°C | 7/40 days |
| Water | Polycyclic Aromatic Hydrocarbons (PAHs) | SW-846 8270CSIM, 8270C | G (amber) | 1 L | Cool to 4°C | 7/40 days |
| Water | Radium-226 (Ra-226) | EPA Method 903.1 | P | 1 L | $HNO_3$ to pH<2 | 6 months |
| Water | Radium-228 (Ra-228) | EPA Method 904.0 | P | 1 L | $HNO_3$ to pH<2 | 6 months |
| Water | Semi-Volatile Organic Compounds (SVOCs)<br><br>Alternative methods:<br><br>Pentachloroethane (8260B)<br><br>Famphur (8141A) | SW-846 8270C, 8330, 8321A | G (amber) | 2 x 1000 mL | Cool to 4°C | 7/40 days |
| Water | Specific Conductance | EPA 120.1, SM2510B | P, G | 100 mL | Cool to 4°C | 28 Days |
| Water | Strontium-90 (Sr-90) | EPA Method 905.0 | P | 1 L | $HNO_3$ to pH<2 | 6 months |
| Water | Sulfate | EPA 300.0, EPA 375.4 | P, G | 50 mL | Cool to 4°C | 28 days |
| Water | Sulfide | EPA 376.2, EPA SM4500 SD | P | 250 mL | Zinc Acetate/ NaOH | 7 days |
| Water | Sulfite | EPA 377.1 | P | 500 mL | Cool to 4°C | 24 Hours |

| Matrix | Analytical Parameter | Method | Container | Sample Volume or Weight[(a)] | Preservative | Holding Time |
|---|---|---|---|---|---|---|
| Water | Temperature | 170.1 | P, G | 125 mL | None | Immediate |
| Water | Terphenyls | SW-846 8015B | G | 1 L | Cool to 4°C | 7/40 days |
| Water | Thorium-228 (Th-228), Thorium-230 (Th-230), Thorium-232 (Th-232) | EPA Method 907.0, HASL 300 Th-01-RC | P | 1 L | $HNO_3$ to pH<2 | 6 months |
| Water | Total Dissolved Solids | EPA 160.1, SM2540C | P, G | 500 mL | Cool to 4°C | 7 days |
| Water | Total Organic Carbon | SW-846 9060 | P,G | 125 mL | pH < 2 $H_2SO_4$<br>Cool to 4°C | 28 Days |
| Water | Total Petroleum Hydrocarbons (TPH)[(b)] | SW-846 8015B | G (amber) | 2 x 1 L | HCl or $H_2SO_4$<br>pH <2 | 14 days |
| Water | Tritium | EPA Method 906.0 | G | 2 x 8 oz | None | 6 months |
| Water | Turbidity | EPA 180.1, SM2130B | P | 250 mL | Cool to 4°C | 48 hours |
| Water | Uranium-234 (U-234), Uranium-235 (U-235), Uranium-233/234 (U-233/234), Uranium-238 (U-238), | EPA Method 908.0, HASL 300 U-02-RC | P | 1 L | $HNO_3$ to pH<2 | 6 months |
| Water | Volatile Organic Compounds (VOCs)<br>Alternative methods:<br>Pentachloroethane (8270C) | SW-846 8260B | G | 3 x 40 mL | pH < 2 HCl<br>Cool to 4°C | 14 days preserved; 7 days unpreserved |

NOTES AND ABBREVIATIONS:

(a) Each analytical laboratory may specify a larger or smaller volume at each stage of the project. The volume listed above is a recommended minimum.

(b) Project defined hydrocarbon ranges.

G = Glass

P = Polyethylene

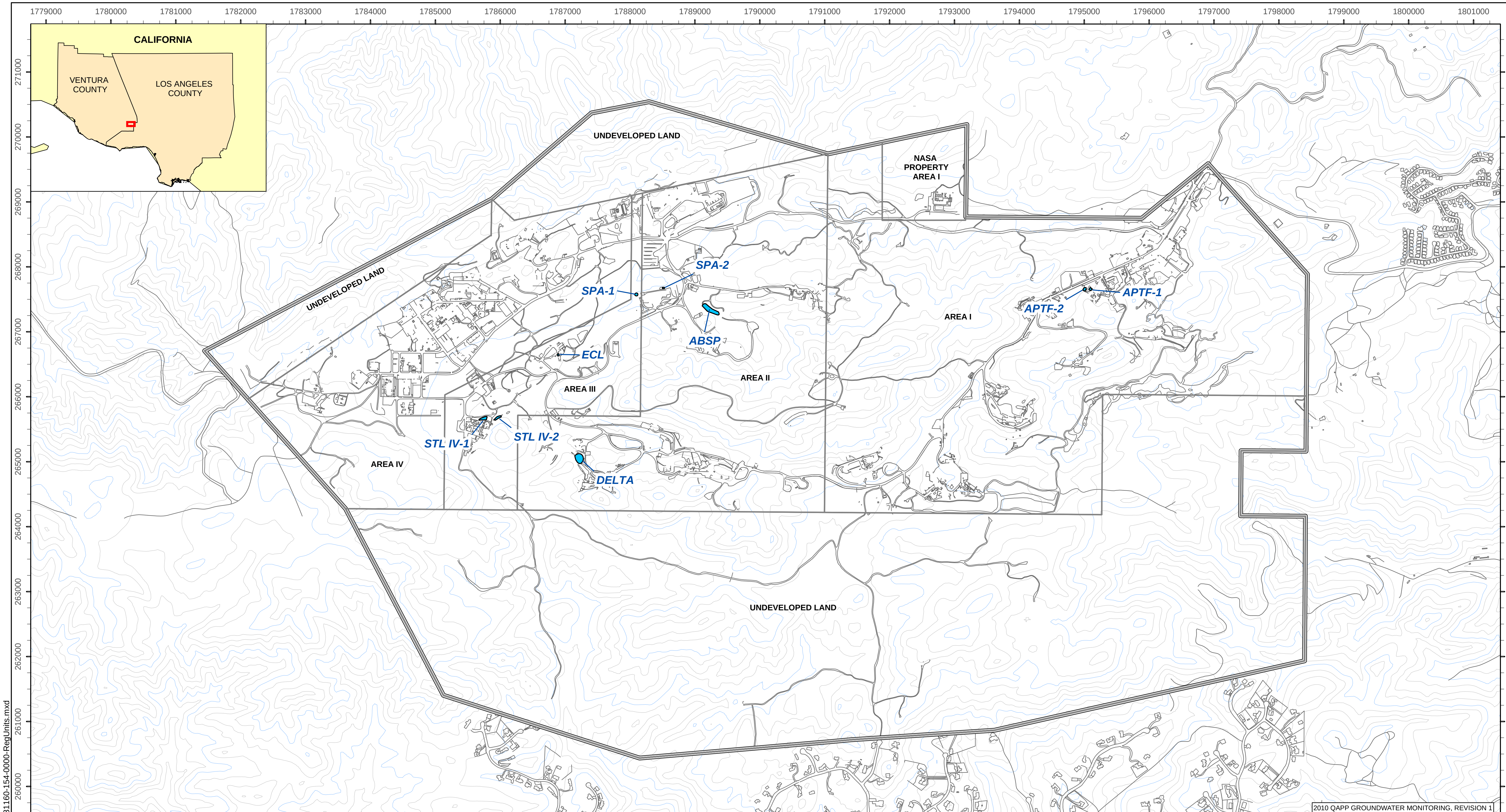
SIM = Selected Ion Monitoring

For additional methods requested, see the Quality Assurance Project Plan SSFL RCRA Facility Investigation Surficial Media Operable Unit (March 2009, Revision 4).

| Quality Control Sample | DQI | Frequency | Method QC Acceptance Limits | Project Acceptance Criteria | Corrective Action |
|---|---|---|---|---|---|
| **Field QA/QC** | | | | | |
| Field Duplicate | Precision | 1 per 20 Samples | NA | RPD <35% | Qualify or resample |
| Equipment Rinse Blank | Accuracy | 1 per method per day at locations without dedicated or disposable sampling equipment | NA | <CRQL | |
| Field Blank | Accuracy | 1 per Event | NA | <CRQL | |
| Split | Comparability | Variable* | NA | RPD<35% | |
| Trip Blank | Accuracy | 1 per cooler for VOCs and GRO | NA | <CRQL | |
| **Laboratory QA/QC** | | | | | |
| Laboratory Duplicate | Precision | 1/Batch of 20 Samples | RPD < 20% for analytes >5 x CRQL | RPD < 20% for analytes >5 x CRQL | Re-analyze or qualify in lab report |
| Method Blank | Accuracy | 1/Batch of 20 Samples | [analyte] <½CRQL or sample [analyte] 10 x [Blank] | [analyte] <½CRQL or sample [analyte] 10 x [Blank] | Re-prep and re-analyze blank and all associated samples |
| Laboratory Control Sample / Laboratory Control Sample Duplicate (LCS/LCSD) | Precision and Accuracy | 1/Batch of 20 Samples | %R = 70-130% True Value | %R = 70-130% True Value | Re-analyze, confirm or qualify |
| Matrix Spike/ Matrix Spike Duplicate Sample (MS/MSD) | Precision and Accuracy | 1/Batch of 20 Samples | Method Specific Criteria | %R = 50-150% True Value | Re-prep and re-analyze, if confirmed, qualify data in report |

**Notes and Abbreviations:**

CRQL = Contract Required Quantitation Limit
DQI = Data Quality Indicator
NA = Not Applicable
QA/QC = Quality Assurance/Quality Control
RPD = Replicate Percent Difference
[ ] = Concentration
%R = Percent Recovery
* = Split samples are collected at least once per year, when the primary analytical laboratory changes, and/or when verification sampling is needed.




## LEGEND

UNIT NAME

REGULATED UNIT

SSFL PROPERTY BOUNDARY

Map Coordinates: CA State Plane, NAD 27, Zone V, US Survey FT

**SPA** = STORABLE PROPELLANT AREA
**ABSP** = ALFA BRAVO SKIM POND
**ECL** = ENGINEERING CHEMISTRY LAB
**STL IV** = SYSTEMS TEST LABORATORY IV
**APTF** = ADVANCED PROPULSION TEST FACILITY

N W E S

0 1500 3000
SCALE IN FEET

HALEY & ALDRICH

SANTA SUSANA FIELD LABORATORY
VENTURA COUNTY, CALIFORNIA

SITE MAP

SCALE: AS SHOWN
DECEMBER 2010

FIGURE B-1

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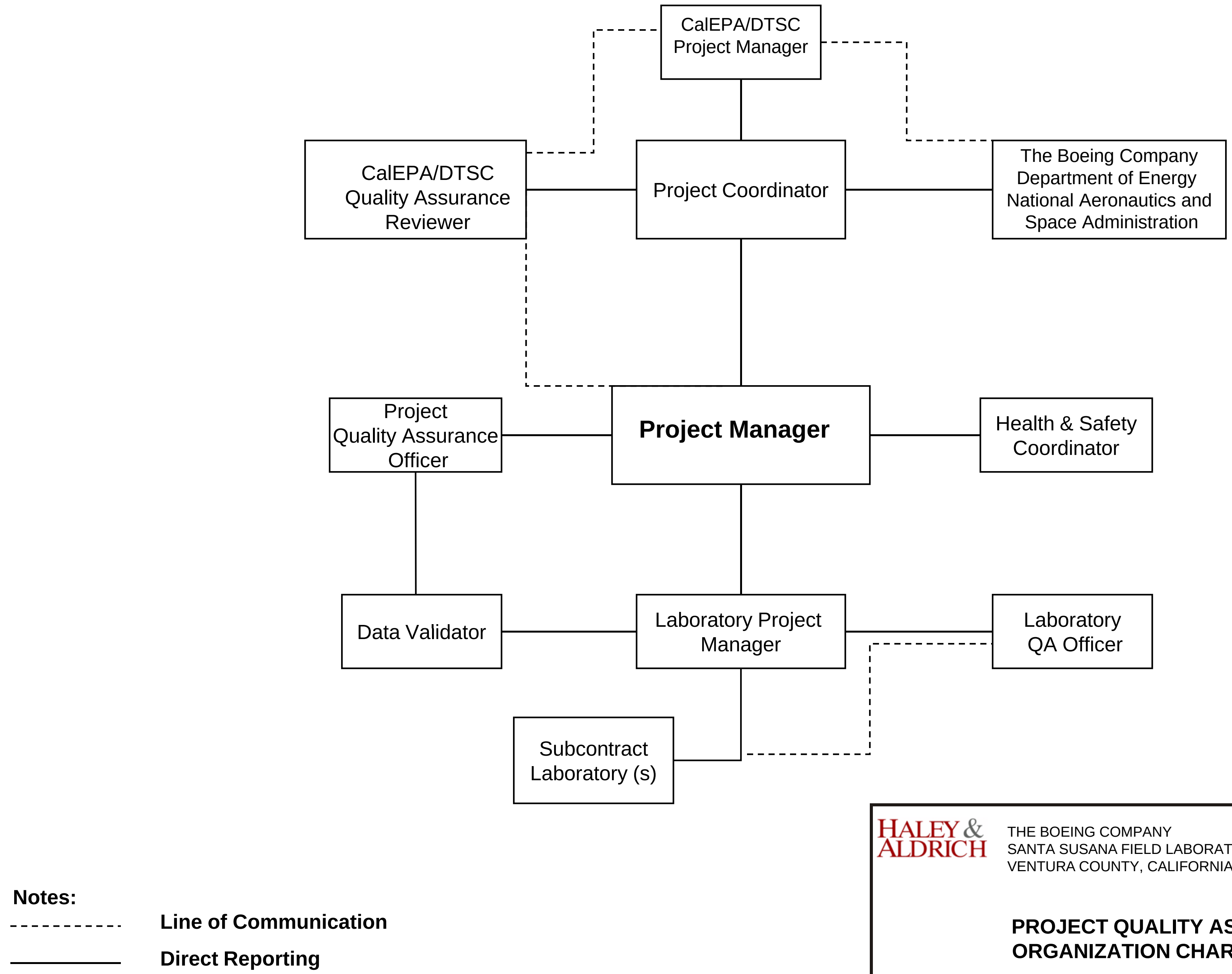


HALEY & ALDRICH

THE BOEING COMPANY
SANTA SUSANA FIELD LABORATORY
VENTURA COUNTY, CALIFORNIA

**PROJECT QUALITY ASSURANCE TEAM ORGANIZATION CHART**

DECEMBER 2010

FIGURE B-2

# APPENDIX C

## Site-Specific Health & Safety Plan
## Groundwater Sampling

HALEY & ALDRICH

# HALEY & ALDRICH, INC.
## SITE-SPECIFIC HEALTH & SAFETY PLAN
## GROUNDWATER SAMPLING
## REVISION 2

for

The Boeing Company
National Aeronautics and Space Administration
Department of Energy

Santa Susana Field Laboratory

Project/File No. 20090
Report No. M-505

Prepared by: Scott Boston — Date: 10 April 2009

Revised by: Laura Davis — Date: 14 April 2010

APPROVALS: The following signatures constitute approval of this Health & Safety Plan

Scott Boston - Regional Health & Safety Coordinator — Date: 04/10/09; 06/29/09; 04/14/10

Laura Davis - Project Manager — Date: 04/10/09; 06/29/09; 04/14/10

Scott Boston - Corporate H&S Manager
(Only required per request of LHSCs) — Date:



**Note: This HASP is developed for Haley & Aldrich purposes only and not for use by subcontractors. Subcontractors may use this HASP as reference only.**

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**Note: This HASP is developed for Haley & Aldrich purposes only and not for use by subcontractors. Subcontractors may use this HASP as reference only.**

# 1.0 PROJECT INFORMATION

| | |
|---|---|
| **Name of Project:** SSFL | **H&A File No.:** 20080 |
| **Location:** 5800 Woolsey Canyon Road, Canoga Park, CA 91304 | |
| **Client/Site Contact:** The Boeing Company<br>Safety, Health and Environmental Affairs<br>Mr. Art Lenox<br>Ms. Deborah Taege<br>Mr. Daniel Trippeda | **Contact Phone No.:**<br>Lenox: 818.466.8795<br>Taege: 818.466.8849<br>Trippeda: 818.466.8977 (phone)<br>Trippeda: 818.595.6141 (pager) |
| **H&A Project Manager:** Laura Davis | **PM Phone No.:** 520.289.8600<br>**Direct No.:** 520.289.8627 |

**SCOPE OF WORK:**

Groundwater sampling activities at the Santa Susana Field Laboratory (SSFL) and adjacent off-site properties are anticipated for various on-going and future site investigations by Haley & Aldrich and other site consultants. These groundwater sampling activities are expected to collect data required by Haley & Aldrich and others for the following programs:

- Regulated Unit groundwater monitoring;
- Site-wide groundwater monitoring;
- Surficial Media Operable Unit RCRA Facility Investigation;
- Chatsworth Formation Operable Unit RCRA Facility Investigation;
- Leaking Underground Fuel Tanks; and
- Miscellaneous monitoring outside of these programs.

These groundwater sampling activities are expected to include the following well maintenance and well sampling activities:

- Troubleshooting and repairing existing submersible pumps;
- Removing and replacing existing submersible pumps;
- Installing dedicated low flow sampling pumps;
- Well development of existing monitor wells;
- Well vault or surface monument repair and/or replacement;
- Purging monitor wells with existing submersible pumps and/or low flow sampling pumps;
- Purging monitor wells with removable submersible pumps, low flow sampling systems, or bailers;
- Collecting samples with submersible pumps, low flow sampling pumps, bailers, or FLUTe or Westbay systems; and
- Other miscellaneous activities, as needed, to complete well maintenance and well sampling at the site.

**Subcontractor**(s) to be involved in on-site activities:

| **Subcontractor Firm Name** | **Work Activity** |
|---|---|
| MP Environmental Services | Collect and transfer purge water from well locations to on-site groundwater storage containers. |
| Layne Christensen Company and/or other drilling companies. | Conduct routine well maintenance and repair activities, as needed. |

Haley & Aldrich subcontractors are required to have a Site-Specific HASP on site while conducting their activities. The Haley & Aldrich SSO will verify that subcontractor have a Site-Specific HASP on site prior to beginning field work.

The requirements listed in the Boeing Service Provider Manual will be followed and a copy of the manual will be kept on site.

**Projected Start Date:** Quarterly, starting April 2010 and throughout the year, as needed.

**Projected Completion Date:** June 2017

**Estimated Number of Days to Complete Field Work:** Will vary based on site conditions.

## 2.0 SITE DESCRIPTION

Check one of the following:

| | | | |
|---|---|---|---|
| **Site classification:** | ☑ Industrial | ☐ Commercial | ☐ Other |

### 2.1 General Description

The Santa Susana Field Laboratory (SSFL) encompasses approximately 2,850 acres of rugged terrain in the Simi Hills of eastern Ventura County, California. It has been operated as an aerospace and energy research and development facility since the late 1940s. Limited testing of rocket propulsion systems still occurs at the Facility, but the majority of the test areas are currently inactive. Paved roads connect the test areas at the site; however, most of the site is road-less or accessed by dirt roads. Hazardous materials, including fuels, oxidizers, solvents, metals, acids and bases are stored or have been stored in some areas of the site. These areas are generally signed to indicate the specific hazards that may be present.

**Site Status** Note: Are there current operations at the site? (mark all that apply):

| | |
|---|---|
| ☐ Active | ☐ Inactive |
| ☑ Partially active | ☐ Other |

Is a **site plan** or sketch available? ☑ Y ☐ N See attached Figures C-1 and C-2.

### 2.2 Work Areas

Work areas include the following:

- Several well locations distributed across the site;
- Additional well locations on adjacent off-site properties; and
- Groundwater storage and treatment systems across the site.

## 3.0 PROJECT TASK BREAKDOWN

List and describe each distinct work task below:

| Task No. | Detailed Task Description | Employee(s) | Work Date(s) or Duration |
|---|---|---|---|
| 1 | **Well Maintenance** – Troubleshooting, repair, removal, and installation of submersible pumps by a pump contractor. Can also include surface repairs such as replacement of well vaults or surface monuments and any other miscellaneous repair work necessary to maintain the monitor wells in good condition to ensure safe and efficient sample collection. | Benjamin Babcock<br>Shannon Collinge<br>David Camacho<br>Humberto Hernandez<br>Miguel Hernandez<br>Paul Kroger<br>Jeffery A. Miller<br>Marc Simpson | Anticipated to start in April 2010 and last about 2 weeks each quarter (Jan., Apr., Jul., and Oct.). |
| 2 | **Well Sampling** – Purging monitor wells by a variety of methods (low-flow, submersible pump, bailer, etc.), followed by collecting groundwater samples. Purge water is containerized on site for disposal and/or treatment. | Shannon Collinge<br>David Camacho<br>Humberto Hernandez<br>Miguel Hernandez<br>Paul Kroger<br>Jeffrey A. Miller<br>Marc Simpson<br>Benjamin Babcock | Anticipated to start in April 2010 and last about 1 month each quarter (Jan., Apr, Jul., and Oct.). |

## 4.0 HAZARD ASSESSMENT

### 4.1 Chemical Hazards

**Material Safety Data Sheets (MSDS) of hazardous materials used during the execution of work shall be available on site.** MSDSs are required for chemicals used to prepare samples, calibration gases, etc.

Note: MSDSs are not required for waste materials.

Does chemical analysis data indicate that the site is contaminated? ☑ Y ☐ N

Potential **physical state** of the hazardous materials at the site (mark all that apply):

☑ Gas/Vapor ☐ Sludge

☑ Liquid ☑ Solid/Particulate

Anticipated/actual **class of compounds** (mark all that apply).

☐ Asbestos ☑ Inorganics

☑ BTEX ☐ Pesticides

☑ Chlorinated Solvents ☑ Petroleum products

☑ Heavy Metals ☑ Other low level radionuclides in Area IV

**Impacted environments** (indicate the primary media(s) in which contamination is expected):

☐ Air ☑ Groundwater

☑ Soil ☐ Sediment

☑ Surface water ☐ Other

**Estimated concentrations**/medium of major chemicals expected to be encountered by on-site personnel:

| Work Activity | Media | Chemical | Anticipated Concentration |
|---|---|---|---|
| Well maintenance (Task 1) and well sampling (Task 2) activities that result in exposure to groundwater and/or vapors from monitor wells. | A/GW | Trichloroethene<br>1,2-Dichoroethene<br>Benzene | < 6,000 μg/L (in water)<br>< 3,000 μg/L (in water)<br>< 1 μg/L (in water) |

(Media key: A = Air; GW = Groundwater; SW = Surface Water; SO = Soil; SE = Sediment)
μg/L = micrograms per liter

**Trichloroethene (TCE)** is a colorless, heavy liquid with a chloroform-like odor. It is stable, has a low boiling point, is miscible with common organic solvents and is slightly soluble in water. TCE encountered in site work is expected be present at low concentrations in an aqueous solution and is unlikely to have a discernible odor, but should be detectable with a PID. TCE is a moderate fire risk, is highly toxic by inhalation but moderately toxic by ingestion or skin absorption.

The Cal/OSHA permissible exposure limit (PEL) for TCE is 25 parts per million (ppm) as an 8-hour time weighted average (TWA); an acceptable ceiling concentration of 300 ppm; and a short term exposure limit (STEL) of 100 ppm. The standard routes of entry into the body are through inhalation, percutaneous absorption, ingestion, skin and eye contact. The points of attack are the respiratory system, heart, liver, kidneys, central nervous system and skin.

**1,2-Dichloroethene (1,2-DCE)** is commonly reported as either a cis- or trans- isomer. 1,2-DCE is a colorless liquid with a low boiling point and a pleasant odor. It is miscible with common organic solvents and is slightly soluble in water. 1,2-DCE encountered in site work is expected to be present at low concentrations in an aqueous solution and is unlikely to have a discernible odor, but should be detectable with a PID. 1,2-DCE can form flammable vapors at high concentrations and also has narcotic effects. It is considered to be moderately toxic by skin absorption route.

The Cal/OSHA PEL for 1,2-DCE is 200 ppm as an 8-hour time weighted average (TWA). Cal/OSHA has not established a ceiling limit or STEL for 1,2-DCE. The standard routes of entry into the body are through inhalation, ingestion, and skin and eye contact. The points of attack are the eyes, respiratory system, and central nervous system.

**Benzene** is a common component of gasoline and is frequently present in aqueous solutions as a result of fuel spills. Benzene is a colorless to light yellow, strongly aromatic liquid which is highly flammable and highly toxic by ingestion, inhalation and skin absorption. Benzene can be detected at very low concentrations by odor.

Cal/OSHA PEL for benzene is 1 ppm as an 8-hour TWA and the Cal/OSHA STEL is 5 ppm. The standard routes of entry into the body are inhalation, ingestion, skin contact, and skin adsorption. The points of attack are the eyes, skin, respiratory system, blood, central nervous system, and bone marrow.

### 4.2 Physical and Biological Hazards

Is any site work area(s) to be entered for this project considered a confined space? ☐ Y ☑ N

If yes, indicate which area(s) and why: Not Applicable

**ALL CONFINED SPACE ENTRY PROJECTS REQUIRE SPECIAL PROCEDURES, PERMITS AND TRAINING AND MUST BE APPROVED BY THE CORPORATE HEALTH & SAFETY MANAGER AND SUBJECT TO REVIEW BY SSFL HEALTH & SAFETY.**

## Physical Hazard Checklist

Indicate all hazards that may be present for each task. Note: Task numbers refer to those identified in Section 3.

| Potential Job Hazards | Task 1 | Task 2 |
|---|---|---|
| Underground utilities | ✓ | |
| Overhead utilities | ✓ | |
| Excavations greater than 4' depth | | |
| Open excavation fall hazards | | |
| Heavy equipment | ✓ | |
| Drilling hazards | ✓ | |
| Noise (above 85 dBA) | ✓ | ✓ |
| Traffic concerns | ✓ | ✓ |
| Extreme weather conditions | ✓ | ✓ |
| Rough terrain for drilling equipment | ✓ | |
| Buried drums | | |
| Heavy lifting (more than 50 lbs) | ✓ | ✓ |
| High risk fire hazard | ✓ | |
| Poisonous insects or plants | ✓ | ✓ |
| Water hazards | | |
| Use of a boat | | |
| Lockout/Tagout requirements | ✓ | |
| Rough Terrain for foot traffic | ✓ | ✓ |

Indicate any **unusual features** at the site (e.g., power lines at low heights, variable terrain, excessive insects, etc.) that are **unique to this project** and steps to be taken to minimize risk:

**<u>Heat Stress</u>**

Heat stress on hazardous waste sites or construction sites usually is a result of protective clothing decreasing natural body ventilation, although it may occur at any time work is being performed at elevated ambient temperatures. Because heat stress is one of the most common and potentially serious illnesses associated with hazardous waste site work, regular monitoring and other preventative measures are vital. Site workers must learn to recognize and treat the various forms of heat stress. Haley & Aldrich Operating Procedure OP 1015 *Heat Stress*, which is herein incorporated by reference provides greater detail regarding heat stress management.

The best approach is preventative heat stress management. In general:

- Workers should drink 16 ounces of water before beginning work, such as in the morning or after lunch. The water should be maintained at 50 to 60 $^{o}$F. Workers should drink one to two 4-ounce cups of water every 30 to 60 minutes. A cool area for rest breaks should be designated, preferably air-conditioned. The use of alcohol during non-working hours and the intake of caffeine during working hours can lead to an increase in susceptibility to heat stress. Monitor for signs of heat stress.

- Workers should acclimate to site work conditions by slowly increasing workloads, i.e., do not begin site work activities with extremely demanding activities. This acclimation process may require up to two weeks for completion.

- Cooling devices should be used to aid natural body ventilation. These devices, however, add weight, and their use should be balanced against worker efficiency. An example of a cooling aid is long cotton underwear, which acts as a wick to help absorb moisture and protect the skin from direct contact with heat-absorbing protective clothing.

- Installed mobile showers and/or hose-down facilities should be used to reduce body temperature and cool protective clothing in serious heat stress situations.

- In hot weather, field activities should be conducted in the early morning or evening.

- Adequate shelter should be available to protect personnel from heat, as well as cold, rain, snow, etc., which can decrease physical efficiency and increase the probability of both heat and cold stress. Set up a command post in the shade or erect temporary shade at the workstation, if practical.

- In hot weather, rotate shifts of workers with potential heat stress exposure.

- Good hygienic standards must be maintained by frequent changes of clothing and showering. Clothing should be permitted to dry during rest periods. Persons who develop skin problems should immediately consult medical personnel.

**Effects of Heat Stress**

If the body's physiological process fails to maintain a normal body temperature because of excessive heat, a number of physical reactions can occur ranging from mild (such as fatigue, irritability, anxiety, and decreased concentration, dexterity, or movement) to fatal.

Heat-related problems are:

<u>HEAT STROKE:</u> An acute and dangerous reaction to heat exposure caused by failure of heat regulating mechanisms of the body; the individual's temperature control system that causes sweating stops working correctly. Body temperature rises so high that brain damage and death will result if the person is not cooled quickly.

Symptoms: Red, hot, dry skin, although the person may have been sweating earlier; nausea; dizziness; confusion; extremely high body temperature; rapid respiratory and pulse rate; unconsciousness or coma.

Treatment: Cool the victim quickly and obtain immediate medical assistance. If the body temperature is not brought down fast, permanent brain damage or death may result. Soak the victim in cool, but not cold water, sponge the body with rubbing alcohol or cool water, or pour water on the body to reduce the temperature to a safe level (102 $^{o}$F). Observe the victim and obtain medical help. Do not give coffee, tea or alcoholic beverages.

HEAT EXHAUSTION: A state of definite weakness or exhaustion caused by the loss of fluids from the body. This condition is much less dangerous than heat stroke, but it nonetheless must be treated.

Symptoms: Pale, clammy, moist skin, profuse perspiration and extreme weakness. Body temperature is normal, pulse is weak and rapid, and breathing is shallow. The person may have a headache, may vomit, and may be dizzy.

Treatment: Remove the person to a cool place, loosen clothing, and place in a head-low position. Provide bed rest. Consult physician, especially in severe cases. The normal thirst mechanism is not sensitive enough to ensure body fluid replacement. Have patient drink 1 to 2 cups water immediately and every 20 minutes thereafter until symptoms subside. Total water consumption should be 1 to 2 gallons per day.

HEAT CRAMPS: Caused by perspiration that is not balanced by adequate fluid intake. Heat cramps are often the first sign of a condition that can lead to heat stroke.

Symptoms: Acute painful spasms of voluntary muscles (e.g., abdomen and extremities).

Treatment: Remove the victim to a cool area and loosen clothing. Have the patient drink 1 to 2 cups water immediately, and every 20 minutes thereafter until symptoms subside. Total water consumption should be 1 to 2 gallons per 8 hour shift.

HEAT RASH: Caused by continuous exposure to heat and humid air and aggravated by chaffing clothes; decreases ability to tolerate heat.

Symptoms: Mild red rash, especially in areas of the body in contact with protective gear.

Treatment: Decrease amount of time in protective gear, and provide powder to help absorb moisture and decrease chaffing.

**Noise Reduction**

Site activities in proximity to heavy equipment and portable generators often expose workers to excessive noise. It is anticipated that situations may arise when noise levels may exceed the Cal/OSHA Action Level of 85 dBA in an 8-hour TWA. An example of this possibility is working in close proximity to a portable generator. If excessive noise levels occur, it will be controlled by issuance of earplugs to personnel near the source of excessive noise. As a rule of thumb, if you have to raise your voice for someone 3 feet away from you to hear you, hearing protection should be worn.

**Working Around Heavy Equipment**

Staff Members must be especially careful and alert when working with contractors who use heavy equipment, since equipment failure or breakage can lead to accidents and worker injury. Heavy equipment should be visually inspected and checked for proper working order prior to the commencement of field work. Those that operate heavy equipment must meet all of the requirements to operate the heavy equipment safely. Haley & Aldrich staff members that supervise projects or are associated with heavy equipment should use due diligence when working with the heavy equipment operator. Haley & Aldrich, Inc. staff members that supervise projects or are associated with such high risk projects that involve lifting should use due diligence when working with the contractor. Maintain visual contact with operators at all times and keep out of the strike zone whenever possible. Always approach heavy equipment with an awareness of the swing radius and traffic routes of each piece of equipment and never go beneath a hoisted load. High-visibility safety vests must be worn onsite at all times. Avoid fumes created by heavy equipment exhaust.

**Traffic Concerns**

Follow the facility speed limits and traffic control signs. Always wear a seat belt. Stop completely at all stop signs. Use a spotter when backing up. Personnel in high-traffic areas or areas in which heavy equipment is being operated should wear high-visibility traffic safety vests and make eye contact with the operator before approaching any equipment.

When working at locations along facility roads that require parking vehicles along roadways, traffic control measures, such as cones, delineators and flagman should be used when deemed necessary. Traffic control measures shall meet the requirements of the California Manual on Uniform Traffic Control Devices (CAMUTCD).

Set the emergency brake and place the transmission in park (for automatic) or first gear (for manual) whenever parking on a grade. Avoid fire potential by not parking a vehicle off the roadway in grass or brush.

**Rough Terrain**

Avoid rough terrain, whenever possible, while operating vehicles and equipment at the Site. Care should be taken to keep vehicles off steep side pitches and grades, and uneven ground. When vehicular travel in rough terrain is required, low-profile, four-wheel drive vehicles should be utilized. When walking in the field on rough terrain, a two way radio must accompany each Haley & Aldrich staff member.

**Heavy Lifting**

The guidelines listed below should be observed when lifting or carrying objects. Many injuries can be avoided if these are done properly.

When lifting an object you should:

- Keep your lower back bowed in while bending over.
- Keep the weight of the object as close as possible to your body.
- Bow your back in, and raise up with your head first.
- Never jerk or twist.
- Put the weight down by keeping your low back bowed in.
- Squat whenever possible.

- Have a stable base of support.
- Don't twist or rotate your trunk. If it is necessary to turn, turn with your feet, not your body.
- Whenever possible, stabilize the body against a stationary object, such as a wall, cabinet, etc.
- If you have difficulty getting up from a squatting position, support yourself on a stable surface (table, chair) and push up with your hands in addition to your legs.

To lower an object to the floor, use the same mechanics in reverse order. Have a firm grasp on the object, place feet shoulders' width apart, one foot ahead, and keep your back straight as you bend your legs to lower the object. Extend arms straight down; do not rotate your trunk.

**Poison Oak**

Contact with poison oak plants can result in painful skin rashes and should be carefully avoided. It is essential to look for the poison oak plant in weedy areas and to be able to recognize it by its characteristic three-leaf-per-stem configuration. It is a small green plant with rounded leaves that normally grows close to the ground. Its leaves turn yellow and red in the late summer and fall, which helps greatly in identification. In the winter after leaves have fallen off, it is more difficult to recognize. Haley & Aldrich field personnel should be familiar with identifying poison oak plants during all four seasons of the year.

A skin rash may appear within a day or two after contact with the plant. The affected area may be itchy, red, swollen, blistered, and painful. It is imperative that any persons experiencing swelling in the throat, tongue or lips; difficulty in breathing or swallowing; or weakness and dizziness seek emergency care immediately. These symptoms indicate a severe allergic reaction to poison oak.

Preventative measures should be taken prior to entering a work area where poison oak is expected to be encountered. Preventative measures may include:

- Wearing protective clothing, such as long pants and long-sleeved shirts, or tyvek coveralls;
- Wearing protective gloves made of rubber or nitrile, depending on work activity;
- Coating exposed skin with Ivy Block; and
- Visually identifying all vegetation prior to touching it to help avoid contact with poison oak.

The following steps should be taken within 6 hours of contact if contact with poison oak is suspected:

- Remove all clothes and shoes that may have touched the plant and wash clothes well;
- Wash the skin thoroughly with soap and tepid water;
- Apply rubbing alcohol or TechNu with cotton balls to the affected skin areas; and
- Rinse with tepid water.

To reduce itching after exposure to poison oak:

- Apply calamine lotion, zinc oxide ointment, or a paste made with baking soda and water;
- Take a bath with Aveeno colloidal oatmeal treatment; and/or
- Take an over-the-counter antihistamine such as Benadryl.

**Ticks**

Passage through weedy/grassy areas may expose site personnel to ticks that cling to the vegetation. Western black-legged ticks, which are associated with the transmission of Lyme's Disease (ticks transmit the bacteria that causes the disease) have been observed in Southern California may transmit the bacterial infection to humans through their bites.

Lyme disease is diagnosed by a characteristic skin rash and clinical symptoms. In the first stage of the disease, victims experience flu-like symptoms accompanied by an expanding red rash, fatigue, fever, joint pain, and headache. In later stages (after 2 months or more), arthritis may develop and major body systems such as the heart and nervous system may be affected. If correctly diagnosed in the early disease stage, Lyme disease can be successfully treated through the use of antibiotics.

To prevent exposure to ticks and their bites, skin exposure to vegetation should be limited. When walking through grassy/brushy areas:

- Pants should be bloused into or tied around the boot or sock tops;
- Long-sleeved shirts are helpful;
- Light-colored clothing allows for easier tick detection; and
- Clothing should be inspected frequently for the presence of ticks.

Tick repellent should be applied to the outside of clothing (spray on pant legs). DEET repellent (Pemethrin) should be used for extra protection. Finally, a visual check of one's body is effective in controlling exposure and should be done immediately after leaving an area suspected of containing ticks. A tick will typically search for 1 to 2 hours before beginning its feeding process (biting). They like warm, moist, confined areas.

If a tick is found attached to the skin, it should be removed by using forceps (tweezers). Grasp the tick behind its mouthparts and apply steady pressure to encourage the tick to withdraw. If the head is detached during removal, do not probe with a pin or other sharp object, since ticks react to violent trauma by regurgitating (which may inject tick fluids into the bite). Do not use alcohol, petroleum oils, chemicals, lighters, or hot matches to try to remove the tick. Once removed, the tick should not be smashed or handled with the fingers.

**Bees**

Honeybees, Yellow Jacket Wasps, and Paper Wasps are very active in the summer and may sting more people in summer than in the winter months. These social insects only sting in self-defense if disturbed, although the Africanized Honeybee is known to be more aggressive than the other Honeybees.

The Honeybee is the only insect that will leave a stinger behind. The female worker honeybee carries the barbed stinger and dies soon after discharging the sting. It is thus easy to identify the honeybee as the culprit – whereas the wasp does not leave a stinger behind.

Normally some redness and swelling will result from the sting, but this usually resolves in a few hours. In the allergic individual, a more long lasting and severe reaction will occur. A mild reaction will include intense redness, swelling, itching and pain, all occurring within minutes. More severe reactions include generalized swelling and itching, faintness, sweating, a pounding headache, stomach cramps or vomiting, a feel of impending doom, a tight chest or choking sensation with swelling of the throat and in extreme cases anaphylactic shock with death resulting.

People allergic to bee and wasp stings should try to avoid being stung and stay away from areas that bees and wasps frequent e.g. well monuments, uncovered cold drink cans, etc. If a swarm of bees approach, run for shelter as bees are slow fliers and can normally be outrun.

Remember that bees generally fly in straight lines between flower and hive, hence collision with unsuspecting individuals occurs. If a wasp or bee approaches, STAY STILL, do not try to swat the insect as this may frighten it. If it lands, gently try to blow it off the skin.

If stung, try to look for the barbed stinger and carefully remove it by flicking it or scratching it out of the skin from the stinger sack. Stings to the head and neck are more dangerous. Life threatening reactions are more likely to occur in people who are already known to be very allergic to bee venom, older people with pre-existing heart and chest complaints or with multiple stings. When stung immediately apply ice or cold compresses to the sting site.

Wasps and bees are drawn to flower fragrances and clothing with bright colors (white is safest), perfumes, fruit juices and eating fruit out of doors, hair tonics, suntan lotions and floral odors. Carefully shake out any clothing left on the ground. Cover open containers and any foods out of doors. If you encounter a bee hive, don't disturb it – contact The Boeing Company personnel to arrange for an exterminator to remove the hive.

Individuals who are prone to severe reactions to bee stings should notify the Site Safety Officer and carry their prescribed medication(s) with them for self administration. Others should carry antihistamine pills. All bee allergic patients should wear a Medic Alert bracelet. Emergency medical treatment should be sought immediately for individuals who are allergic to bee stings or other individuals who exhibit severe reactions described above.

**Black Widow Spiders**

The adult female is a velvety jet black color, but males and immature black widows are striped with white or yellow. The underside of the abdomen of the adult female usually shows two reddish markings, often joined to resemble the shape of an hourglass. The back of the abdomen is usually entirely black, but may be marked with a broken stripe of white, red, or yellow spots.

An adult female, including legs, is 3 to 4 centimeters (about 1½ inches) in diameter. This species is usually associated with dry, undisturbed piles of firewood, old lumber, dry crawl spaces, outbuildings, rock piles, bales of hay, and inside well monuments. Black widow webs are poorly defined, amorphous sheetings of very strong, fine silk. Caution should be exercised when working in or disturbing areas where black widows may be present. Visually inspect hidden areas to ensure spiders are not present before reaching into the area. If practical, overturn suspicious areas with a stick or rod and inspect for spiders before handling. Wearing gloves, long pants, and long-sleeved pants can help provide additional protection from spider bites.

The bite of the adult female is more toxic than that of juveniles or males. However, black widows are shy, retiring spiders and bite only reluctantly, usually only when molested. Black widows are more aggressive when they are protecting an egg sac. The bite of the black widow spider causes little immediate pain and may go unnoticed. Slight, localized swelling and reddening at the bite site are early signs, followed by intense muscular pain, rigidity of the abdomen and legs, difficulty in breathing, and nausea. There is little first aid advised other than cleaning the bite and calming the victim. Consult a physician as soon as possible. In untreated cases symptoms generally fade in 2-3 days. Black widow bites are more dangerous if the victim is a small child or an elderly person.

**Scorpions**

Scorpions, found mostly in the western and especially the southwestern United States, are up to 3 inches in length. They have eight legs and a pair of crablike pinchers. The stinger, which injects venom, is located at the end of a narrow tail that curves around and over the back of the scorpion's body.

Scorpions are found in cool, damp places, such as basements, junk piles, and wood piles. The following precautions should be followed to help prevent scorpion stings:

- Wear protective footwear;
- Exercise caution when lifting rocks, logs, or other items/debris; and
- Never handle a scorpion.

Symptoms of a scorpion sting may include:

- Intense and immediate burning pain lasting from minutes to 24 hours;
- Swelling, itching, and a change in skin color;
- Headache, nausea and vomiting;
- Anxiety, drowsiness, and fainting;
- Increased saliva, tears, sweat;
- Numbness of the tongue;
- Vision problems;
- Diarrhea or inability to control bowels; and/or
- Swollen glands.

If stung by a scorpion, seek immediate medical attention. An ice pack applied to the sting will relieve some of the pain. The stung individual should be watched closely for breathing difficulties, which can lead to death.

**Rattlesnakes**

The rugged terrain where the SSFL site is located is prime habitat for rattlesnakes. **Never attempt to handle or remove a rattlesnake. Notify Security (818-466-8911) if you encounter a rattlesnake that requires relocation.**

All employees who work at SSFL, as well as those who visit on occasion, must be aware of the following basic precautions to avoid serious injury:

- Great care should be taken when walking through brushy and rocky areas where snakes may be hiding. Make noise when traveling though these areas and listen for the snake's telltale rattling sound.
- Do not go into snake-infested areas alone. It is very difficult to administer adequate first-aid measures to yourself and also obtain the necessary medical assistance.
- Rattlesnakes are active mostly at night in the warm weather. When inactive, most rattlesnakes seek cover in crevices of rocks, under surface objects, beneath dense vegetation, and in rodent burrows.
- Snakes are best avoided by never putting your hands or feet where you can't see. If you should sustain a snake bite, keep as quiet as possible and get emergency medical aid immediately. Do not apply ice, do not slash or cut, do not apply suction, and do not apply a tourniquet. Please call Security at 818-466-8911 to report the snake bite.
- Do not handle or transport a freshly killed snake by hand, as they may bite by reflex action.
- Check the immediate area before sitting down.
- Rattlesnakes can strike up to half their body length, so keep at least five feet away from any visible rattlesnake.

**West Nile Virus**

The most likely way to become infected with West Nile Virus (WNV) is through the bite of an infected mosquito. Most human WNV infections cause either no symptoms or a mild flu-like illness. Mild symptoms include fever, fatigue, headache, and muscle or joint pain. Signs of severe infection include high fever, stiff neck, disorientation, tremors, muscle weakness, and paralysis. The most severely affected patients may develop an inflammation of the brain, or the membranes of the brain or spinal cord, or both, called encephalitis, meningitis, or meningoencephalitis, respectively. The incidence of severe disease is highest among persons over age 50. These severe cases may be fatal. The time of incubation from mosquito bite to clinical symptoms is reported to be from 3 to 14 days.

Any worker who has health concerns should contact his or her health care provider. No specific treatment exists for WNV infection. Treatment consists of supportive care for the individual. Currently, no approved vaccine exists to prevent WNV infection in humans.

**Hanta Virus**

Hantavirus pulmonary syndrome (HPS) is a rare but deadly viral infection. It is spread by mice and rats. They shed the virus in their urine, droppings and saliva. Tiny droplets with the virus can enter the air. People can get the disease if they breathe infected air or come into contact with rodents or their urine or droppings. You cannot catch it from people.

Early symptoms of HPS include

- Fatigue
- Fever
- Muscle aches, especially in the thighs, hips and back
- Headaches
- Chills
- Dizziness
- Nausea, vomiting, diarrhea or abdominal pain

Later symptoms include coughing and shortness of breath.

Controlling rodents in and around your work area is the best way to protect yourself from infection. If you suspect there are significant rodent populations in your work area, or observe heavy evidence of their presence (droppings) contact the SSO immediately.

**Mountain Lions**

Generally, mountain lions are calm, quiet and elusive. They are most commonly found in areas with plentiful prey and adequate cover. Such conditions exist in mountain subdivisions, urban fringes and open spaces. Consequently, the number of mountain lion/human interactions has increased. Even so, the potential for being killed or injured by a mountain lion is quite low compared to many other natural hazards. There is a far greater risk, for example, of being struck by lightning than of being attacked by a mountain lion.

What Should You Do If You Encounter A Mountain Lion?

- Do not approach a mountain lion: Most mountain lions will try to avoid a confrontation.
- Give them a way to escape.

- Do not run from a mountain lion: Running may stimulate a mountain lion's instinct to chase.
- Stand and face the animal. Make eye contact.
- Do not crouch or bend over: A person squatting or bending over looks a lot like a four-legged prey animal.
- Appear larger: Raise your arms. Open your jacket, if you are wearing one.
- Throw stones, branches, or whatever you can reach without crouching or turning your back.
- Wave your arms slowly and speak firmly in a loud voice.
- The idea is to convince the mountain lion that you are a predator and that you may be a danger to it.
- Fight back if attacked: Many potential victims have fought back successfully with rocks, sticks, caps, jackets, garden tools and their bare hands.
- Since a mountain lion usually tries to bite the head or neck, try to remain standing and face the animal.

About half of California is prime mountain lion country. This simple fact is a surprise to many residents and visitors. These large, powerful predators have always lived here, preying on deer and other wildlife, and playing an important role in the ecosystem. Like any wildlife, mountain lions can be dangerous. With a better understanding of mountain lions and their habitat, we can coexist with these magnificent animals.

**Lockout/Tagout**

Before commencing work on any equipment, which is connected to the Facility electrical system, the work must be coordinated with a Boeing electrician, who will identify all circuits which must be de-energized, locked out, and tagged out before work can be safely initiated.

Any contractor performing electrical work at SSFL, on behalf of Haley & Aldrich, shall read and comply with the provisions in this HASP. Only qualified personnel shall conduct electrical work. Upon completion of work an inspection is required to verify that the work has been completed to National Electrical Code (NEC) standards and the system is ready to be re-energized. Boeing Environmental Remediation staff must clear any exceptions to these provisions.

Lockout/tagout ensures that machines and electricity remain temporarily off. Without a lockout/tagout system, there is the possibility that a machine will suddenly start up. Then someone could be cut, hit, or crushed. There is also a serious danger of electrocution when working with submersible electric pumps. To prevent startups, you need to identify a machine's power sources: electrical current, stored electricity (such as in a capacitor), stored pressure (such as compressed air), stored mechanical energy (such as in a coiled spring), or gravity.

Take Seven Steps for Lockout/Tagout

- Think, plan, and check. If you are in charge, think through the entire procedure. Identify all parts of any systems that need to be shut down. Determine what switches, equipment and people will be involved. Carefully plan how restarting will take place.

- Communicate with coworkers and SSFL staff. Notify all those who need to know that a lockout/tagout procedure is taking place.

- Identify all appropriate power sources, whether near or far from the job site. Include electrical circuits, hydraulic and pneumatic systems, spring energy and gravity systems.

- Neutralize all appropriate power at the source. Disconnect electricity. Block movable parts. Release or block spring energy. Drain or bleed hydraulic and pneumatic lines. Lower suspended parts to rest positions.

- Lock out all power sources. Use a lock designed only for this purpose.

- Tag out all power sources and machines. Tag machine controls, pressure lines, starter switches and suspended parts.

- Do a complete test. Double check all the steps above. Do a personal check. Push start buttons, test circuits and operate valves to test the system. All circuits must be tested with a voltage meter prior to commencement of work to verify that power has been completely turned off.

When it's time to restart after the job is completed, remove only your own locks and tags. With all workers safe, clearance from an electrician, and equipment ready, it's time to turn on the power.

Additional information regarding Haley & Aldrich's requirements for lockout/Tagout can be found in OP 1032 *Control of Hazardous Energy*, which is herein incorporated by reference.

## Rig Safety

Each day, prior to the start of work, the driller will inspect the pump rig and associated equipment. The following checks will be made:

- Vehicle condition: Check proper operation of brakes, lights, steering mechanism, and horn.

- Equipment storage: All equipment such as auger flights, split spoon samplers, hammers, hand tools, etc. will be properly stored in an appropriate location and will be secured before moving the rig.

- Wire rope, Cat Line: All wire rope, cable and Cat Line will be inspected for signs of wear such as broken wires, a reduction in rope diameter, abrasion, or signs of rust. Worn, frayed, or otherwise damaged wire, rope or cable will be replaced.

- Safety equipment: Each rig will have at least one fire extinguisher (Type B/C) and one First Aid Kit.

## Radiation Safety

In one area of the Facility (Radioactive Materials Handling Facility, or RMHF, in Area IV), all personnel entering the facility are required to wear radiation badges. The badges are obtained from ETEC health physics personnel. Prior to being issued a badge, you will be required to watch a radiation safety video. Once you are in the health physics database you can simply visit the health physicist, prior to going to RMHF, and he will issue you a new badge, good for that monitoring event. When you sign in to enter the RMHF gate, they will verify that you have a current badge. After completing all work in the area, the badge should be turned in at the RMHF office. If you have any questions about the hazards of working at RMHF, feel free to ask the staff working at RMHF.

### Radiation Dose Limits

The federal government has set standards for how much radiation can be received safely. The limit for whole body radiation for persons working in occupations that involve radiation exposure is 5,000 millirem per year. To put this value in perspective, the average American receives about 360 millirem per year from natural background radiation.

### Protection from Radiation Sources

The primary concern is external exposure from a radiation source. The fundamental principle in radiation protection is that all radiation exposures should be maintained as low as reasonably achievable. This is referred to as the ALARA principle. The three key factors that influence an individual's radiation dose from a given source are time, distance and shielding. Control of these factors, therefore, is the key to keeping radiation dose ALARA.

Time - The most direct way to reduce radiation dose is to reduce the time spent working with or in the vicinity of radiation sources. If the exposure time is cut in half, the dose will be reduced by the same fraction.

Distance - Distance is one of the most effective means to reduce dose due to basic principles of geometry. When the working distance from a point radiation source is increased by a factor of two, the dose received from that source will be reduced by a factor of four. This is referred to as the inverse square law, i.e., the radiation intensity from a point source decreases with the square of the distance from the source.

Shielding - Shielding is any material used to reduce the intensity of radiation by absorbing or attenuating the radiation coming from the source. Shielding can be as simple as clothing or paper, to shield from alpha radiation, up to lead or concrete barriers to protect from gamma radiation. ETEC personnel will explain the types and intensity of radiation that can be encountered working at RMHF. Additional information may also be obtained from the Haley & Aldrich Corporate Radiation Safety Officer.

## Daily Vehicle Inspections

You must complete and document a vehicle inspection every morning. The inspection will cover the items listed in the Vehicle Inspection Report contained in Appendix C3.

## Compressed Gas Cylinder Safety

Staff Members will follow the requirements of OP 1048 *Compressed Gas Cylinder Safety* (Appendix C4) for the safe use, handling, and storage of compressed gas cylinders.

## 5.0 PROTECTIVE MEASURES

### 5.1 Personal Protective Equipment Requirements

| Required PPE | Task 1 | Task 2 |
|---|---|---|
| Hard hat | ✓ | ✓ |
| Safety spectacles | ✓ | ✓* |
| Steel-toe footwear | ✓ | ✓ |
| Hearing protection (plugs, muffs) | ✓% | ✓% |
| Tyvek ™ coveralls | | |
| PE-coated Tyvek™ coveralls | | |
| Boots, chemical resistant | | |
| Boot covers, disposable | | |
| Leather work gloves | | |
| Inner gloves - nitrile | ✓+ | ✓ |
| Outer gloves - nitrile | | |
| Tape all wrist/ankle interfaces | | |
| Half-face respirator | | |
| Full-face respirator | | |
| Organic vapor cartridges | | |
| Acid gas cartridges | | |
| Other cartridges: none | | |
| P-100 (HEPA) filters | | |
| Face shield | | |
| Personal Flotation Device (PFD) | | |
| High-Visibility Safety Vest | ✓ | ✓# |
| Other: Gators | ✓ | ✓ |
| Level of protection required [C or D]: | D | D |

**The PPE checked in any box above must be on site during the task being performed. Work shall not commence unless the PPE is present.**

* Sampling personnel should exercise caution when filling sample containers preserved with HCl, $HNO_3$ or NaOH. Sampling flow rates should be minimized (100 to 200 ml/min) to reduce the possibility of splashing. Additionally, safety goggles or faceshields should be worn to minimize the potential for eye injury, should splashing occur.

% Hearing protection only required when working near equipment generating excessive noise.

+ Nitrile gloves only required when handling parts and/or equipment that is wet with groundwater from a monitor well.

# High visibility vests only required when working along roads.

### 5.2 Personal Hygiene Safeguards

The following additional personal hygiene safeguards shall be adhered to:

- No Smoking or tobacco product use while conducting field activities at SSFL.
- No eating or drinking in the exclusion (hot) zone which is defined as a 5 foot perimeter around the groundwater monitoring well.
- It is especially important to wash your hands before eating, smoking, taking medication, chewing gum/tobacco, using the restroom, or applying cosmetics and before you leave the site for the day. It is recommended that personnel present on site shower or bathe at home at the end of each day of working on the site. Site personnel should also change their shoes prior to entering their personal vehicles at the end of the day.

### 5.3 Site Safety Equipment

Check all items that are required to be on site:

| | | |
|---|---|---|
| ☑ Fire Extinguisher | ☑ First Aid Kit | ☐ Flashlight |
| ☐ Air horn/signaling device | ☑ Cellular Phone | ☐ Duct tape |
| ☐ Ladder | ☐ Barricade tape | ☐ Drum dolly |
| ☑ Two-way radio | ☑ Safety cones | ☐ Harness/Lanyard |
| ☐ Other | | |

**The equipment checked in any box above must be on site during the task being performed. Work shall not commence unless the equipment is present.**

Safety cones are only required when working in high traffic areas. Due to the remote nature of the site, cellular phone reception is limited. Two way radios are typically more reliable means of communication than cellular phones.

### 5.4 Site Security & Work Area Controls

Can **site access** be controlled by a perimeter fence or similar means? ☑ Y ☐ N

The site as a whole is surrounded by a perimeter fence and is patrolled by security personnel. Access to monitor wells is controlled by locking steel well covers.

## 5.5 Training Requirements

### 5.5.1 Health and Safety Training

Personnel will not be permitted to supervise or participate in field activities until they have been trained to a level required by their job function and responsibility. Haley & Aldrich staff members, contractors, subcontractors, and consultants who have the

potential to be exposed to contaminated materials or physical hazards must complete the training described in the following sections.

The Haley & Aldrich PM and RHSC will be responsible for maintaining and providing to the client/site manager documentation of Haley & Aldrich staff members' compliance with required training as requested. Records shall be maintained per Cal/OSHA requirements.

### 5.5.2 40-Hour Health and Safety Training

The 40-Hour Health and Safety Training course provides instruction on the nature of hazardous waste work, protective measures, proper use of personal protective equipment, recognition of signs and symptoms which might indicate exposure to hazardous substances, and decontamination procedures. It is required for all personnel working on site, such as equipment operators, general laborers, and supervisors, who may be potentially exposed to hazardous substances, health hazards, or safety hazards consistent with 8 CCR 5192.

### 5.5.3 8-hour Annual Refresher Training

Personnel who complete the 40-hour health and safety training are subsequently required to attend an annual 8-hour refresher course to remain current in their training. When required, site personnel must be able to show proof of completion (i.e., certification) of an 8-hr refresher training course within the past 12 months.

### 5.5.4 8-Hour Supervisor Training

On-site managers and supervisors directly responsible for, or who supervise staff members engaged in hazardous waste operations, should have eight additional hours of Supervisor training in accordance with 8 CCR 5192. Supervisor Training includes, but is not limited to, accident reporting/investigation, regulatory compliance, work practice observations, auditing, and emergency response procedures.

### 5.5.5 Additional Training for Specific Projects

Haley & Aldrich PM and SSO will ensure field staff receive additional training on specific instrumentation, equipment, confined space entry, construction hazards, etc., as necessary to perform their duties. This specialized training will be provided to personnel before engaging in the specific work activities. Any staff member engaging in the following activities will be required to have additional training:

- Client specific training or orientation;
- Competent person excavations;
- Heavy equipment including aerial lifts and forklifts;
- First aid/ CPR;
- Use of fall protection;
- Commercial Drivers License; and
- Asbestos.

## 6.0 MONITORING PLAN AND EQUIPMENT

### 6.1 Monitoring/Screening Equipment

Is air/**exposure monitoring** required at this work site for personal protection? ☑ Y ☐ N

Is **perimeter monitoring** required for community protection? ☐ Y ☑ N

Monitoring/Screening equipment required to be on site:

☐ HNu analyzer (PID) ☐ 10.2eV ☐ 11.7eV

☐ Combustible Gas Indicator (CGI) (LEL)

☐ Organic vapor monitor (FID)

☐ Multiple Gas Detector-LEL/$O_2$/$H_2S$/CO

☐ Photovac Micro Tip, 10.6eV

☐ Dust Monitors (RAMs)

☐ Photovac GC

☐ Colorimetric tubes

☑ Other MiniRAE 2000

### 6.2 Standard Action Levels and Required Responses

The PID air monitoring action level for work at the SSFL site is 1 ppm above background, sustained over a 5-minute period. This action level value represents the Cal/OSHA PEL for benzene and is below the 5 ppm STEL. This action level based on benzene (a less prevalent contaminant at the site), provides a 25-fold safety factor below the PEL for trichloroethylene which is the contaminant identified most frequently and at the greatest concentrations in groundwater at the site.

When the PID action level is reached, site personnel working in the immediate area should vacate the area of concern and move upwind. Work may resume when PID readings fall below 1 ppm. If PID readings are consistently greater than 1 ppm above background, cease work and vacate the area of concern. Work may only continue if PID readings decrease to less than 1 ppm above background.

The action level for noise exposure is an 8-hour TWA of 85 deciBels (dBA) and the PEL is 90 dBA. When the action level is exceeded, exposed personnel are required to wear hearing protection.

Exposure Guidelines for common contaminants expected to be encountered at the site are listed in Table C-I. A summary of monitoring methods, action levels, and protective measures is included in Table C-II.

### 6.3 Description of Monitoring Requirements:

A PID will be used to monitor the concentration of organic vapors in well vaults immediately after opening the vault and prior to measuring water levels or conducting well maintenance. If the organic vapor concentration in the breathing zone is greater than the PID action level (Section 6.2), allow the well monument to ventilate until PID readings are lower than the PID action level. A PID will be used to establish background prior to beginning daily field activities. PID monitoring is not required for those wells with an established history of PID readings of 0.0 ppm.

Standard Haley & Aldrich field forms or Daily Field Report (DFR) forms will be used to document air monitoring activities during field activities, and will be maintained with project files.

### 6.4 Calibration and Use of Equipment

Calibrate PID monitoring equipment in accordance with manufacturer's requirements and site-specific requirements (daily). Calibration of the PID shall be documented in the field notes or Daily Field Report.

Air monitoring for exposure should be based on the frequency established above (see Section 6.3). Record time, location and results of monitoring and actions taken based upon the readings.

# 7.0 DECONTAMINATION

## 7.1 Personnel Decontamination

Are **decontamination procedures** required for personnel working on site? ☐ Y ☑ N
If yes, describe steps:

**Disposal of PPE:** Any PPE to be disposed of will be contained in a labeled drum provided by the Boeing-contracted waste-handler and picked up by the Boeing-contracted waste handler for proper disposal after each field program is completed.

Check all **equipment and materials needed for decontamination** of tools and other equipment:

| | | |
|---|---|---|
| ☐ Acetone | ☑ Distilled water | ☑ Poly sheeting |
| ☑ Alconox soap | ☑ Drums for water | ☐ Steam cleaner |
| ☑ Brushes | ☐ Hexane | ☑ Tap water |
| ☑ Disposal bags | ☐ Methanol | ☑ Washtubs |
| ☐ Other | | |

## 7.2 Tools & Equipment Decontamination

- Tools and equipment will contact groundwater will be decontaminated before initial use, between monitor wells, and before leaving the site with an alconox detergent wash, tap water rinse, final deionized water rinse, and air dried.

- Monitor well purge pumps will be decontaminated before and after use in each well with an alconox detergent wash, tap water rinse, and final deionized water rinse. This wash and rinse sequence will be circulated through the pump system and applied to exterior surfaces that will be or have been in contact with groundwater.

- Contractors are responsible for decontaminating their own equipment and tools.

**Disposal methods for contaminated decontamination materials** (e.g., wash water, rags, brushes, poly sheeting) will consist of:

Water generated during decontamination procedures will be containerized and transported to a Boeing designated on-site location. Rags, brushes, poly sheeting, and other disposable items which have contacted groundwater will be contained in a labeled drum provided by the Boeing-contracted waste-handler and picked up by the Boeing-contracted waste handler for proper disposal after each field program is completed.

## 8.0 CONTINGENCY PLANNING

**All on-site emergencies will be reported to Boeing fire and security personnel either by calling 911 from an on-site phone, 818-466-8911 from a cell phone, or in person at the fire station.**

### 8.1 Fire

- **Major Fires** - Major fires will be mitigated by the local fire departments.

- **Incipient Stage Fires** -Incipient stage fires will be extinguished by on-site personnel using fire extinguishers. Only those who have received annual training may use an extinguisher.

### 8.2 Medical

Haley & Aldrich employee injuries and illnesses will be documented using the Supervisor's Accident / Injury / Near Miss Report (SAIR). A copy of this form is included in Appendix C2.

- **First Aid** - First aid will be addressed using the on-site first aid kit. Haley & Aldrich Staff Members are not required or expected to administer first aid/CPR to Haley & Aldrich, subcontractor, subconsultant, or general public personnel at anytime. It is Haley & Aldrich's position that those who do so are doing it on their behalf as individuals and not as a function of their job.

- **Trauma** - Based upon the nature of the injury, the injured party may be transported to the nearest hospital or emergency clinic by on-site personnel or by ambulance. First response to a trauma incident is to call Boeing fire and security personnel. Haley & Aldrich staff members are expected to assist in ancillary roles only such as directing ambulances to the scene. It is the discretion of the staff member on site whether an ambulance should be procured in remote locations where ambulance services will not be effective.

- **Non-Emergency Medical Treatment** - If the injury is not an emergency, but medical treatment is required, contact the WorkCare Incident Intervention Team to identify the nearest industrial occu-med clinic. WorkCare will provide medical consultation and if necessary, identify the clinic with an immediate authorization to treat the staff member which will ensure that treatment is rendered as soon as possible. WorkCare Invention Team: 1 (888) 449-7787. This number is staffed 7/24.

### 8.3 Hazardous Materials Spill

- **Small incidental spills** (e.g. - pint of motor oil). Boeing EHS or the On-site Activity Representative will be notified. Small incidental spills caused by Haley & Aldrich employees and/or by the contractor will be mitigated by the Haley & Aldrich staff member and/or the contractor.

- **<u>Large spills</u>** (e.g. - large leak from heavy equipment fuel tank). Boeing EHS or the On-site Activity Representative will be notified. The contractor is responsible for cleanup. In the event that it posses a serious human or environmental threat, the local Fire Department will be contacted by Boeing fire and security personnel. Once the emergency has been mitigated, clean up will typically be provided by a vendor.

### 8.4 Rescue

- Haley & Aldrich employees will not enter any confined spaces for rescue purposes. There are no exceptions to this, instead contact Boeing fire and security personnel.

### 8.5 Weather Related Emergencies

- Haley & Aldrich employees and their subcontractors should be aware of potential health effects and/or physical hazards of working during inclement weather.

### 8.6 Emergency Alarming and Communication

In the event of an emergency, all Haley & Aldrich and Subcontractors shall assemble in a designated area and be accounted for. No personnel shall leave until the emergency is over and the responding agency or facility has given an all clear. **Evacuation alarms** and/or emergency information will be communicated among personnel on site by v**erbal communication**. **Emergency services will be summoned:** Via on-site phone, cell phone, or by facility radios carried by Boeing personnel.

The **site evacuation plan** is as follows:

Site maps located in buildings throughout the Facility show locations of emergency assembly areas. This Emergency Instructions map is also included below in this HASP (Figure C-2). Haley & Aldrich employees and contractors shall locate the map closest to their work area and note the location of the nearest emergency assembly area to meet at in the event of an emergency evacuation.

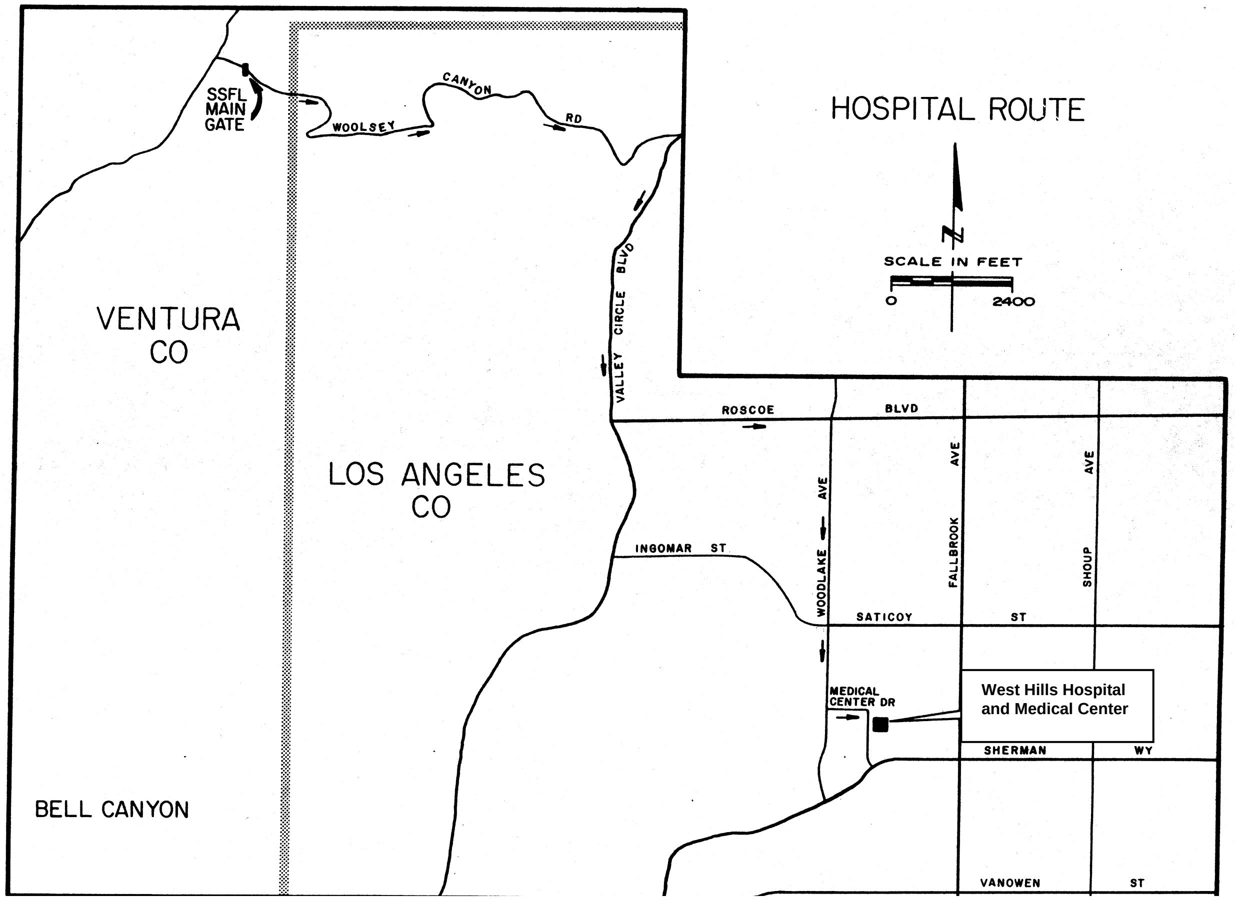
## EMERGENCY RESPONSE RESOURCES

| | |
|---|---|
| **Nearest Hospital:**<br>(see attached map) Address:<br><br>Phone Number: | West Hills Hospital & Medical Center<br>7300 Medical Center Dr.<br>West Hills, CA 91307<br>818.676.4999 |
| **Emergency Response Number:**<br>Ambulance, Fire, Police, or<br>Environmental Emergency: | On-site phone: 911<br>Cell phone: 818.466.8911<br>Off-site phone: 818.466.8911 |
| Haley & Aldrich Project Manager:<br>Phone Number:<br><br>Haley & Aldrich Health & Safety:<br>Phone Number:<br>Emergency Phone Number:<br><br>Client Contact/Coordinator:<br>Phone Number:<br>Emergency Phone Number:<br><br>Client Contact/Project Manager:<br>Phone Number: | Laura Davis<br>520.289.8627<br><br>Scott Boston<br>714.371.1800<br>714.616.1565<br><br>Dan Trippeda<br>818.466.8977<br>818.595.6141 (pager)<br><br>Debbie Taege<br>818.466.8849 |
| Client Contact/Health & Safety:<br>Phone Number:<br>Emergency Cell / Pager | Bob Mako / Mike Nagaoka / Brian Lam<br>818.466.8735 / 818.466.8151 / 818.466.8817<br>818.702.7603 / 818.595.4441 / 818.595.6149 |
| Haley & Aldrich<br>Program Manager:<br>Phone Number: | <br>William Kay<br>714.371.1815 |



Note: This HASP is developed for Haley & Aldrich purposes only and not for use by subcontractors. Subcontractors may use this HASP as reference only.

**HOSPITAL ROUTE**




## Hospital Route Driving Instructions:

**Leave the facility traveling on Woolsey Canyon Road.**
**Stay right just outside the gate at the Y-intersection with Black Canyon Road.**
**Turn right onto Valley Circle Blvd at the stop sign.**
**Turn left onto Roscoe Blvd at the stop light.**
**Turn right onto Woodlake Ave.**
**Turn left onto Medical Center Drive.**
**West Hills Hospital and Medical Center is located at 7300 Medical Center Dr.**

## 9.0 HEALTH & SAFETY PLAN ACKNOWEDGMENT FORM

**Note: Only H&A employees sign this page.**

I hereby acknowledge receipt and briefing on this Health & Safety Plan prior to the start of on-site work and declare that I understand and agree to follow the provisions and procedures set forth herein while working on this site.

| PRINTED NAME | SIGNATURE | DATE |
|---|---|---|
| ______________________ | ______________________ | __________________ |
| ______________________ | ______________________ | __________________ |
| ______________________ | ______________________ | __________________ |
| ______________________ | ______________________ | __________________ |
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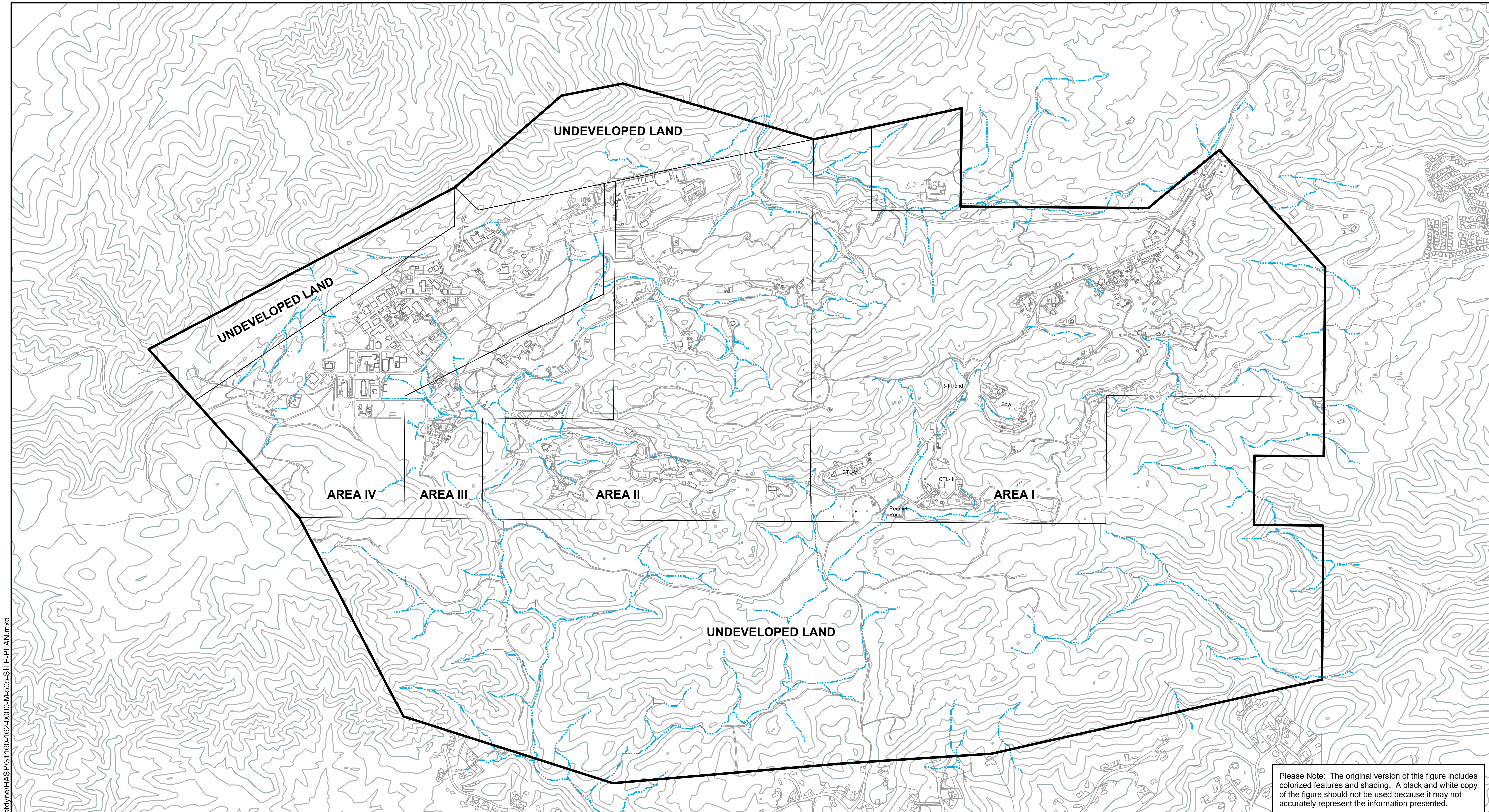
| ______________________ | ______________________ | __________________ |
| ______________________ | ______________________ | __________________ |

## 10.0 PRE-JOB SAFETY CHECKLIST

The following checklist is designed to help Project Managers verify that all Health & Safety requirements are satisfied for projects involving site work and to aid in the preparation of the site-specific HASP.

Please initial and date the appropriate box once each requirement has been satisfied prior to commencement of site work.

| # | **Project H&S Requirements** | **Approval by PM or RHSC (initial each box or place NA)** | **Date Approved** |
|---|---|---|---|
| 1 | Project site history has been researched and summarized, current site conditions have been determined and documentation of previous investigations, risk analyses and chemical data has been assembled and summarized. | | |
| 2 | Project work scope has been outlined and potential chemical and physical hazards associated with work tasks have been identified. | | |
| 3 | Task Safety Analysis has been performed and attached to the HASP. | | |
| 4 | H&A personnel to be involved with the project have been identified and are current with medical surveillance, Cal/OSHA 40 hour and 8 hour refresher training. HAZWOPER site supervisor requirements are satisfied. | | |
| 5 | Additional training requirements have been met: e.g. nuclear density gauge, DOT, Confined Space Entry, Competent Person Training for Excavation, OSHA 10 hour certification, Railway Safety Training, etc. | | |
| 6 | H&A personnel that may be required to wear a respirator are medically qualified and have current certification of fit testing. | | |
| 7 | Client's additional H&S requirements have been met: e.g. facility safety orientations, safety documentation, meetings, special PPE requirements | | |
| 8 | H&A subcontractors have met H&A's minimum requirements including: current Cal/OSHA 40 hour training, medical surveillance, written HASP, insurance, MSDSs. | | |
| 9 | MSDSs are on site and available for chemicals on site. | | |
| 10 | Safety equipment is available: e.g. flashlight, telephone, ladders, traffic cones, barricade tape, fire extinguisher, first aid kit, PPE, respiratory protection, air and dust monitoring instrumentation (calibrated), personal flotation device (PFD), 90' life line with ring, decontamination equipment, etc. | | |
| 11 | HASP and supporting documentation is complete and signed by all members. | | |




## LEGEND

— PROPERTY BOUNDARY

N
W E
S

0 1000 2000 3000

SCALE IN FEET

HALEY & ALDRICH

SITE SPECIFIC HELATH & SAFETY PLAN
SANTA SUSANA FIELD LABORATORY
VENTURA COUNTY, CALIFORNIA

SITE PLAN MAP

SCALE: AS SHOWN
APRIL 2010

FIGURE C-1

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# EMERGENCY INSTRUCTIONS

## EMERGENCY NUMBER 911

FROM CELL PHONE
(818) 466-8911

## SANTA SUSANA FIELD LABORATORY

Reporting Emergencies
Report any type of emergency, injury, illness, fire, explosion or chemical spill to the Boeing Control Center by using the facility emergency number. Be sure to give your name, location, nature of the emergency and telephone number. Use the building number and column number to describe emergency locations. Stand by, if possible, to direct responding personnel.

Emergency numbers for Rocketdyne facilities are located on each telephone.

Personnel Emergency Information
The public address system is the preferred means of informing personnel of any action they must take during an emergency. If an emergency should occur and no public address system is accessible:

- Security and Fire Services officers using bullhorns will direct personnel.

  or

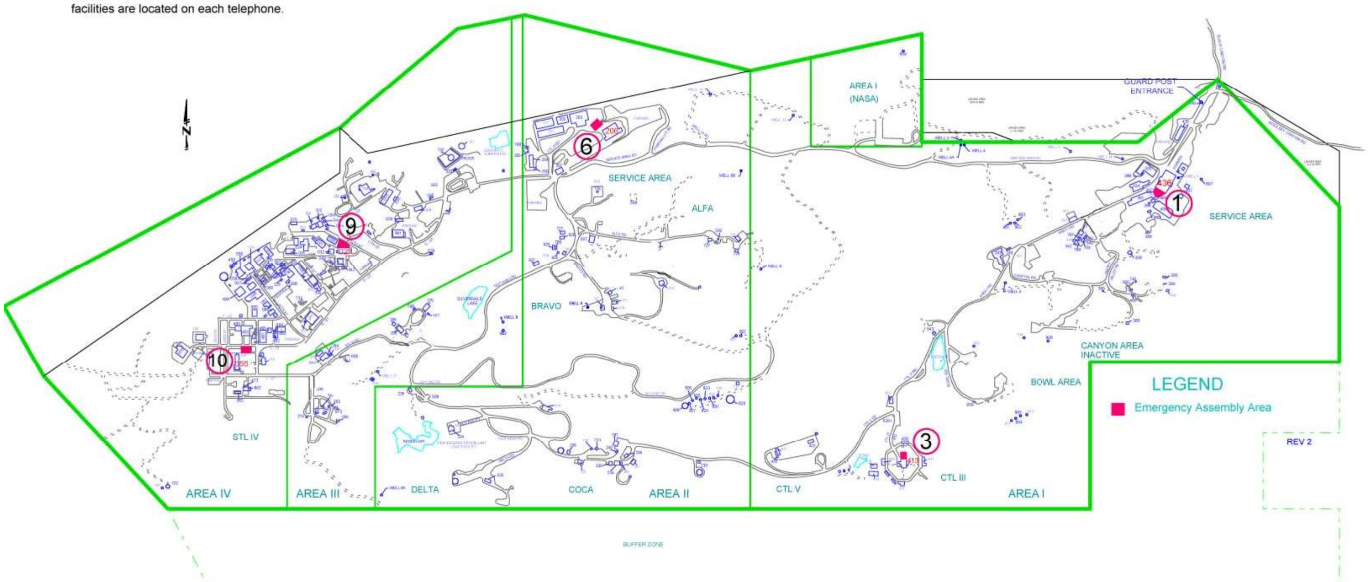
- Managers will direct personnel

To protect yourself in the event of an emergency, familiarize yourself with the location of building exits and plan your emergency exit routes.

Exit Routes and Assembly Areas
For location of major exit routes, emergency exit doors and emergency assembly areas, see diagram.

### Location of Emergency Assembly Areas

1. South of Bldg 31-436
3. North of Bldg 31-413
6. South West of Bldg 42-206
9. West of Bldg 44-034
10. North East of Bldg 44-055




HALEY & ALDRICH

THE BOEING COMPANY
SANTA SUSANA FIELD LABORATORY
VENTURA COUNTY, CALIFORNIA

EMERGENCY INSTRUCTIONS

SCALE: AS SHOWN
APRIL 2010

FIGURE C-2

**TABLE C-I**
HAZARD MONITORING
Boeing Santa Susana Field Laboratory
Ventura County, California

| CONTAMINANTS OF CONCERN | ROUTES OF EXPOSURE | IDLH | PEL | TLV | PID (IP eV) | FID | ODOR THRES-HOLD | IRRITATION THRESHOLD | ODOR DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|
| Acetone | R, I, C | 2500 | 500 | 500 Cv 750 | 9.69 | 60 | 13 | -- | Chem, sweet, pungent |
| Ammonia | R, A, I, C | 300 | 25 | 25 Cv 35 | -- | -- | 0.5-2 | 10 | Pungent suffocating odor |
| **Benzene** | **R,A,I,C** | **Ca** | **1** | **Sk 0.5** | **9.25** | **150** | **4.68** | **--** | **Solvent** |
| Carbon tetrachloride (Tetrachlormethane) | R,A,I,C | Ca | 2 Cv 10 200: 5 min peak | Sk 5 Cv 10 | 11.47** | 10 | 50 | -- | Sweet, pungent |
| Chlorobenzene | R,I,C | 1000 | 10 | 10 | 9.07 | 200 | 0.68 | -- | Almond like |
| Chloroform | R,I,C | Ca | 2 | 10 | 11.42** | 65 | 50 | -- | Sweet |
| Cyanides | R,A,I,C | 50 mg/m$^3$ | 5 mg/m$^3$ | Cv 5 mg/m$^3$ Sk | -- | -- | -- | -- | Faint almond odor |
| o-Dichlorobenzene | R,A,I,C | 200 | 25 | 25 Cv 50 | 9.06 | 50 | 0.3 | E 20-30 | Pleasant, aromatic |
| p-Dichlorobenzene | R,I,C | 150 | 10 | 10 | 8.94 | -- | 0.18 | E 80-160 | Distinct, aromatic mothball-like |
| Dichlorodifluoromethane (Freon 12) | R,C | 1500 | 1000 | 1000 | 11.97** | 15 | -- | -- | -- |
| 1,1-Dichloroethane | R,I,C | 3000 | 100 | 100 | -- | 80 | 200 | -- | Distinct |
| 1,2-Dichloroethane | R,I,A,C | Ca | 1 | 10 | 11.12** | 80 | 88 | -- | Chloroform |
| 1,1-Dichloroethene (1,1-Dichloroethylene, 1,1-DCE) | R,I | Ca | 1 | 5 | * | 40 | 190 | -- | -- |
| **1,2-Dichloroethene (1,2-Dichloroethylene)** | **R,I,C** | **1000** | **200** | **200** | **9.65** | **50** | **0.85** | **--** | **Ether-like acrid** |
| Ethanol | R,A,I,C | -- | 1000 | 1000 | 10.48** | 25 | 10 | -- | Sweet |
| Ethylbenzene | R,I,C | 800 | 100 | Cv 125 100 | 8.76 | 100 | 2.3 | E 200 | Aromatic |
| Ethylene Glycol vapor | R,A,I,C | -- | 40 | - | -- | -- | -- | -- | -- |
| Formaldehyde | I,C | Ca | 0.75 | Cv 0.3 | 10.88** | -- | 0.83 | -- | Hay |
| Gasoline | R,I,C | Ca | 300 | 300 | -- | -- | -- | E 0.5 | Petroleum |
| Hexane, n-isomer | R,I,C | -- | 50 | 50 | 10.18 | 70 | 130 | E.T 1400-1500 | Mild, gasoline-like |
| Hydrogen Cyanide (as CN) | R,A,I,C | 50 | Sk Cv-4.7 | Sk Cv-4.7 | ** | -- | 0.58 | -- | Bitter almond |
| Hydrogen peroxide | R,I,C | 75 | 1 | 1 | 11** | -- | -- | -- | Shar[ |
| Methanol | R,I,C | 25000 | Sk 200 | Sk 200 | 10.84** | 12 | 1000 | -- | Sweet |
| MEK peroxide | R,I,C | -- | Cv 0.2 | Cv 0.2 | -- | -- | -- | -- | -- |
| Methyl Chloroform (1,1,1-TCA) | R,I,C | 700 | 350 | 350 | ** | 105 | 20-100 | -- | Chloroform-like |
| Methylene Chloride (Dichloromethane, Methylene dichloride) | R,I,C | Ca | 25 | 50 | 11.35** | 100 | 25-50 | E 5000 | Ether-like |
| Methyl Mercaptan | R,C | 150 | 0.5 | 0.5 | 9.44 | -- | -- | -- | Garlic, Rotten Cabbage |
| MIBK (Hexone) | R,I,C | 500 | 50 | 50 Cv 75 | -- | -- | -- | -- | Pleasant |
| Naptha (coal tar) | R,I,C | 1000 | 100 | 400 | -- | -- | -- | -- | Aromatic |
| Naphthalene | R,A,I,C | 250 | 10 | 10 | 8.14 | -- | 0.3 | E 15 | Mothball-like |
| Octane | R,I,C | 750 | 300 | 300 Cv 375 | 9.9 | 80 | 48 | -- | Gasoline-like |
| Pentachlorophenol | R,A,I,C | 2.5 mg/M$^3$ Ca | 0.5 mg/m$^3$ Sk | 0.5 mg/m$^3$ Sk | -- | -- | -- | -- | Pungent when hot |
| Phenol | R,A,I,C | 250 | Sk 5 | Sk 5 | 8.5 | -- | 0.04 | E.N.T. 68 | Medicinal |
| Propane | R,C | 2100 | 1000 | 2500 | 10.95** | 80 | 1600 | -- | Natural gas odor |
| Stoddard Solvent (Mineral Spirits) | R,CI,I | 20000 mg/m$^3$ | 100 | 100 | * | -- | 1 | E 400 | Kerosene-like |

**TABLE C-I**
HAZARD MONITORING
Boeing Santa Susana Field Laboratory
Ventura County, California

| CONTAMINANTS OF CONCERN | ROUTES OF EXPOSURE | IDLH | PEL | TLV | PID (IP eV) | FID | ODOR THRES-HOLD | IRRITATION THRESHOLD | ODOR DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|
| Styrene | R,I,C | 700 | Sk 50 | 20 | 8.47 | 85 | 0.047 | E 200-400 | Rubber, solvent |
| 1,1,2,2-Tetrachloroethane | R,A,I,C | Ca (100) | 1 | 1 | 11.1** | 100 | 1.5 | -- | -- |
| Tetrachloroethene (Tetrachloroethylene, (Perchloroethylene) | R,I,C | Ca | 25 | 25 | 9.32 | 70 | 4.68 | N.T513-690 | Ether, chloroform-like |
| Toluene | R,A,I,C | 500 | 50 | 50 | 8.82 | 110 | 2.14 | E300-400 | Mothball-like |
| **Trichloroethene (Trichloroethylene)** | **R,I,C** | **Ca (1000)** | **25** | **50** | **9.47** | **70** | **21.4** | **--** | **Solventy, chloroform-like** |
| Turpentine | R,A,I,C | 800 | 100 | 100 | -- | -- | 200 | E.N 200 | Pine-like |
| Vinyl Chloride | R | Ca | 1 | 2 | 9.995 | -- | 3000 | -- | Ethereal |
| Xylenes | R,A,I,C | 1000 | 100 | 100 | 8.56/8.44 | 111/116 | 1.1 | E.N.T. 200 | Aromatic |
| **DUSTS, MISTS AND MISCELLANEOUS COMPOUNDS** | | | | | | | | | |
| Asbestos | R | Ca | 0.1 fibr/cc | Species dependent | -- | -- | -- | -- | -- |
| PCBs-42% Chlorine | R,A,I,C | Ca | 1 $mg/m^3$ Sk | 1 $mg/m^3$ Sk | -- | -- | -- | -- | Mild, hydrocarbon |
| PCBs-54% Chlorine | R,A,I,C | Ca | 0.5 $mg/m^3$ Sk | 0.5 $mg/m^3$ Sk | -- | -- | -- | -- | Mild, hydrocarbon |
| Aluminum- metal dust- total | R,I,C | -- | 10 $mg/m^3$ | 10 $mg/m^3$ | -- | -- | -- | -- | -- |
| -soluble salts | R,I,C | -- | 2 $mg/m^3$ | 2 $mg/m^3$ | -- | -- | -- | -- | -- |
| Arsenic- inorganic | R,A,I,C | Ca | 0.01 $mg/m^3$ | 0.2 $mg/m^3$ | -- | -- | -- | -- | -- |
| Barium:soluble compounds | R,I,C | 250 $mg/m^3$ | 0.5 $mg/m^3$ | 0.5 $mg/m^3$ | -- | -- | -- | -- | -- |
| Beryllium | R, I | 4 $mg/m^3$ | 0.0002 $mg/m^3$ 0.025 $mg/M^3$ Ceiling | 0.002 $mg/m^3$ 0.01 $mg/M^3$ STEL | -- | -- | -- | -- | -- |
| Cadmium dusts | R,I | Ca | 0.005 $mg/m^3$ | 0.01 $mg/m^3$ | -- | -- | -- | -- | -- |
| Chromium: Species Dependent (Hexavalent) | R,I,A,C | 25 $mg/m^3$ | Spec Dep hex- (0.005mg/m$^{3)}$ | Spec Dep | -- | -- | -- | -- | -- |
| Copper - dust & mist | R,I,C | -- | 1 $mg/m^3$ | 1 $mg/m^3$ | -- | -- | -- | -- | -- |
| Dioxin (TCDD) | R, I | Ca | 70 $pg/m^3$ MRL | -- | -- | -- | -- | -- | -- |
| Lead - arsenate | R,I,C | Ca | 0.05 $mg/m^3$ | 0.15 $mg/m^3$ | -- | -- | -- | -- | -- |
| - inorg. dust & fume | R,I,C | -- | 0.5 $mg/m^3$ | 0.15 $mg/m^3$ | -- | -- | -- | -- | -- |
| - chromate (as Pb) | R,I,C | -- | 0.02 $mg/m^3$ | 0.05 $mg/m^3$ | -- | -- | -- | -- | -- |
| Manganese & compounds | R,I | 500 $mg/m^3$ | 0.2 $mg/m^3$ | 0.2 $mg/m^3$ | -- | -- | -- | -- | -- |
| Mercury & inorg. comp. | R,A,C | 10 $mg/m^3$ | 0.025 $mg/m^3$ | 0.1 $mg/m^3$ | -- | -- | -- | -- | -- |
| - (organo) alkyl comp. | R,A,I,C | 2 $mg/m^3$ | 0.01 $mg/m^3$ | 0.1 $mg/m^3$ | -- | -- | -- | -- | -- |
| Nickel - metal, insoluble | R,I,C | Ca | 1 $mg/m^3$ | 1 $mg/m^3$ | -- | -- | -- | -- | -- |
| - soluble comp. | R,I,C | Ca | 0.1 $mg/m^3$ | 0.1 $mg/m^3$ | -- | -- | -- | -- | -- |
| Nuisance Dust | R | | 5$mg/m^3$(Resp) 10$mg/m^3$(total) | 5$mg/m^3$(Resp) 10$mg/m^3$(total) | -- | -- | -- | -- | -- |
| PAH's (as Coal Tar Pitch Volatiles) | R,A,I,C | -- | 0.2 $mg/m^3$ | 0.2 $mg/m^3$ | -- | -- | -- | -- | Mild, hydrocarbon |
| Portland cement | R,I,C | -- | 10 $mg/m^3$ | 10 $mg/m^3$ | -- | -- | -- | -- | -- |
| Selenium compounds | R,A,I,C | 100 $mg/m^3$ | 0.05$mg/m^3$ | 0.2 $mg/m^3$ | -- | -- | -- | -- | -- |
| Silver - metal | R,I,C | -- | 0.01 $mg/m^3$ | 0.1 $mg/m^3$ | -- | -- | -- | -- | -- |
| - soluble comp. | R,I,C | -- | 0.01 $mg/m^3$ | 0.1 $mg/m^3$ | -- | -- | -- | -- | -- |
| Thallium, soluble | R,A,I,C | 20 $mg/m^3$ | 0.1 $mg/m^3$ Sk | 0.1 $mg/m^3$ Sk | -- | -- | -- | -- | -- |

**TABLE C-I**
HAZARD MONITORING
Boeing Santa Susana Field Laboratory
Ventura County, California

| CONTAMINANTS OF CONCERN | ROUTES OF EXPOSURE | IDLH | PEL | TLV | PID (IP eV) | FID | ODOR THRES-HOLD | IRRITATION THRESHOLD | ODOR DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|
| Tin, metal & inorganic | R,C | 400 mg/m$^3$ | 2 mg/m$^3$ | 2 mg/m$^3$ | -- | -- | -- | -- | -- |
| Comp. except oxides | | | | | | | | | |
| Tin, organic compounds | R,A,I,C | 200 mg/m$^3$ | 0.1 mg/m$^3$ | 0.1 mg/m$^3$ Sk | -- | -- | -- | -- | -- |
| TPH (as Naphtha) | R,A,I,C | -- | 300 ppm | 300 ppm | 10.6 | -- | 0.89 ppm | -- | Kerosene |
| Zinc chromates, as Cr | R,I,C | -- | 0.005 mg/m$^3$ | Cv 0.1 mg/m$^3$ | -- | -- | -- | -- | -- |
| Zinc oxide dust (total) | R,I,C | -- | 15 mg/m$^3$ | 10 mg/m$^3$ | -- | -- | -- | -- | -- |

**NOTES:**
1. R = Respiratory (inhalation).
2. I = Ingestion.
3. A = Skin absorption.
4. C = Skin and/or eye contact.
5. Ca = Carcinogen.
6. SK = Skin.
7. Cv = Ceiling value.
8. ** = Use 11.7 eV lamp.
9. All units are in ppm unless otherwise noted.

STEL - Short Term Exposure Limit.
MRL - ASTDR MRL for Intermediate Exposure.
Coal tar pitch volatiles (benzene or cyclohexane-soluble fraction) include fused polycyclic hydrocarbons.

**TABLE C-II**
MONITORING METHOD, ACTION LEVELS AND PROTECTIVE MEASURES
BOEING SANTA SUSANA FIELD LABORATORY
VENTURA COUNTY, CALIFORNIA

| INSTRUMENT | HAZARD | ACTION LEVEL | ACTION RESPONSE |
|---|---|---|---|
| Respirable Dust Monitor | Total Particulates | > 5 $mg/m^3$ | Upgrade to Level C Protection |
| OVA, HNU[2], Photovac Microtip | Total Organic Vapors | Background | Level D Protection |
| | | 1 ppm > background sustained for >5 minutes in the breathing zone. | Evacuate the area and wait for concentration to decrease to below action level |
| Explosimeter[4] (LEL) | Flammable/Explosive Atmosphere | <10% Scale Reading | Proceed with work |
| | | 10-15% Scale Reading | Monitor with extreme caution |
| | | >15% Scale Reading | Evacuate site |
| Oxygen Meter[5] | Oxygen-Deficient Atmosphere | 19.5% - 23.5% $0_2$ | Normal - Continue work |
| | | < 19.5% $0_2$ | Evacuate site; oxygen deficient |
| | | > 23.5% $0_2$ | Evacuate site; fire hazard |
| Radiation Meter[6] | Ionizing Radiation | 0.1 Millirem/Hour | If > 0.1, radiation sources may be present[7] |
| | | > 1 Millirem/Hour | Evacuate site; radiation hazard |
| Drager Tubes | Vapors/Gases | Species Dependent<br>> 1 ppm vinyl chloride<br>> 1 ppm benzene<br>> 1 ppm 1,1-DCE | Consult Table 1 or other resources for concentration toxicity/detection data. Upgrade to Level C if concentration of compounds exceed thresholds shown at left; May need to cease work if other levels exceeded - site specific |
| Gas Chromatograph (GC) | Organic Vapors | 3 ppm total OV > background or > lowest specific OSHA permissible exposure limit, whichever is lower | On-site monitoring or tedlar bag sample collection for off-site/laboratory analysis |

Notes:
1. Monitor breathing zone.
2. Can also be used to monitor some inorganic species.
3. Positive pressure demand self contained breathing apparatus.
4. Lower explosive limit (LEL) scale is 0-100%. LEL for most gasses is 15%.
5. Normal atmospheric oxygen concentration at sea level is 20%.
6. Background gamma radiation is ~0.01-0.02 millirems/hour.
7. Contact Haley & Aldrich Health and Site Safety Officer immediately.

# APPENDIX C1

## HASP Amendment Form

## HASP Amendment Form

This Appendix is to be used whenever there is an immediate change in the project scope that would require an amendment to the HASP. For project scope changes associated with "add-on" tasks, the changes must be made in the body of the HASP. Before changes can be made, a review of the potential hazards must be initiated by the H&A Project Manager.

| | |
|---|---|
| Amendment No. | |
| Site Name: | |
| Work Assignment No.: | |
| Date: | |
| Type of Amendment: | |
| Reason for Amendment: | |
| Alternate Safeguard Procedures: | |
| Required Changes in PPE: | |

Project Manager Signature: ________________________________ Date: _________________

Regional Health and Safety Coordinator: __________ __________ Date: _________________

This original form must remain on site with the original HASP. If additional HASPs are in the field, it is the Project Manager's responsibility to forward a signed copy of this amendment to those who have copies.

**APPENDIX C1.A**

**HASP Amendment Form**
**12 May 2010**

## HASP Amendment Form

This Appendix is to be used whenever there is an immediate change in the project scope that would require an amendment to the HASP. For project scope changes associated with "add-on" tasks, the changes must be made in the body of the HASP. Before changes can be made, a review of the potential hazards must be initiated by the H&A Project Manager.

| | |
|---|---|
| Amendment No. | Amendment 1 of Revison 2 |
| Site Name: | Santa Susana Field Laboratory, SSFL |
| Work Assignment No.: | 20090-293 and 20090-193 |
| Date: | Prepared 12 May 2010 |
| Type of Amendment: | **ADD TASK 3** for Well Drilling and Construction |
| Reason for Amendment: | Provide information for safe practices during **TASK 3** well drilling and construction activities to be conducted at SSFL which are not addressed in the Site-Specific Health & Safety Plan (HASP), Revision 2 dated 14 April 2010.<br>ADD **Appendix C6 OP 1002 Drilling Safety**<br><br>**1.0 PROJECT INFORMATION:**<br>ADD **H&A Project Manager:**<br>The Task 3 H&A project manager is:<br>Kurt Blust<br>Direct Office Phone: 520-289-8617<br>Cell Phone: 520-904-5332<br>**SUBCONTRACTOR**<br>No changes or additions.<br>**SCOPE OF WORK**<br>Drilling and construction of four monitor wells at the SSFL to collect data for satisfy the requirements of the Regulated Unit Post Closure Permit Modification dated 5 January 2010.<br><br>**2.0 SITE DESCRIPTION:**<br>No changes or additions.<br><br>**3.0 PROJECT TASK BREAKDOWN**<br>ADD **TASK 3**<br>**Detailed Task Description:**<br>Task will include drilling and construction of 4 new monitor wells using the air rotary casing advance drilling method; re-drilling of the open-borehole interval of up to four existing wells (RD-45A, RD-49C, RD-51C and RD-52B); and destruction of one existing monitor well (PZ-003) by over-drilling and filling with cement<br><br>**Employee(s)**<br>Jason Raucci is an additional H&A employee. |

| | |
|---|---|
| | **Work Date(s)**<br>1 June to 30 June 2010.<br><br>**4.0 HAZARD ASSESSMENT**<br>**4.1 Chemical Hazards**<br>No changes or additions.<br>**4.2 Physical and Biological Hazards**<br>**Physical Hazard Checklist**<br>No changes or additions.<br>Same as **TASK 1**.<br><u>ADD **Drill Rig Safety**</u><br>Working in the vicinity of a drill rig involves requires safeguard measures in addition to those for working around other heavy equipment including the proper securing of the drilling rig and associated equipment.<br>The driller will inspect the rig and associated equipment prior to the start of work each day. Items checked must include:<br>• Vehicle condition (brakes, lights, steering and horn operational);<br>• Proper equipment storage;<br>• Condition of wire rope and cables and replace if worn or frayed;<br>• Presence and condition of safety equipment including First Aid kit and fire extinguisher.<br>The driller will be responsible for breaking (incl. tire chocks), blocking and leveling the rig to ensure stability before raising the derrick, and for lowering the derrick fully before moving the rig.<br>Drilling will proceed only if:<br>• The Site Contract Coordinator has ensured an adequate safety zone around the drilling operation<br>• Any underground utilities have been located and marked<br>• Safe distance from overhead powerlines is maintained.<br><br>**5.0 PROTECTIVE MEASURES**<br>No changes or additions.<br>**5.1 PPE Requirements**<br>No changes or additions.<br>Same as Task 1 and 2.<br><br>**6.0 MONITORING PLAN & EQUIPMENT**<br>**6.1 Monitoring/Screening Equipment**<br>**ADD** Dust Monitor (RAMs)<br>**6.2 Standard Action Levels and Required Responses**<br><u>ADD</u> The action level for VOCs measured with a PID will be 1 ppm above background, sustained for 5 minutes. If the PID action level is reached, personnel should vacate the work site to an upwind area until PID readings fall below the action level.<br><br>The action level for dust will be 5 milligrams per cubic meter total particulates, sustained for 5 minutes. If the action level is reached, |

| | |
|---|---|
| | workers may be required to don a half-face respirator with a particulate filter.<br>**6.3 Description of Monitoring Requirements:**<br>ADD Airborne VOCs and dust will be monitored every 15 minutes during drilling operations using a PID and a respirable dust meter. Background levels will be established prior to beginning work.<br>**6.4 Calibration and Use of Equipment**<br>ADD Calibrate the dust monitoring equipment in accordance with the manufacturer's requirements, if necessary. Field calibration of the dust monitor shall be documented in the field notes or Daily Field Report.<br><br>**7.0 DECONTAMINATION**<br>No changes or additions.<br><br>**8.0 CONTINGENCY PLANNING**<br>No changes or additions.<br><br>**9.0 HEALTH & SAFETY PLAN ACKNOWLEDGEMENT FORM**<br>No changes or additions.<br><br>**10.0 PRE-JOB SAFETY CHECKLIST**<br>No changes or additions.<br><br>ADD **Appendix C6 _OP 1002 Drilling Safety** |
| Alternate Safeguard Procedures: | |
| Required Changes in PPE: | Workers may be required to use a half-face respirator with a particulate filter, based on monitoring results.<br><br>Otherwise, same as Task 1. |

Project Manager Signature: [signature] Date: 5/13/10

Regional Health and Safety Coordinator: [signature] Date: May 12, 2010

This original form must remain on site with the original HASP. If additional HASPs are in the field, it is the Project Manager's responsibility to forward a signed copy of this amendment to those who have copies.

# APPENDIX C2

## Issuance and Compliance,
## Site Safety Officer Role and Responsibilities,
## Training Requirements

# APPENDIX C2
## Issuance and Compliance
## Site Safety Officer Role and Responsibilities
## Training Requirements

This Health & Safety Plan (HASP) has been prepared in accordance with the requirements of Title 8 of the California Code of Regulations (CCR) Section 5192 to provide guidance for the protection of onsite personnel from physical harm and chemical exposure while working at the subject site.

The specific requirements of this HASP include precautions for hazards that exist during this project and may be revised as new information is received or as site conditions change.

- This HASP must be signed by all Haley & Aldrich (H&A) staff members who will work on the project, including H&A visitors. By signing the Health and Safety Plan Acknowledgement Form personnel are acknowledging that they are aware of the specific hazards of the site and agree to follow the provisions and procedures required to safeguard themselves and others from those hazards.
- This HASP or a current signed copy must be retained at the site at all times when H&A staff members are present.
- Deviations from this HASP are not permitted without prior approval from the above signed. Unauthorized deviations may constitute a violation of H&A company procedures/policies and may result in disciplinary action.
- Revisions to this HASP must be outlined within the contents of the HASP. If immediate or minor changes are necessary, the RHSC and H&A Project Manager may use Appendix A (HASP Amendment Form), located in the back of this HASP. Any revision to the HASP requires personnel to be informed of the changes and that they understand the requirements of the change.
- This HASP is not for H&A Subcontractor use. Each subcontractor engaged is responsible for all matters relating to the health and safety of their personnel and the safe operation of their equipment. This HASP will be made available as a reference so that subcontractors are informed of the potential hazards associated with the site to the extent we are aware. Subcontractors must develop their own HASP which must be, at a minimum, at least as protective as this HASP.
- This Site Specific HASP provides only site-specific descriptions and work procedures. General safety and health compliance programs in support of this HASP (e.g., injury reporting, medical surveillance, personal protective equipment (PPE) selection, etc. are described in detail in the H&A Corporate Health and Safety Program Manual and within Standard Operating Procedures (OPs). Both the manual and OPs can be located on the Company Intranet. When appropriate, users of this HASP should always refer to these resources and incorporate to the extent possible. The manual and OPs are available to clients and regulators per request.

**Site Safety Officer:**

The site safety officer (SSO) is defined as the individual responsible to the employer with the authority and knowledge necessary to implement the HASP and verify compliance with applicable health and safety requirements.

The H&A Project Manager may designate any person as the site safety officer (SSO) and determines the order of authority on site. Usually the highest ranking person on site is the SSO. A site safety officer must be on site at all times. When none of the designated SSOs are present on site, the senior person for H&A on site will default to the SSO. This project has identified the following hierarchy for SSO.

1. Paul Kroger
2. Marc Simpson
3. Shannon Collinge
4. David Camacho
5. Jeffery A. Miller

**Site Safety Officer Roles and Responsibilities:**

The SSO is responsible for field implementation of this HASP and enforcement of safety rules and regulations. SSO functions include:

- Act as H&A's liaison for health and safety issues with client, staff, subcontractors, and agencies.
- Verify that utility clearance has been performed by H&A subcontractors.
- Oversee day-to-day implementation of the HASP by H&A employees on site.
- Interact with subcontractor project personnel on health and safety matters.
- Verify use of required PPE as outlined in the HASP.
- Inspect and maintain H&A safety equipment, including calibration of air monitoring instrumentation used by H&A.
- Perform changes to HASP and document in Appendix A of the HASP as needed and notify appropriate persons of changes.
- Investigate and report on-site accidents and incidents involving H&A and its subcontractors.
- Verify that site personnel are familiar with site safety requirements (e.g., the hospital route and emergency contact numbers).
- Report accidents, injuries, and near misses to the H&A PM and RHSC as needed.

The SSO will conduct initial site safety orientations with site personnel (including subcontractors) and conduct toolbox and safety meetings thereafter with H&A employees and H&A subcontractors at regular intervals and in accordance with H&A policy and contractual obligations. The SSO will track the attendance of site personnel at H&A orientations, toolbox talks, and safety meetings. Subcontractors will document training and provide training rosters to the H&A SSO.

The SSO will report accidents such as injury, overexposure, or property damage to the RHSC, to the Project Manager, and to the safety managers of other on-site consultants and contractors. The SSO will consult with the safety managers of other on-site consultants and subcontractors on specific health and safety issues arising over the course of the project, as needed.

**Health and Safety Training Requirements:**

Personnel will not be permitted to supervise or participate in field activities until they have been trained to a level required by their job function and responsibility. H&A staff members, contractors, subcontractors, and consultants who have the potential to be exposed to contaminated materials or physical hazards must complete the training described in the following sections.

The H&A Project Manager/RHSC will be responsible for maintaining and providing to the client/site manager documentation of H&A staff members' compliance with required training as requested. Records shall be maintained per Cal/OSHA requirements.

**40-Hour Health and Safety Training**

The 40-Hour Health and Safety Training course provides instruction on the nature of hazardous waste work, protective measures, proper use of personal protective equipment, recognition of signs and symptoms which might indicate exposure to hazardous substances, and decontamination procedures. It is required for all personnel working on-site, such as equipment operators, general laborers, and supervisors, who may be potentially exposed to hazardous substances, health hazards, or safety hazards consistent with 8 CCR 5192.

**8-hour Annual Refresher Training**

Personnel who complete the 40-hour health and safety training are subsequently required to attend an annual 8-hour refresher course to remain current in their training. When required, site personnel must be able to show proof of completion (i.e., certification) at an 8-hr refresher training course within the past 12 months.

**8-Hour Supervisor Training**

On-site managers and supervisors directly responsible for, or who supervise staff members engaged in hazardous waste operations, should have eight additional hours of Supervisor training in accordance with 8 CCR 5192. Supervisor Training includes, but is not limited to, accident reporting/investigation, regulatory compliance, work practice observations, auditing, and emergency response procedures.

**Additional Training for Specific Projects**

H&A personnel will ensure their personnel have received additional training on specific instrumentation, equipment, confined space entry, construction hazards, etc., as necessary to perform their duties. This specialized training will be provided to personnel before engaging in the specific work activities including:

- Client specific training or orientation
- Competent person excavations
- Heavy equipment including aerial lifts and forklifts
- First aid/ CPR
- Diving certification
- Use of fall protection
- Commercial drivers license
- Asbestos awareness

## APPENDIX C3

## Supervisor’s Accident / Injury / Near Miss Report

HALEY & ALDRICH

# Supervisor's Accident/ Injury/ Near Miss Report (SAIR)

Safety Form 004



- **Staff Manager is responsible for completing this form. RHSC and/or Field Supervisor will complete form only as a backup.**
- **Staff Manager forwards completed copy to RHSC; RHSC reviews, signs and faxes to CHSM & BOS HR within 24 hours.**

1. Name of injured: ____________________ 2. Employee ID#: ____________

3. Office of Injured: ____________________ 4. Date and time of incident: ____________

5. Project Name: ____________________ 6. Project No.: ____________

7. Location of incident (be specific):

8. Brief explanation of incident (attach separate sheet if necessary):

9. List Witnesses (if not H&A, give company & phone no.)::

10. Equipment/materials involved in incident:

11. Describe injury or illness symptoms in detail:

12. Describe first aid/medical treatment received:

13. Name and address of medical treatment provider:

14. Lost time from work? ☐ Yes ☐ No 15. Actual or estimate of lost days: ____________

16. Preliminary determination of the cause of the incident:

17. Recommended corrective action/comments:

18. Person(s) responsible for corrective actions:

Date Corrected: (Verified by RHSC): ____________ RHSC Signature: ____________

**Staff Member:** ____________________ **Date:** ____________

**Staff Manager:** ____________________ **Date:** ____________

**RHSC:** ____________________ **Date:** ____________

**Corporate H&S Manager:** ____________________ **Date:** ____________

**APPENDIX C4**

**Motor Vehicle Inspection Report**

# DAILY MOTOR VEHICLE INSPECTION REPORT

***"PRE-TRIP" REPORT***

Each work day, drivers are required to list any defect or deficiency reported by others or discovered by them for any vehicle they operated. This report must also indicate whether no defect or deficiency was reported. In all instances, the driver must sign the report. A separate report must be prepared for each vehicle the driver operated. These reports must be kept for 3 months.

**Vehicle ID** ______________________ **Mileage** ______________ **Date** ______________ **Time** __________ (am) (pm)

**Driver's printed name** ______________________________ **Driver's signature** ______________________________

Mark with an X if ***defects*** were discovered by or reported to me regarding this vehicle.

DRIVER: CHECK BELOW WHERE REPAIR IS NEEDED.
SITE SAFETY OFFICER: CHECK IF REPAIR IS NOT REQUIRED FOR SAFE VEHICLE OPERATION.

| REPAIR NEEDED | REPAIR NOT REQUIRED | | REPAIRED* | REPAIR NEEDED | REPAIR NOT REQUIRED | | REPAIRED* |
|---|---|---|---|---|---|---|---|
| ___ | ___ | Service brakes | ___ | ___ | ___ | Trailer brake connections | ___ |
| ___ | ___ | Steering mechanism | ___ | ___ | ___ | Lights and reflectors | ___ |
| ___ | ___ | Emergency equipment | ___ | ___ | ___ | Parking (hand) brakes | ___ |
| ___ | ___ | Horn | ___ | ___ | ___ | Tires | ___ |
| ___ | ___ | Rear-vision mirrors | ___ | ___ | ___ | Coupling devices | ___ |
| ___ | ___ | Wheels and rims | ___ | ___ | ___ | Windshield wipers | ___ |

* For each completed repair indicated above, the Site Safety Officer must sign below certifying that the repair was made or the rental vehicle was returned to the rental agency.

Site Safety Officer's signature ______________________ Site Safety Officer's printed name ______________________ Date ____________

# APPENDIX C5

## Compressed Gas Cylinder Safety Operating Procedure

# OPERATING PROCEDURE: OP1048

# COMPRESSED GAS SAFETY



**PREPARATION AND APPROVALS**

| VERSION | AUTHORED/DATE | REVIEWED/ DATE | REVIEWED/ DATE | REVIEWED/ DATE | APPROVED/ DATE |
|---|---|---|---|---|---|
| Ver.1.0 | **S.Boston/5Mar2010** | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

## Total Pages: <u>11</u>

**TABLE OF CONTENTS**

**OPERATING PROCEDURE: OP1048**

**COMPRESSED GAS CYLINDER SAFETY**

## 1. PURPOSE

The purpose of the procedure is to esta blish safe us e, handling a nd storage requirements for the use of compressed gas cylinders.

### 1.1 Discussion

Hazards associated with compressed gases include oxygen displacement, fires, explosions, and toxic gas exposures, as well as the physical hazards associated with high pressure systems. Special storage, use, and handling precautions are necessary in order to control these hazards.

### 1.2 Applicability

Site control applies to all Haley & Aldrich field activities.

## 2. PROCEDURE

### 2.1 Identification "ALWAYS READ THE LABEL"

The contents of any compressed gas cylinder must be clearly identified. Gas identification should be stenciled or stamped on the cylinder or a label. Commercially available three-part tag systems may be used for identification and inventory.

No compressed gas cylinder should be accepted for use that does not legibly identify its contents by name. If the labeling on a cylinder becomes unclear the cylinder should be marked "contents unknown" and returned to the supplier.

Do not rely on the color of the cylinder for identification. Color-coding is not reliable because cylinder colors may vary with supplier. Also, never rely on labels on caps because they are interchangeable.

All gas lines leading from a compressed gas supply should be clearly labeled to identify the gas and the area served. The labels should be coded to distinguish hazardous gases such as flammable, toxic, or corrosive substances. Signs should be posted in areas where flammable compressed gases are stored or used, identifying the substance and appropriate precautions.

### 2.2 Handling and Use

#### 2.2.1 Prior To Use:

- Make sure the cylinder is equipped with the correct regulator.

Inspect the regulator and cylinder valves for grease, oil, dirt, and solvent. Never use grease or oil to lubricate regulators or cylinder valves because they can cause an explosion.

- The cylinder should be placed so that the valve handle at the top is easily accessible.
- When using toxic or irritating gas, the valve should only be opened while the cylinder is in a working fume hood.
- Only use wrenches or tools that are provided by the cylinder supplier to open or close a valve. Pliers should never be used to open a cylinder valve. Some regulators require washers; this should be checked before the regulator is fitted.
- Refer to MSDS for the gas being used for information regarding use and toxicity.
- Fire extinguishing equipment should be readily available when combustible materials can be exposed to welding or cutting operations using compressed cylinder gases.

### 2.2.2 Cylinder Storage

- Cylinders must be stored standing upright (valve up, >45$^{o}$ from horizontal unless designed specially for use in horizontal position).
- Gas cylinders must be secured at all times to prevent tipping.
- Use appropriate material, such as chain, plastic coated wire cable, commercial straps, etc., to secure cylinders.
- Gas cylinders can not be stored in public hallways or other unprotected areas.
- Cylinders must be segregated in hazard classes while in storage. Oxidizers (oxygen) must be separated from flammable gases, and empty cylinders must be isolated from filled cylinders.
- The proper storage for oxygen cylinders requires that a minimum of 25 feet is maintained between flammable gas cylinders and oxygen cylinders or the storage area be separated, at a minimum, by a firewall five (5) feet high with a fire rating of 30 minutes.
- Store out of direct sunlight and away from sources of heat and ignition; temperatures must not exceed 125 F.
- Acetylene cylinders must never be stored on their sides.
- Always place valve protectors on gas cylinders when the cylinders are not connected for use.
- Cylinders must be protected from damage. Do not store cylinders near elevators or gangways, or in locations where heavy-moving objects may strike or fall on them.
- Cylinders must be stored where they are protected from the ground to prevent rusting.
- Cylinders should be protected against tampering by unauthorized individuals.
- Storage areas must be well-ventilated, cool, dry, and free from corrosive materials.

### 2.2.3 Moving Cylinders

- Never drag, slide or roll a cylinder; use a cylinder cart or basket.
- Always have the protective cap covering the valve when transporting the cylinder.
- Never transport the cylinder with the regulator in place.
- Make sure the cylinder is secured to the cart before moving it.
- Do not drop cylinders or strike them against each other or against other surfaces violently.
- Do not use the valve cover to lift cylinders; they could be damaged and become unattached. If the cylinder is dropped on a hard surface it can cause an explosion.

### 2.2.4 Use and Operation

Only properly trained personal should handle compressed gas cylinders.

Before attaching cylinders to a connection, be sure that the threads on the cylinder and the connection mate, and are of a type intended for gas service.

The threads and mating surfaces of the regulator and hose connections should be cleaned before the regulator is attached. Wipe the outlet with a clean, dry, lint-free cloth. Particulate can clog the regulator filter (if so equipped) or cause the regulator to malfunction.

Always use the proper regulator for the gas in the cylinder. Check that the CGA numbers match, and always ensure that the regulator appears sound before attaching it to a cylinder. If the connections do not fit together readily, the wrong regulator or a defective regulator is probably being used.

Attach the regulator securely with the secondary valve closed and preferably with the regulator flow backed off (counterclockwise) before opening the cylinder valve wide.

Always use a cylinder wrench or other tightly fitting wrench to tighten the regulator nut and tube connections. Use "backup" wrenches to minimize stress on tubing and fittings where appropriate.

*Teflon tape should never be used on cylinder connections or tube-fitting connections*. Use Teflon tape only on pipe threads where the seal is made at the threads. All other connections have metal to metal face seals or gasket seals.

Back off the pressure adjusting screw of the regulator to release spring force before opening the cylinder valve.

**NOTE: Never use a wrench or hammer to open or close a hand wheel type cylinder valve. If the valve is frozen and cannot be operated by hand, return the cylinder to the vendor.**

Cylinder connections must be leak tested around the valve and valve outlet connection

Acetylene or other flammable gas cylinder valves should not be opened more than ½ turns of the spindle, and preferably no more than ¾ of a turn. This reduces the risk of explosion and allows for the cylinder valve to be closed quickly cutting off the gas flow.

Never heat a cylinder to raise the pressure of the gas (this can defeat the safety mechanisms built in by the supplier).

Keep the cylinder clear of all electrical circuits, flame, and sparks.

Never leave the valve open when equipment is not in use, even when empty; air and moisture may diffuse through an open valve, causing contamination and corrosion within the cylinder.

Do not refill a cylinder; mixing of residual gases in a confined area may cause a dangerous reaction.

Never use copper fittings or tubing on acetylene tanks – an explosion may result.

Never use compressed gas to dust off clothing; this could cause injury to the eyes or body and create a fire hazard. Clothing can become saturated and burst into flames if touched off by an ignition source such as a spark or cigarette.

Never leave pressure in a regulator when it is not in use.

Valve protection caps should remain in place until ready to withdraw gas, or connect to a manifold.

Cylinder discharge lines should be equipped with approved check valves to prevent inadvertent contamination of cylinders connected to a closed system.

Do not force connections that do not fit.

Close the cylinder valve and release all pressure before removing the regulator from the cylinder.

Do not smoke when oxygen or fuel gases are present.

If an outlet valve becomes clogged with ice, thaw it with warm water (if the gas is not water reactive), applied only to the valve.

Use the cylinder valve for turning gas off, not the regulator.

Workers should wear safety glasses and face shields when handling and using compressed gases, especially when connecting and disconnecting regulators and lines.

**NOTE: OXYGEN IS NOT COMPRESSED AIR, IT IS OXYGEN**

Never use oxygen as a substitute as a “compressed air” to run pneumatic tools.

### 2.2.5 Cylinder Leaks

- If the cylinder contains a **flammable, inert, or oxidizing gas**, remove it to an isolated area, away from possible ignition sources. Allow it to remain isolated until the gas has discharged, making certain that appropriate warnings have been posted.
- If the gas is a **corrosive**, remove cylinder to an isolated, well-ventilated area. The stream of leaking gas should be directed into an appropriate neutralizing material.
- For **toxic** material, the cylinder should be removed to an isolated, well-ventilated area, but only if this is possible while maintaining personal safety. It may be necessary to evacuate the facility.
- If the leak is at the junction of the cylinder valve and cylinder, do not try to repair it. Contact the supplier and ask for response instructions.
- Never use a flame to detect a gas leak. Use soapy water.

### 2.2.6 End of Service

Empty containers are not really empty. They contain gas at atmospheric pressure, which of course does not cause deflection of the gauge needle because the gauge reports psig, the pressure greater than atmospheric. In absolute terms the cylinder still contains approximately 15 psia (pounds per square inch absolute). Depending on cylinder size, this can be a substantial quantity of toxic or flammable substance.

- Do not completely empty the cylinder; always leave some residual pressure (i.e. 25 psig).
- If the cylinder is empty, replace the cap and remove it to the empty cylinder storage area.
- Label all empty cylinders with tags so that everyone will know their status. Empty cylinders can be marked with "MT and date" with chalk.
- Handle empty cylinders as carefully as full ones; residual pressure can be dangerous.
- Never refill a cylinder. This requires specialized equipment and techniques.
- Never mix gases in a cylinder. The next person who draws from it may unknowingly cause an explosion.

### 2.2.7 Piping for Compressed Gases

- Polyvinyl chloride (PVC) plastic pipes can not be used for transporting compressed gases aboveground unless they are completely enclosed in a conduit or casing of sufficient strength to provide protection from external damage and deterioration. The heat generated from compressed air can weaken the PVC pipe and create an explosion hazard. When PVC piping explodes, plastic shrapnel pieces can be thrown in all direction and injure workers or damage equipment.
- Copper piping shall not be used for acetylene.
- Do not use cast iron pipe for chlorine.
- Distribution lines and their outlets need to be clearly labeled.
- Inspect piping systems on a regular basis.
- Pay attention to fittings as well as possible cracks that may have developed.

### 2.2.8 Hoses and Connections

- Examine hoses regularly for leaks, set up an inspection schedule.
- Do not use unnecessarily long hoses.
- Keep hoses free from kinks and away from high traffic areas.
- Repair leaks promptly and properly.
- Store hoses in a cool place, and protect them from hot objects, and sparks.
- Do not use a single hose having more than one gas passage.

## 2.3 Personal Protection

### 2.3.1 Minimum Requirements

Personnel moving or handling gas containers must be provided with:

- protective footwear, e.g. steel-toed shoes
- heavy gloves
- hand cart or other suitably designed device for transporting containers and a chain or another method for securing the container while it is being moved.
- Safety Spectacles, goggles and/or face shield

### 2.3.2 Technique

Most accidents and injuries involving compressed gases occur during the moving or handling of the gas container. Personnel should be instructed in the following key points:

- remember the mass of the container
- beware of trapping fingers between containers while they are being moved
- when it is necessary to lift heavy containers manually, seek help and to observe the correct lifting posture
- use a cylinder hand cart or other suitable device for transporting heavy containers, even for short distances, and ensure the container is secured
- ensure valve protection devices, e.g., caps, guards, etc., are fitted to containers while they are being moved
- the identification of the gas container contents and the potential hazards. They should also have access to the appropriate Material Safety Data Sheets.
- the operation and use of the safety and emergency equipment where provided, e.g., fire extinguishers, breathing apparatus, eye protection, ventilated gas cabinets, etc.
- the gas container and its valve, including the procedures for rectification of leakages at the valve gland (where appropriate) and outlet connection.
- the correct operation of the gas flow and control equipment including purging procedures
- the importance of ensuring that the gas container is not contaminated by a backfeed from the process

## 2.4 Emergency Considerations

### 2.4.1 Anticipate Emergencies

Emergencies involving compressed gases are unlikely, provided the recommendations are followed for their correct storage, handling, and use. When problems do arise they are usually due to:

- Fire threatening the cylinder: The compressed gas container is a high integrity package. However, if it comes in contact with excessive heat for prolonged periods, then there is a risk of rupture and explosions.

- Flammable gas leak: All flammable gases will form explosive mixtures with air. When ignited, significant explosive energy can be released from flammable gas-air mixtures.

- Toxic gas leak: Safe working limits are prescribed by the Material Safety Data Sheets. Where proper facilities and equipment are provided, personal injury from exposure to toxic gas is extremely unlikely.

- 'Inert' gas leak: This is usually considered to be harmless. However, if in a confined space, asphyxiation (oxygen starvation) of unprotected personnel can occur.

Unplanned chemical or other reaction: This can arise when gas users allow process material back into the gas supply cylinder and can possibly result in rupture or explosion. It can also arise if the gas cylinder content is mistakenly identified. This type of emergency is extremely unlikely where operational procedures are properly controlled and staff are properly trained.

### 2.4.2 Dealing with Fire Situations

- General: If possible, isolate gas supplies into affected area, and safely release the gas pressure in affected pipelines and equipment.
- Fire threatening compressed gas containers: There is a risk of a rupture or explosion of cylinders subjected to prolonged heating (such as in a fire). Such cylinders should be moved to a safe place before they become too hot. If this is impossible, cool cylinders with water hosed from a safe distance. Any cylinder that has been involved in a fire must be clearly marked as such, and the supplier must be notified accordingly.
- Ignited flammable gas leak: If possible, isolate the gas supply. If this is impossible, try to ensure the flammable gas burns in as controlled a manner as possible, does not ignite anything else, and does not impinge on any pressurized gas containers, equipment, or pipelines.
- Never extinguish a flammable gas leak without stopping the flow of gas, because a potential explosion hazard would result.

### 2.4.3 Dealing with Gas Leaks

- General: Assess the likely effects of the gas leakage and the affected area. This will determine the subsequent emergency action taken and the level of personnel protection needed.
- Leaking cylinder: Most leaks occur at the valve fitted into the top of the cylinder. Leakage areas that may be involved are:
  - Valve outlet connection: Leakage here is frequently due to dirt in the connection, or damaged connections or washers where required. Such leaks are easily rectified.
  - Valve stem (i.e., around valve operating spindle): Leakage from valves fitted with an adjustable gland can easily be cured by gently tightening the gland nut while the valve is partially open. A quarter turn is normally sufficient (maximum torque: 50 ft-lbs). All gland nuts have "right-hand" threads. Some gland nuts are backed with a lock-nut (which must be loosened before gland nut adjustment and tightened afterwards).
  - Joint between cylinder valve and cylinder: Leakage here is extremely rare and where it does occur, is normally identified and rectified by the cylinder filler. No attempt should be made to tighten a cylinder valve into a full cylinder. Such cylinders must be set aside for the attention of the supplier.
  - Valve closure: Leakage from a cylinder valve that will not readily shut off can usually be reduced by careful application of a greater closing torque (using a wrench or other means of greater leverage). All defective cylinders should be clearly labeled before being returned to the supplier.
- Leaking gas control equipment/pipelines, etc: Isolate the gas supply. Before attempting to repair leaking equipment, ensure that the pressure has been released and the equipment purged to remove all hazardous gases.

## 3. REFERENCES

ANSI/CGA V-1 American National, Compressed Gas Association Standard for Compressed Gas Cylinder Valve Outlet and Inlet Connections, Compressed Gas Association, Inc., 1725 Jefferson Davis Hwy., Suite 1004, Arlington, VA 22202.

CGA P-1, Safe Handling of Compressed Gases in Containers, Compressed Gas Association, Inc., 1725 Jefferson Davis Hwy., Suite 1004, Arlington, VA 22202.

CGA C-7, Guide to the Preparation of Precautionary Labeling and Marking of Compressed Gas Containers, Compressed Gas Association, Inc., 1725 Jefferson Davis Hwy., Suite 1004, Arlington, VA 22202

## 4. ASSOCIATED FORMS

Gas Cylinder Inspection Form

# Compressed Gas Safety Checklist (A) General Use

**To Be Used with OP 1048 Compressed Gas Cylinder Safety**

| | | | |
|---|---|---|---|
| **Job Name:** | | **Job Number:** | |
| **Location:** | | **Date:** | |
| **Inspector:** | | | |

| **General** | **Yes/No/NA** |
|---|---|
| Are containers/cylinders labeled properly? | **Y N NA** |
| Are Labels in good condition and readable? | **Y N NA** |
| Pressure Relief Device present and free from damage? | **Y N NA** |
| Container free of corrosion and other recognized damage? | **Y N NA** |
| Valve protection caps in place and at least hand tight? | **Y N NA** |
| Are empty cylinders marked as such and valves closed? | **Y N NA** |
| Cylinders are not placed where they may become part of an electrical circuit? | **Y N NA** |
| Cylinders are not exposed to temperatures greater than 125 F? | **Y N NA** |
| Are cylinders Leaking? | **Y N NA** |
| Valve caps are not used to lift cylinders. | **Y N NA** |
| Employees trained on handling and use of cylinders? | **Y N NA** |
| Compressed gasses are not used to dust off clothing? | **Y N NA** |
| **Storage** | **Yes/No/NA** |
| Are cylinders grouped by types and labeled with name of gas | **Y N NA** |
| Are full and empty containers separate and stored upright | **Y N NA** |
| Are storage locations covered and well ventilated | **Y N NA** |
| Cylinders are not stored near salts, corrosive chemicals or fumes, dampness | **Y N NA** |
| Cylinders are protected from damage by other material | **Y N NA** |
| Outside storage chemicals protected from bottom corrosion | **Y N NA** |
| Cylinders are secured to prevent them from being knocked over? | **Y N NA** |
| Containers, valves, regulators, hose, and other apparatus free from oil and grease | **Y N NA** |
| Stored 20 feet from combustibles or separated by a wall at least 5 foot high and made of non-combustible material with at least a 30 minute fire rating. | **Y N NA** |
| | **Y N NA** |
| | **Y N NA** |

# APPENDIX C6

## Operating Procedure: OP1002
## Drilling Safety

# OPERATING PROCEDURE: OP1002

## DRILLING SAFETY



**PREPARATION AND APPROVALS**

| VERSION | AUTHORED/DATE | REVIEWED / DATE | REVIEWED / DATE | REVIEWED / DATE | APPROVED / DATE |
|---|---|---|---|---|---|
| Ver. 0.0 | CLM/ Dec. 2002 | CSO/June 2003 | TWN/Sep. 2003 | JPD/Sep. 2003 | SRK/Oct. 2003 |
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HALEY & ALDRICH

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**OPERATING PROCEDURE: OP1002**

**DRILLING SAFETY**



## 1. PURPOSE

This OP defines the responsibilities of Haley & Aldrich (H&A) staff members and drilling subcontractors with regard to safety during execution of drilling programs as required by governing regulations and standard contractual agreements. In addition, this document provides an outline of safety-related issues and guidance toward safe operations during site investigations with drilling equipment in common practice.

### 1.1 Discussion

Familiarity with basic drilling safety is an essential component of all drilling projects. Potential hazards related to drilling operations include, but are not limited to encountering underground or overhead utilities, traffic and heavy equipment, hoisting heavy tools, steel impacts, open rotation entanglement, and the use or unexpected encountering of toxic or hazardous substances. While H&A staff members do not operate drilling equipment, they may work in close proximity to operating drilling equipment and may be exposed to many of the same hazards as the drilling subcontractor.

Haley & Aldrich may be held responsible by regulatory agencies and others for personal injuries or property damage as a result of drilling related accidents. It is the responsibility of the H&A Field Staff to be knowledgeable of, and in conformance with Federal (OSHA) regulations applicable to worker safety and to adhere to company health and safety (H&S) policies and procedures. Deviation from applicable safety regulations and established guidelines by H&A Field Staff and subcontractors is not permitted. Failure to adhere to these regulations, policies and procedures is grounds for disciplinary action or termination.

### 1.2 Application

The following procedures apply to all Haley & Aldrich projects that include mechanical drilling activities where drilling rigs are used for soil and rock drilling, boring advancement, subsurface sample collection, groundwater monitoring well or instrumentation installation, and in-situ testing.

## 2. EQUIPMENT & SUPPLIES

A project or site specific Health & Safety Plan (HASP) may be developed to address the particular concerns of a given project. The HASP must always be referred to prior to assembling safety and monitoring equipment in preparation for fieldwork. In the absence of a HASP, Field Staff must consult with project team leaders and the Health & Safety Coordinator for guidance.

### 2.1 Standard Required Personnel Protective Equipment (PPE)

- Hard Hat
- Safety Glasses
- Sound Dampeners
- Steel Toe Boots
- Protective Gloves
- Work Clothing (Denim Blue Jeans or Equivalent, Short or Long Sleeve Shirt)
- Rain Gear
- Reflective Safety Vest
- First Aid Kit/Eye Wash Kit

### 2.2 Additional Personnel Protective Equipment (PPE) as Required

- Tyvek or Saranex Coveralls/Sleeves/Apron

- Latex/Nitrile Inner Gloves/Boot Covers

- Air-Purifying Respirator & Spare Cartridges (Type Varies with Contaminants commonly Type GMC or Type H)

- Personnel Flotation Device (PFD)

- Safety Harness

### 2.3 Required Contractor-Provided Safety Equipment

- Fire Extinguishers
- First Aid Kit/Eye Wash Kit
- Traffic Controls (Safety Cones, Lighting & Signs)
- Caution Tape (Flagging for Exclusion Zones)

### 2.4 Required Air Quality Monitoring Equipment

Most environmental fieldwork will have extensive equipment requirements specifically related to the project needs. The following list is a representative list of air quality monitoring equipment that may be used in order to comply with requirements set forth in the HASP or project contract documents. A comprehensive list of environmental equipment and PPE must be developed for each project in coordination with the Project Manager (PM) and Health & Safety (H&S) Coordinator prior to the start of the field program.

### 2.4.1 Air Quality Monitoring Equipment

- Photo-Ionization Detector (PID)
- Flame Ionization Detector (FID)
- Organic Vapor Analyzer (OVA)
- Combustible Gas Meter-LEL/O2
- Dust Monitor
- Multigas Meter-HCn/Methane/H2S
- Gas Pointer
- Draeger Tube Sampling Kit
- Radiation Survey Meter

## 3. PROCEDURE

### 3.1 Underground Hazards

Haley & Aldrich staff members must ensure that permission has been gained from the property owner to access the property prior to site entry and before marking any proposed exploration or drilling locations. On public property the estimated location of utility installations, such as gas, electric, water, sewer, telephone, fuel, or any other underground installation that may be expected to be encountered during drilling work, will be identified by the appropriate authority. Appropriate authorities include client representatives, utility companies, nonprofit organizations (e.g. "Dig-Safe"), and others. A list of all state "utility locators" is posted on the Health and Safety Homepage under "Guidance Documents".

> *Note: It is important to note that not all utilities participate in the "one-call" agency or process. As such, inquiries must be made with the "one-call" agency to determine which entities do not participate, so they can be contacted independently.*
>
> *Also, most stake-outs or markings have a limited time period for which they remain valid, typically 2 to 3 weeks. It is critical that this time period be taken into account to prevent expiration of clearance prior to completion of the invasive activities. If the utility clearance period expires before completion, the clearance process must be repeated.*

Utility companies or owners of underground installations shall be contacted within established or customary local response times, advised of the proposed work, and asked to establish the location of the utility underground installations prior to the start of drilling. Note that it is H&A policy is to have the drilling subcontractor call in to utility owners and any required authority or utility locating service.

Completion of the utility clearance is not a guarantee that underground facilities will not be encountered in the boreholes. Utility locators and owners of underground installations do not accept the liability for damage or losses if a utility is encountered or an accident occurs. In addition, utility owners and utility locating service firms do not typically conduct clearances on private properties. Accordingly, Haley & Aldrich Field Staff are required to review all available utility plans and conduct a thorough site walkover with the drillers to view all proposed boring locations prior to the start of any drilling. H&A Field Staff and subcontractors must walk along all utility alignments to identify gate boxes and manholes, open all manholes and identify utility depths and alignment, sight along alignments, use existing plans and measure existing features (manholes etc.) to determine accuracy of plans with as-builts. Using any information that can be obtained, the site should be viewed in detail for physical evidence of buried lines or structures. Evidence of surface elements of buried utilities should be documented, such as manholes, gas or water valves, catch basins, patched pavement cuts, etc. If on private property, onsite facilities personnel must be contacted to obtain utility plans.

It is expected that caution will be exercised while drilling in the uppermost 5 feet below the ground surface in the event the clearance has failed to identify an existing utility. Hand-excavation, vacuum pre-excavation or probing may be necessary to confirm the location of shallow utilities when utility companies or owners cannot respond to a request to locate underground utilities or cannot establish the exact location of these installations. Geophysical techniques, such as ground penetrating radar and magnetometry can also be utilized to locate potential underground hazards.

No subsurface drilling activities will be allowed until efforts described above have been made to have utilities properly located and marked.

Proposed boring locations can be marked using spray paint on the ground, stakes, or other similar method. All markings of proposed locations shall be made in white, in accordance with the generally accepted universal color code for facilities identification (AWMA 4/99).

| | |
|---|---|
| White: | Proposed excavation or drilling location |
| Pink: | Temporary Survey Markings |
| Red: | Electrical, Power Lines, Cables, Conduit, and Lightning Cables. |
| Yellow: | Gas, Oil, Steam, Petroleum, and Gaseous Materials. |
| Orange: | Communications, Alarm, or Signal Lines, Cables, and Conduits. |
| Blue: | Potable Water. |
| Purple: | Reclaimed Water, Irrigation, and Slurry Lines. |
| Green: | Sewers and Drain Lines. |

The public and private utility entities generally only mark the locations of their respective underground facilities within public rights-of-way. Determination of utility locations on private property is the responsibility of the property owner. It is incumbent on Haley & Aldrich and the drilling subcontractor to exercise caution and use good judgement when faced with uncertainty.

## 3.2 Subcontractor Safety Requirements

All H&A subcontractors must conform to applicable OSHA regulations governing worker safety including the wearing of hard hats, eye protection, sound protection, suitable work clothing, gloves, steel toe boots and additional PPE such as air-purifying respirators and Tyvek suits as necessary. All equipment must be designed for the purpose for which it is to be used, maintained in good condition and have current licenses and inspection certificates. Drillers must be qualified to operate the equipment and experienced in the activities conducted. Certificates of training or applicable licensure must be available upon request. Personnel will conduct themselves in a professional manner and be safety conscious at all times.

### 3.2.1 Power Lines

The subcontractor shall note the location of overhead power lines and other overhead electrical sources. Drilling must not occur near these areas unless precautions are taken to prevent contact. Under no circumstances is the drilling rig to be moved with the mast raised. The drilling rig mast must maintain at least 35 feet of clearance from all energized power lines. Power lines can be deenergized or shielded and the drill rig may be grounded when working within the 35-foot clearance distance. Contact the utility company to find out their requirements when working within the 35-foot clearance minimum.

### 3.2.2 Lightning

Because of the high potential for lightning strike on the mast of a drilling rig, drilling must cease when thunder and lightning storms approach and workers should take shelter away from the rig. If possible, the mast should be lowered prior to the onset of lightning storms. This decision should be a joint decision between the Haley & Aldrich field representative and the subcontractor. Typically work should be suspended if lightning is visible in two directions or is estimated to be less than 2 miles away.

### 3.2.3 Setting up and Blocking the Drilling Rig

It is the drilling rig operator's responsibility to ensure that the rig is properly set up. The stability of the drilling rig is critical to assure safe drilling operations. Whenever possible, the operator shall choose a dry, level and reasonably smooth drilling site. The operator shall make sure the rig's emergency brake is engaged and that the wheels which will remain on the ground are chocked. Blocking the rig will help to provide a more stable drilling structure by distributing the weight of the rig evenly. If the rig is equipped with jacks or outriggers, they will be extended from the rig to the ground, raising the rig partially or entirely off the ground. Proper blocking of the rig will prevent differential settling which could result in the rig toppling sideways. Blocks should be placed between the jack swivel and the ground to provide more support area under the pad.

### 3.2.4 Operation of the Drilling Rig

Haley & Aldrich staff members must never operate any of the subcontractor's vehicles or equipment. The drilling subcontractors are solely responsible for the safe operation of the drilling rig and for handling the equipment associated with the drilling. Drillers and H&A personnel must be aware of the location and operation of the drill rig's emergency shut off (kill switch) which cuts the power to the rig in the event of an entanglement. The kill switch must be maintained in working order at all times.

The driller should never leave the controls of the drilling rig while the tools are rotating.

### 3.2.5 Precautions Against Entanglement

All staff members who will work in the vicinity of the drilling rig should secure all loose clothing to prevent them from becoming caught in the drilling mechanism. Only employees necessary to run the rig are allowed in close proximity, except during essential sampling and other activities. Personnel will not reach into or near the borehole or the rotating equipment, unless the drilling rig has been shut down. For the same reasons, a long handled shovel or other similar device should be used to clear the drill cuttings away from the borehole and from rotating tools. Hands and/or feet should not be used to clear cuttings.

### 3.2.6 Work on the Mast

Drill rig operators shall not climb the mast to conduct repairs if the mast can be lowered. If the mast cannot be lowered to conduct repairs, workers may utilize a ladder or may climb the mast if fall protection, such as a harness and attached lanyard, is available. Fall protection devices, in the form of a harness and lanyard, will be used where workers must climb to 6 feet or greater in height. No one should climb the mast to conduct repairs while the drilling rig is operating.

### 3.2.7 Hoisting Safety

Worn or misused cables and rope are potentially the most dangerous pieces of equipment on the drilling rig. When a steel cable or fiber rope breaks under significant tension it has a tendency to snap like a rubber band. Be constantly aware of the condition of all cables and rope being used to hoist drill pipe or other heavy objects. Any cable or rope used for such purposes which has begun to fray, stretch or unravel, or which has a number of breaks in the same strand must be replaced. Use of thumb clips or clevis pins on hoisting hooks is required.

### 3.2.8 Equipment Safety Inspections

Drill rig operators are responsible for ensuring rigs are properly inspected. All drilling rigs and related support equipment and vehicles shall be scheduled for a periodic safety inspection. The inspections shall be the responsibility of the owner/operator of the equipment. The inspections shall include, but are not limited to, all hydraulic lines and fittings for wear and damage, all cable systems and pull ropes for damage and proper installation, exhaust systems, brake systems, drill controls, etc. The kill switches must be operable from various locations on the rig. Certification of inspection may be required from the driller upon request.

The driller in charge shall inspect the rig on a regular basis covering all major systems. If potentially hazardous deficiencies are found during the inspections, the rig may be shut down until the deficiencies are corrected and potential hazards are addressed or repaired. If Haley & Aldrich Field Staff believe that equipment is unsafe, the project manager must be informed so that a decision can be made on whether the drilling should be stopped until the owner/operator can confirm that the rig is safe to operate.

### 3.2.9 General Housekeeping

The work area around the drill area must be kept clean and orderly at all times. Items such as hand tools, rakes, shovels, etc. shall not be left lying on the ground to pose a trip hazard. Excess pipe, augers, connections, etc., should be stored in a rack or on the rig and not left lying around the rig. Remove and dispose of empty bags or other containers which have held drilling mud, cement or other dust producing materials.

Preventive measures must be in place to contain all drill fluids and cuttings. Spray, spills and run-off of drilling fluid must be arrested and recovered immediately in order to prevent the escape of potentially contaminated fluids into the environment or to avoid exposing passers by to a potential slipping hazard. During freezing weather salt or sand must be scattered on the ground surface within the work zone and the surrounding area to provide traction against slipping hazards.

## 3.3 H&A Field Staff Safety Requirements

All H&A Field Staff must conform to applicable OSHA regulations governing worker safety including the wearing of hard hats, eye protection, sound protection, suitable work clothing, gloves, steel toe boots and additional PPE such as air-purifying respirators and Tyvek suits as necessary. Personnel will conduct themselves in a professional manner and be safety conscious at all times.

A fundamental approach to minimizing one's personal risk of exposure to a variety of potential hazards is to plan ahead of the execution of activities and to set up a work space outside the immediate area of drilling or other traffic. The added distance from the drilling activities serves to provide a safety zone from vehicular traffic, falling objects, bursting hoses, vapors and fumes.

Many activities require Field Staff to enter into close proximity to the drill rig during operation. At such moments one should never become preoccupied or distracted from the drilling operation. Make certain of the drillers next move at all times and be aware of the hazards of hoisted objects falling and open rotation entanglement. Close to the drill rig there is a greater potential for eye damage from hammering steel splintering, bursting hydraulic lines and other solids or fluids associated with either the rotating drill stem or the borehole. Dangerous sound levels are common as well.

There are many visual and audible cues to an imminent hazard around the drill rig and any number of unsafe drilling practices to be aware of such as excessive stacking of drill rods, excessive rotation speeds, lifting overweight objects, and loose ropes, cables or chains near the rotation.

Take care against disrupting the driller's concentration or approaching him when he's hoisting or adjusting feed. Do not allow the drillers to rush their activities and suggest they take a break if frustration is an issue.

Whenever possible exercise engineering controls to minimize low level exposure to engine or borehole vapors by working up-wind. Exhaust pipe extensions and fans may be necessary to provide adequate ventilation when working in an interior or confined area. Near continuous air quality monitoring in the breathing zone may be required on both environmental and non-environmental projects. Consult with the Project Manager and the

H&S Officer for compound-specific guidelines for detection and the proper response actions according to company policy.

Use latex gloves in order to minimize low level exposure to soils. Use disposable boot covers to prevent small amounts of soil from boots from contaminating your personal vehicle and potentially exposing those you interact with, including your children, to harmful doses of lead or other contaminants.

Setting up exclusion zones around the work area may be necessary to ensure public safety. In some cases this may be done using caution tape and reflective cones or steel drums. Depending upon the hazard it may be necessary to install a temporary chain-link fence around the work area.

Setting up a decontamination area is a common practice to effectively recover contaminated wash water and materials while decontaminating equipment and PPE. H&S protocols are most easily followed when field decontamination practices are properly executed.

For environmental projects, the practical implications of having on hand and utilizing all of the required PPE, decontamination, sampling and monitoring equipment require use of a rented or company-owned vehicle of sufficient capacity and design to adequately transport and effectively access the equipment at the work site. In addition to the above, it may be necessary to have the applicable Material Safety Data Sheets (MSDS) for the various decontamination chemicals and environmental preservatives.

General field safety calls for attention to a variety of factors including physical stress due to extreme heat and cold as well as potential exposure to any number of hazards. Night drilling in urban neighborhoods may present security risks sufficient to warrant a police escort. Drilling over water or near water poses special hazards addressed in OP 1008 necessitating use of personal flotation devices (PFD) and other safety requirements. Highway projects and large-scale construction sites typically involve working around vehicular traffic and heavy equipment where high visibility reflective safety vests are necessary. Railway and airport projects may involve a number of special protocols including the use of defined communications and the completion of a specialized training program. Working in and around quarries, deep excavations and tunnels may require use of safety harnesses to guard against falls. Rural and undeveloped areas may present risks from poison ivy, ticks or snakes and limited access to medical attention in the event of an accident.

### 3.3.1 Basic Personal Protective Equipment (PPE)

Certain personal protective equipment (PPE) must be worn because of the physical hazards posed by the drilling operation. As a minimum on Haley & Aldrich field projects, hard hats, steel-toed work shoes, and safety eyewear must be worn at all times within the vicinity of the mast of the drilling rig. Hearing protection devices, such as ear plugs and ear muffs, shall be worn as required when the noise exposure is 85 dB (A) or greater over an 8-hour workday. Although noise levels vary with the type of drilling equipment utilized, potentially hazardous noise levels are likely to be generated during split spoon sampling and air drilling. Typically, speech at normal conversational levels becomes difficult at 2 to 3 feet when noise levels are in excess of 85 dB (A). Be aware of any addiotional personal protective equipment that may be required by the client. Though H&A is not responsible for issuing subcontractor PPE or the use of it, we must be diligent of our client's requirements and work closely with our drillers to ensure conformance with the site requirements. All protective equipment shall be provided by respective employer(s).

### 3.3.2 Special Precautions for Drilling in Landfills

In addition to the usual physical hazards of drilling, staff members drilling in landfills may experience an increased hazard from methane gas. Methane, a decomposition product of organic materials is a very flammable gas, which may accumulate in the borehole or in the general work area. To help reduce the hazards due to the presence of methane while drilling in landfills, the following procedures shall be implemented:

- No one shall smoke within 75 feet from the drilling area.
- The drilling rig must be diesel powered and equipped with a spark-arresting muffler.
- All ignition sources shall be placed at least 75 feet from the borehole and, if possible the rig should be located upwind of the borehole.
- Methane concentrations shall be monitored as frequently as possible using a Combustible Gas Indicator (CGI). The frequency of monitoring must be established on the health and safety plan (HASP). The meter should be kept near the rig. Results of the monitoring data should be entered on the field log.
- H&A policy requires that all work stop if gases are detected at 10% or greater of the lower explosive limit (LEL) in the hole being drilled or in the work area surrounding the hole. Under such circumstances it may become necessary to inert, ventilate, or flood the borehole with water during drilling to reduce the risk of downhole explosions.

### 3.3.3 Other Fire and Explosion Hazards

Flammable and/or combustible materials are typically present at drilling sites. These materials include gasoline, diesel fuel, polyethylene, wood, weeds, and others. To help prevent these materials from igniting, Haley & Aldrich staff members should first and foremost ensure that all sources of ignition (e.g., matches, lighters, etc.) have been identified and maintained at a safe distance from flammable and combustible materials.

Smoking, open flames or spark-producing equipment are not permitted within 75 feet of drilling rigs open wells, gasoline-driven pumps, or fuel storage areas. Flammable liquids (includes empty/full cans) shall not be stored or left within 50 feet of drilling rigs, pumps, or other related machinery. A fire extinguisher shall be located on, or within 10 feet, of any operating drilling rig. Equipment engines shall be shut off during fueling. Containers used for fuel shall be bonded and grounded during dispensing to prevent the discharge of static electricity. Safety fuel cans shall be returned to a designated safe storage area after fueling is completed.

### 3.3.4 Special Precautions for Drilling in Contaminated Soils

A Site Specific Health and Safety Plan (HASP) must be developed for all drilling operations when environmental contamination is reasonably expected. Follow the requirements of the HASP to safely manage exposure to contaminated soils. In the event environmental contamination is encountered unexpectedly, work must be suspended until the Project Manager and Health & Safety Officer can be contacted to develop a Site Specific Health and Safety Plan.

All contaminated equipment shall be properly decontaminated prior to leaving the general location of the drilling activities. Improperly decontaminated equipment returned to the H&A storeroom is not permitted. Subcontractors are expected to ensure that there will be no cross-contamination of the property and offsite locations as a result of the sampling event.

### 3.3.5 Lighting

Lighting around a drilling operation should be sufficient to provide illumination at all times of at least:

- An average of 5-foot candle (fc) power in the immediate drilling area, with no less than 3-fc power at any point.
- A minimum of 3 fc power on all other walking and working surfaces.

Work shall be suspended until additional lighting is provided should either H&A or the Subcontractor personnel feel that work site lighting is inadequate.

NOTE: The above are minimum OSHA requirements. Under certain circumstances higher lighting values may be warranted.

### 3.3.6 Training

Staff members working in the proximity of an operating drilling rig and the support equipment required should be thoroughly familiar with the operational hazards involved and the applicable work safety regulations. For environmental projects, H&A staff members must have undergone the 40-hour OSHA (Hazwoper) training and shall read, sign and comply with the provisions of the site-specific HASP drafted for the project. For other projects, standard regulations and H&S precautions must be followed. Drilling subcontractors shall have a similar level of training and a HASP when required. Heavy equipment operators in most states must be certified or licensed. If at any time there may be a question about competency in regards to safe operations, the Project Manager should request training records.

### 3.3.7 Personal Hygiene Requirements

To help limit the potential for ingestion of contaminants, eating, drinking, chewing, applying cosmetics or smoking is not allowed when working in the immediate vicinity of the drilling rig or in any restricted work areas (i.e., exclusion and decontamination zones). A break area outside the restricted work areas shall be established with a hand and face washing facility. Before eating, drinking, or smoking, all staff members shall thoroughly wash their hands and face.

## 3.4 Responsibilities

### 3.4.1 Project Manager

The Haley & Aldrich project manager (PM) is responsible for:

- Assuring that provisions specified in this OP are followed by Haley & Aldrich staff members and that the drilling subcontractor adheres to the provisions of the OP.
- Assuring that a HASP is developed for the project if it involves drilling in anticipated or unexpectedly encountered contaminated soils or significant safety hazards.
- Assuring that Haley & Aldrich staff members do not operate or handle the drilling subcontractor's equipment and that they remain clear of the drilling rig when their presence is not necessary.
- Assuring that all required personal protective equipment, for example hard hats, steel-toed shoes, and/or safety glasses are worn within the restricted work areas during the drilling operation. Hearing protection may be required in some instances.
- Confirming that the utility owner and/or property owner has located overhead and underground utilities/hazards.

### 3.4.2 Drilling Subcontractor

The drilling subcontractor is responsible for:

- Identifying any overhead and underground utilities/hazards prior to the start of drilling activities and, if necessary, arranging to have electrical lines de-energized prior to the start of drilling. In California, this might be a contractual/work scope responsibility for H&A.
- Making the final decision as to where they feel they can safely drill all borings.
- Safely operating the drilling rig and handling all equipment associated with the drilling operation.
- Maintaining the drilling rig and equipment in accordance with standard industry practices and safety standards.

- Containing generated material and preventing contamination from being spread as a result of drilling activities.

- Responding to the Haley & Aldrich staff (or field health and safety officer) requests to correct deficiencies related to unsafe conditions or practices.

### 3.4.3 Field Staff

On-site Haley & Aldrich staff members are responsible for:

- Complying with the provisions of this OP.

- Working in a safe manner.

- Notifying subcontractors/contractors of potentially unsafe conditions.

- Notifying the Haley & Aldrich PM or Local Health and Safety Coordinator (LHSC) of any unsafe acts or conditions in the workplace.

- Notifying the PM of any work-related injuries or illnesses that incur during work at the site.

- Conforming with the provisions outlined in applicable site-specific H&A plans.

**APPENDIX A**
**REFERENCES**


- OSHA standard, 29 CFR 1910.134, "Respiratory Protection"

- OSHA Hazardous Waste Operations and Emergency Response (Hazwoper) standard (i.e., 29 CFR 1910.120)

- "Occupational Safety & Health Guidance Manual for Hazardous Waste Site Activities" published by NIOSH/OSHA/USCG/EPA, October 1985

- Occupational Health and Safety Regulations (OSHA) and United States Coast Guard (USCG) 29 CFR 1926 Subpart C, General Safety and Health Provisions; 29 CFR 1926 Subpart E, Personal Protective Equipment; 29 CFR 1926.106, Working Over or Near Water; 33 CFR Part 151, Vessels Carrying Oil, Noxious Liquid Substances, Garbage, Municipal or Commercial Waste, and Ballast Water; 46 CFR Parts 25 and 26, Uninspected Vessels

**APPENDIX B**
**RELATED HALEY & ALDRICH PROCEDURES**

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| OP1003 | Utility Clearance |
| OP1004 | Operation/Calibration of PID Photoionization Detector |
| OP1005 | Operation/Calibration of FID Flame Ionization Detector |
| OP1006 | Operation of Draeger Gas Detector Pump |
| OP1007 | Field Monitoring for Volatile Organics (breathing space-work zone) |
| OP1008 | Operations Over, Near, or On Water |
| OP1009 | Medical Surveillance Program |
| OP1010 | Health and Safety Plans |
| OP1015 | Heat and Cold Stress |
| OP1016 | Recordkeeping and Reporting |
| OP1022 | Health and Safety |
| OP2000 | Monitoring Field Explorations |

**APPENDIX C**
**FORMS**

- See the Health and Safety Home Page (H&A Intranet) for a copy of the HASP and other applicable forms

**APPENDIX D**
**GLOSSARY**

- **Air Drilling**- A method of rotary drilling that uses compressed air as its circulation medium to remove cuttings from the borehole.

- **Bit** - The cutting or boring element used in drilling wells. Most bits used in rotary drilling are roller-cone bits. The bit consists of the cutting elements and the circulating element. The circulating element permits the passage of drilling fluid and utilizes the hydraulic force of the fluid stream to improve drilling rates.

- **Casing** - Steel or PVC pipe placed in a well during the drilling process to prevent the wall of the hole from caving in during drilling and after installation.

- **Cuttings** - The fragments of rock and soil dislodged by the bit and brought to the surface in the drilling mud.

- **Drill Stem** - All members in the assembly used for drilling by the rotary method from the swivel to the bit, including the kelly, drill pipe and tool joints, drill collars, stabilizers, and various subsequent items.

- **Driller** - The staff member of the drilling company directly in charge of a drilling rig and crew. His/her main duty is operation of the drilling rig and hoisting equipment, but he/she is also responsible for the downhole condition of the well, operation of downhole tools, and pipe measurements.

- **Drilling Fluid** - Circulating fluid, one function of which is to force cuttings out of the borehole and to the surface. While a mixture of clay, water, and other chemical additives is the most common drilling fluid, boreholes can also be drilled using air, gas, or water as the drilling fluid.

- **Grouting** - To fill the annulus between the casing and borehole with liquid slurry of grout (cement or bentonite) and water to support the casing and prevent fluid migration between permeable zones.

- **Mast** - A portable derrick capable of being erected as a unit, as distinguished from a standard derrick, which cannot be raised to a working position as a unit.

- **Mud** – A liquid fluid that may be used to circulate through the borehole during rotary drilling and workover operations. It functions to bring cuttings to the surface, to cool and lubricate the bit and drill stem, to protect against blowouts by holding back subsurface pressures and to deposit a mud cake on the wall of the borehole to prevent loss of fluids to the formation. The mud used in modern drilling operations is a complex, three-phase mixture of liquids, reactive solids, and inert solids. The liquid phase may be freshwater, diesel, oil, or crude oil and may contain one or more conditioners.

- **Rig** - The mast, drawworks, and attendant surface equipment of a drilling unit.

- **Rotary Drilling** - A drilling method in which a hole is drilled by a rotating bit to which a downward force is applied. The bit is fastened to and rotated by the drill stem, which also provides a passageway through which the drilling fluid is circulated. Additional joints of drill pipe and added as drilling progresses.

- **Borehole** - The hole drilled by the bit. A borehole may have casing in it or may be open (i.e., uncased), or a portion of it may be cased and a portion of it may be open.

- **Well Head** - The equipment installed at the surface of the borehole when a well is installed in the borehole. A well head may include such equipment as the casing head and tubing head.