Sean McClain

CHATHAM SITE PRP GROUP

SAN DIEGO REGIONAL WATER QUALITY CONTROL BOARD

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2011 OCT 27 P 2:50

October 26, 2011

Mr. Joe Cully Site Mitigation Program CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY DEPARTMENT OF TOXIC SUBSTANCES CONTROL 5796 Corporate Ave Cypress, CA 90630-4732

Subject: Transmittal of Monitoring And Contingency Plan Chatham Site, Escondido, California, Revision 2.0

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Dear Joe:

Enclosed is a CD containing the Monitoring and Contingency Plan (MCP) Chatham Site, Escondido, California (Site), Revision 2.0. This MCP was prepared in accordance with the Consent Decree between the Department of Toxic Substances Control (DTSC) and certain Settling Defendants (the Group), entered by the federal district court, on February 5, 1999, and has been modified in accordance with the revisions outlined in the final Remedy Review Report (RRR) submitted on September 12, 2011.

In our August 18, 2011 letter, the Group formally outlined its efforts since submission of the RRR on July 22, 2010, to reduce the scope of groundwater sampling. The Group has expended a significant amount of time and resources to demonstrate that quarterly monitoring is no longer necessary at this Site. Based on data trends over time, it is commonly accepted, good engineering practice to reduce the frequency of groundwater monitoring at environmental sites. The Group has conducted quarterly groundwater monitoring at this Site since 1992. With close to 20 years of consistent data, the need for quarterly groundwater sampling has long passed. The monitoring portion of this MCP outlines the recommended semi-annual and annual monitoring for the Site that will allow for an adequate assessment of the ground water remedy in meeting the Remedial Action Objectives defined by the Site Remedial Action Plan. A timely review of the recommended program is requested and is required by the Consent Decree.

Additionally, the monitoring program described in the MCP would be implemented after September 2011, with DTSC concurrence, and would remain in effect for five years from submittal of the final RRR. The next RRR would be submitted to DTSC in or about September 2016. The Group recommends having the next five-year review report due in

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Additionally, the monitoring program described in the MCP would be implemented after September 2011, with DTSC concurrence, and would remain in effect for five years from submittal of the final RRR. The next RRR would be submitted to DTSC in or about September 2016. The Group recommends having the next five-year review report due in September 2016 to allow 5 years of data to be collected based on the recommended monitoring program.

This proposed modification to the timing of the next RRR is consistent with the 2001 EPA document *Comprehensive Five-Year Review Guidance* that specifies, "As a matter of policy, you should complete subsequent statutory or policy five-year reviews no later than five years following the signature date of the previous Five-Year Review report." This change is also consistent with the Consent Decree, following the first RRR (covering the period through June 2004), subsequent RRRs shall be submitted "every five (5) years thereafter, which five-year interval may be modified if DTSC determines that more or less frequent remedy evaluation is warranted". If DTSC concurs in the timing for the next RRR, the Group would update the time schedules for document submission and review in the final RRR submitted on September 12, 2011.

The Group would like to thank you in advance for your time and assistance in facilitating DTSC's review of this MCP. Should you have any questions or comments, please contact us.

Sincerely, Chatham Site PRP Group

Edward D. Modiano Project Coordinator

Michael & P.l.

Michael A. Palmer, PG, CHG

Enclosure cc: See Attached List cc (with enclosure):

Number of Copies	Individuals Receiving Transmittal				
1 CD Only	Mr. Joseph Cully, California Environmental Protection Agency, Department of Toxic Substances Control (DTSC), Cypress				
1 Hard Copy Only	Mr. Theo Johnson, California Environmental Protection Agency, Department of Toxic Substances Control (DTSC), Cypress				
1 Hard Copy Only	Mr. Steven Hariri, California Environmental Protection Agency Department of Toxic Substances Control (DTSC), Cypress				
1 CD & 1 Hard Copy	Mr. Dave Gibson/Mr. Sean McClain, California Regional Water Quality Control Board				
1 CD Only	Ms. Cynthia Esparza, Senior Environmental Compliance Inspector, City of Escondido				
1 CD Only	Mr. Kevin Heaton, San Diego County, Department of Environmental Health				
1 CD Only	Mr. Paul Crouthamel, Escondido Public Library				
1 CD Only	Mr. Robert Florez, County of San Diego				

cc (without enclosure):

Number of Conies	Individuals Receiving Transmittal
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1 Mr. Greg Holmes, California Environmental Protection Agency, Department of Toxic Substances Control, Cypress



HARGIS + ASSOCIATES, INC. Hydrogeology • Engineering

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October 26, 2011

Mr. Edward D. Modiano **Project Coordinator** CHATHAM SITE PRP GROUP 1322 Scott Street, Suite 104 San Diego, CA 92106

Transmittal of Monitoring And Contingency Plan, Re: Chatham Site, Escondido, California, Revision 2.0

Dear Mr. Modiano:

Enclosed is the document titled:

Monitoring And Contingency Plan Chatham Site Escondido, California **Revision 2.0**

If you have any questions or comments, please contact us.

Sincerely,

HARGIS + ASSOCIATES, INC.



In 1. chi

Greg T. Cranham, PG 5897, CEG 1994 Senior Hydrogeologist

GTC/JDS/ama

Enclosure

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OCTOBER 26, 2011

MONITORING AND CONTINGENCY PLAN CHATHAM SITE ESCONDIDO, CALIFORNIA REVISION 2.0

PREPARED FOR: CHATHAM POTENTIALLY RESPONSIBLE PARTIES GROUP



HARGIS + ASSOCIATES, INC. HYDROGEOLOGY • ENGINEERING



MONITORING AND CONTINGENCY PLAN CHATHAM SITE ESCONDIDO, CALIFORNIA **REVISION 2.0**

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ACRONYMS AND ABBREVIATIONS

DTSC	California Environmental Protection Agency, Department of Toxic Substances Control
EISB	Enhanced In-Situ Bioremediation
EPA	U.S. Environmental Protection Agency
FS	Feasibility Study
the Group	Chatham Site Potentially Responsible Parties (PRP) Group
GRS	Groundwater Remediation System
H+A	Hargis + Associates, Inc.
MCLs	Maximum Contaminant Levels
MCP	Monitoring and Contingency Plan
the Property	35-acre parcel including the Yard
PRPs	Potentially Responsible Parties
QAPP	Quality Assurance Project Plan
RAP	Remedial Action Plan
RA	Remedial Action
RI	Remedial Investigation
RRR	Remedy Review Report
SAP	Sampling and Analysis Plan
the Site	The areal extent of any known or suspected release or threatened release of a hazardous substance, pollutant, or contaminant originating at the Yard
SOPs	Standard Operating Procedures
SVE	Soil Vapor Extraction
SWRBTLs	Surface water risk-based trigger levels



ACRONYMS AND ABBREVIATIONS (continued)

VOC Volatile organic compound

the Yard

Chatham Brothers Barrel Yard located at 2257 Bernardo Avenue



MONITORING AND CONTINGENCY PLAN CHATHAM SITE ESCONDIDO, CALIFORNIA REVISION 2.0

1.0 INTRODUCTION

This Revised Monitoring and Contingency Plan (MCP) has been prepared by Hargis + Associates, Inc. (H+A) on behalf of the Chatham Site Potentially Responsible Parties Group (the Group) for the Chatham Site¹ located at 2257 Bernardo Avenue, Escondido, California (Figures 1 and 2). This MCP is being submitted in accordance with the Consent Decree between the California Environmental Protection Agency, Department of Toxic Substances Control (DTSC) and the Group (DTSC, 1999).

This Revision 2.0 of the MCP supersedes Revision 1.0 of the MCP prepared in 2005 (H+A, 2005b), and reflects changes in the physical and operational conditions at the Site, as well as changes in the current monitoring program. The 2005 MCP Revision 1.0 described the groundwater monitoring program that commenced with the DTSC approval of the 2005 Remedy Review Report (RRR) (H+A, 2005a). The results of the 5-year groundwater monitoring program, which concluded in March 2010, were described in the 2010 5 Year RRR (H+A, 2011d). Based in part on the results of the evaluation presented in the 2010 RRR and current Site conditions, this MCP provides recommendations for the groundwater monitoring program over the next 5-year remedy review period.

This MCP incorporates an updated Sampling and Analysis Plan (SAP) for the Site, including Standard Operating Procedures (SOPs), as Appendix A. The updated SAP supersedes the

¹ The "Site" shall include the areal extent of any known or suspected release or threatened release of a hazardous substance, pollutant, or contaminant originating at the Yard (as defined herein). The Site includes but is not limited to a 5-acre portion of real property commonly known as the Chatham Brothers Barrel Yard located at 2257 Bernardo Avenue (hereinafter referred to as the "Yard"), Escondido, California, which is part of a 35-acre parcel (the "Property"), as well as property located at 1261 Gamble Lane (the "Gamble Lane Property"), Escondido, California.



SAP revised and submitted to DTSC in February 2005 (H+A, 2005c). This MCP also incorporates an updated Quality Assurance Project Plan (QAPP) as Appendix B. The updated QAPP supersedes the QAPP issued in December 1993 (H+A, 1993). Field data forms are provided as Appendix C. A compilation of historical groundwater and surface water analytical data for data collected and reported as of July 2011, as requested by DTSC, is provided as Appendix D.

This MCP describes ongoing groundwater and surface water monitoring activities at the Site, subject to revision, based on an ongoing evaluation of analytical data. Groundwater monitoring is conducted to 1) evaluate containment of the higher concentration portions of the volatile organic compound (VOC) plume within the Chatham Yard; 2) demonstrate that human health and the environment at the Site remain protected; and 3) monitor compliance with water quality objectives, i.e. the maximum contaminant levels (MCLs), outside of the Yard. Triggers and contingencies have been identified for potential receptors and hypothetical exposures to VOC-impacted groundwater and surface water. These contingencies have been developed to ensure that human health and the environment remain protected at the Site.

The MCP monitoring program is flexible and can be modified, if warranted, by Site conditions, or in response to changes in data collected during groundwater and surface water monitoring. This MCP describes monitoring to be performed during the third remedy review period, for 5 years following submittal of the Final RRR (H+A, 2011d). This MCP also describes actions to be taken in the event that data collected or information developed during monitoring indicates the existence of a potential threat to human health or the environment. This MCP may also be updated in the event that data collected or information developed during monitoring indicates a potential threat to human health or the environment. At the end of the 5-year period, an evaluation will be conducted in accordance with applicable remedy review criteria. The next remedy review will utilize the data collected as described in this MCP.



1.1 BACKGROUND

A plume of VOC-impacted groundwater extends from the Yard, a former solvent and waste oil recycling facility, approximately 5,000 feet southeast toward Felicita County Park. The VOC plume apparently resulted from solvent recycling operations conducted at the Yard from the 1940s through 1981. Investigation of soil and groundwater at the Site began in 1982. In November 1992, the Group entered into an administrative consent order with DTSC (DTSC, 1992), followed by a consent decree in 1999 (DTSC, 1999). Pursuant to these documents, the Group has completed the following:

- Conducted groundwater and surface water monitoring since 1992;
- Conducted a Remedial Investigation (RI) (H+A, 1996b);
- Conducted a Feasibility Study (FS) (Geraghty & Miller, Inc., 1996);
- Conducted a Human Health Risk Assessment and Screening Ecological Evaluation (ENVIRON Corporation, 1996);
- Implemented surface water control measures at and in the vicinity of the Yard (H+A, 1996b);
- Operated an Interim Groundwater Removal Facility at the Yard (H+A, 1999);
- Excavated and removed soil impacted by polychlorinated biphenyls from the 901 Gamble Lane property (H+A, 1997b);
- Prepared a Remedial Action Plan (RAP) for DTSC review, public comment, and approval (DTSC, 1998);
- Placed clean soil cover at the Yard to reduce the potential for contaminant migration by wind, water or human activity (H+A, 2000c);
- Excavated and removed approximately 890 cubic yards of soil impacted by polychlorinated biphenyls from several off-Yard areas near the Property (H+A, 2000a);
- Constructed and operated a soil vapor extraction (SVE) system at the Yard (H+A, 2000c), resulting in the removal of approximately 3,644 pounds of VOCs from soil as of December 2010 (H+A, 2011a); and
- Operated a full-scale Groundwater Remediation System (GRS) at the Yard, resulting in the treatment of over 114 million gallons of groundwater and the removal of approximately 2,271 pounds of VOCs from groundwater as of March 2011 (H+A, 2011b).

• Conducted an enhanced in-situ pilot study (EISB). Data regarding the EISB pilot study is provided in the EISB pilot study implementation report and summary report (H+A, 2007b and 2008b).

Information regarding performance standards for the GRS as well as for the SVE system can be found in the Operation and Maintenance Plan (H+A, 2006a).

1.2 PURPOSE

The purpose of this MCP is to provide a description of the monitoring and contingency programs to be implemented as part of the groundwater remedial action for the next 5-year remedy review period, in accordance with the DTSC-approved RAP (DTSC, 1998).

1.2.1 Monitoring Program

The monitoring program, as revised and implemented herein, will provide groundwater and surface water data for ongoing evaluation of the VOCs dissolved in shallow and deep groundwater at the Site. More specifically, shallow and deep groundwater and surface water monitoring data will be used to:

- Evaluate remedy performance;
- Evaluate the natural attenuation portion of the groundwater remedy in the portion of the VOC plume south of Hamilton Lane;
- Evaluate the effectiveness of active remedial action (RA) in the northern portion of the plume;
- Evaluate containment of the high concentration VOC plume within the boundaries of the Property;
- Evaluate the protection of human health and the environment;
- Evaluate changes in shallow and deep water quality within the VOC plume;
- Evaluate water quality at selected regional groundwater wells in the vicinity of the Site;



- Evaluate potential impacts from downgradient groundwater and surface water exposure to potential receptors;
- Identify any VOC degradation products resulting from natural attenuation;
- Identify VOC plume migration laterally and vertically; and
- Implement the contingency program as discussed in Section 1.2.2.

The results of field measurements and groundwater quality data collected during the RI and subsequent monitoring suggest that biological degradation is occurring at the Yard, but may not be the primary mechanism of natural attenuation in groundwater downgradient of the Yard. Rather, other natural attenuation processes, including dilution, dispersion, and volatilization, appear to be the primary attenuation processes occurring south of Hamilton Lane. As described in Section 5.4.1.2 of the RI and Section 7.1.1.2.4 of the RRR, dilution and dispersion are the dominant mechanisms of natural attenuation in groundwater in the downgradient portion of the plume (H+A, 1996b and 2011d). Monitoring for natural attenuation at the Site will consist of evaluating concentrations of parent and daughter VOCs. Field measurements and laboratory analysis under this monitoring program are therefore not designed for the evaluation of biological degradation.

1.2.2 Contingency Program

Contingencies and decision making processes are identified for implementation, if needed, and to protect human health and the environment at the Site. Contingencies have been identified for responding to levels of VOCs in groundwater from regional supply wells and in surface water from Felicita Creek. In addition, some contingencies may be implemented to modify the scope of the monitoring program in response to changes in field conditions or groundwater quality.

1.3 SCOPE

The following provides a description of the scope of the monitoring program and contingency program.



1.3.1 Scope of Monitoring Program

The results of the monitoring program will be used to evaluate containment of the higher concentration portions of the VOC plume within the Chatham Yard; to demonstrate that human health and the environment remain protected at the Site; and to monitor water quality objectives outside of the VOC plume area (DTSC, 1998).

Periodic groundwater monitoring at the Site was conducted by DTSC between 1982 and 1991. Quarterly groundwater monitoring at the Site has been conducted by the Group since 1992. Groundwater samples have been collected from 65 monitor wells, 10 piezometers, and 13 regional wells at the Site since September 2004 (Figure 3) (H+A, 2011d). To date, more than 2,000 groundwater samples have been collected at the Site.

The monitoring program is based on the DTSC-approved RAP (DTSC, 1998), and is similar in structure to the key well program implemented under the RI during the subsequent 3½ year remedy review period concluded in June 2004 (H+A, 2005a) and during the following 5-year remedy review period concluded in March 2010 (H+A, 2011d). The monitoring program requires the collection of approximately 78 groundwater and surface water samples over the course of a year. The monitoring program includes the following:

- Water level measurement;
- Groundwater sampling, including measurement of water quality parameters in the field;
- Surface water sampling;
- Laboratory analysis;
- Semiannual updates of the GRS/SVE systems;
- Semiannual updates of regional production well uses;
- Semiannual summary of groundwater data; and
- Comprehensive annual reporting.

The detailed features of the key well monitoring program are presented in Table 1. The scope of the groundwater sampling program subsequent to the September 2011 monitoring event has been modified and is discussed in detail in Section 3.2.



1.3.2 Scope of Contingency Program

The contingency program consists of triggers and contingencies, and has been updated from the original MCP. Triggers are defined as predetermined action levels or conditions that activate a contingency action to be taken (DTSC, 1998). Triggers are generally based on :

- Exceedance of predetermined concentration levels at any of several selected sampling locations;
- The use of any regional well at the Site for drinking water supply; and
- VOC concentrations exceeding surface water risk-based trigger levels (SWRBTLs) in surface water samples.

Contingencies are defined as a systematic set of predetermined responses to triggers that may be encountered during the implementation of the groundwater remedy or for as long as monitoring is conducted at the Site under the Consent Decree. The contingency program specifically addresses issues relating to the hypothetical human exposures to groundwater at the Site, and the possibility of human contact with VOC-impacted surface water in Felicita Creek. The overall objectives of the program are to ensure that human health and the environment remain protected during implementation of the RA, and to provide sufficient data for an evaluation of remedy effectiveness during the current remedy review period.

The contingency program includes the following:

- Identification of contingencies;
- Identification of conditions that trigger the contingency program;
- Review of analytical data obtained from the monitoring program to determine if trigger conditions are met;
- Implementation of contingencies specified in this MCP, if warranted; and
- Reporting of contingency implementation.



1.4 RELEVANT SUPPORTING DOCUMENTATION

Background on the Site and the approved remedy may be found in the following documents:

- Administrative Consent Order (DTSC, 1992);
- RI Report (H+A, 1996b);
- FS Report (Geraghty & Miller, Inc., 1996);
- Human Health Risk Assessment and Ecological Screening Evaluation Report (ENVIRON Corporation, 1996);
- RAP (DTSC, 1998);
- Consent Decree between DTSC and Settling Parties (DTSC, 1999);
- RRR for 5-year period ending March 2010 (H+A, 2011d); and
- Administrative record for the Chatham Site.

Groundwater and surface water monitoring has been conducted at the Site since 1982 (H+A, 1996b). Groundwater monitoring was conducted on a quarterly basis at the Site from November 1992 through June/July 2011. Surface water monitoring was routinely conducted at the Site from 1994 through June/July 2011. Groundwater and surface water monitoring data have been provided (Appendix D) and also may be found in the following documents:

- Groundwater and surface water monitoring data for the period 1986 through 1994 are summarized in the RI Report (H+A, 1996b).
- Groundwater and surface water monitoring data for 1995 through mid-2011 are summarized in the respective Annual and Quarterly Monitoring Reports (H+A, 1996a, 1997a, 1998, 1999, 2000b, 2004, 2005d, 2006b, 2007a, 2008a, 2009, 2010, 2011b and 2011c; Tetra Tech EM, Inc, 2001, 2002 and 2003).



2.0 ADDITIONAL DATA REQUIREMENTS

The purpose of this section is to describe additional data requirements needed to optimize the scope of the MCP. At this time, no additional data other than scheduled monitoring are required to implement the scope of this MCP.

In response to DTSC comments to the 2010 RRR, the Group will conduct further soil vapor sampling at the Site. A workplan will be prepared and submitted to DTSC, providing the locations, depths, and design of soil vapor probes. Any soil vapor sampling will be conducted in accordance with DTSC guidance (DTSC and California Regional Water Quality Control Board, Los Angeles Region, 2003) or the most current guidance at the time of soil vapor sampling. The Group understands that a draft guidance document is currently in review that may supersede the cited 2003 document (DTSC, 2010) and applicable portions of this updated guidance will be consulted, as necessary, once it is finalized by DTSC and applicable to activity at the Site.



3.0 GROUNDWATER AND SURFACE WATER MONITORING

The following is a description of the monitoring program to be implemented as part of the RA. The monitoring program consists of water level measurement, groundwater sampling, regional well usage evaluation, surface water sampling, laboratory analysis, and reporting.

3.1 GROUNDWATER LEVELS

Water levels will be measured semiannually in March and September of each year. Water levels will be measured in all extraction wells, accessible monitor wells, piezometers, and accessible regional wells as part of the monitoring program (Figure 3). Some wells may be inaccessible due to private property access restrictions. Water levels will be measured prior to groundwater sample collection. If possible, water levels will be measured while the GRS is in operation.

Several changes to water level measuring were implemented during the 5-year remedy review period concluded in March 2010 including the addition of newly constructed monitor and regional wells and removal of decommissioned wells. The following change to the MCP will be implemented after the September 2011 monitoring event:

The frequency of water level monitoring is reduced from quarterly to semiannually, conducted in March and September of each year, based on the generally stable record of water levels observed at the Site. Quarterly water level contour figures were discontinued in 2005 due to the minor variations observed in the overall direction of groundwater flow. Continued measurement of water levels during December and June are not required, since water level data from the previous 18 years has demonstrated that the seasonal variations do not result in significant groundwater flow direction or gradient changes, and thus do not change contaminant movement interpretations. Water levels continue to be measured semiannually in all accessible piezometers, monitor wells, extraction wells, and regional wells.



Water level measurement will be conducted in accordance with SOPs detailed in the SAP prepared for the Chatham Site (Appendix A). Water levels will be measured using an electric water level sounder. Resulting depth to water data will be recorded and entered in the project database. These data will be used in conjunction with surveyed measuring point elevation data or elevations estimated from San Diego County topographic maps to construct water level elevation contour maps and hydrographs. These maps can be used to interpret groundwater flow conditions and to determine horizontal gradients in monitor wells at the Site. Water level elevation contour maps can also be used to aid in evaluating the distribution and movement of VOCs in groundwater. Hydrographs are useful for the interpretation of water level trends over time.

3.2 GROUNDWATER MONITORING

Pursuant to the RAP, data from the monitor wells and regional wells are evaluated and a set of key wells is sampled on a regular basis. The purpose of groundwater monitoring has been summarized in Section 1.2.1.

The MCP monitoring program is flexible and can be modified, if warranted, by Site conditions or in response to changes in the data collected during groundwater and surface water monitoring. The list of key wells and sampling locations specified in this MCP is subject to revision based on an ongoing evaluation of analytical data. Recommended changes to the scope of the monitoring program will be implemented with the approval of DTSC.

3.2.1 Rationale for Selection of Key Wells

The detailed features of this modified key well monitoring program are presented in Table 1. Historical water quality data were used to assign wells to the semiannual or annual monitoring program for this MCP. Semiannual and annual wells have been designated (Table 1; Figures 6 and 7). Semiannual groundwater sampling will be conducted in September of each year. Annual groundwater sampling will be conducted in March of each year, and will include key wells designated for semiannual sampling as well as those specified for annual monitoring.



Semiannual wells were selected to:

- Focus on the VOC plume toe area at Felicita County Park; and
- Monitor for trigger conditions that would activate the MCP contingency program, thereby protecting human health and the environment (Section 5.0).

Wells identified for sampling on an annual basis, including semiannual wells, were selected to gather further data to evaluate trends in VOC concentrations and remedy effectiveness immediately downgradient of extraction wells, and to facilitate the understanding of the entire VOC plume. The technical rationale for selecting each of the wells has been provided (Table 1).

Unless otherwise specified, groundwater sampling and analysis will be conducted in accordance with SOPs detailed in the SAP and QAPP prepared for the Chatham Site (Appendices A and B). Groundwater samples collected from key wells will be analyzed for VOCs using U.S. Environmental Protection Agency (EPA) Method 8260B. Pursuant to DTSC direction in 2005, groundwater samples collected from a selected subset of key wells will be analyzed for 1,4-dioxane using modified EPA Method 8260B (Table 1) (DTSC, 2005). Laboratory samples will be analyzed by a state certified laboratory.

The groundwater monitoring program is subject to revision based on an ongoing evaluation of analytical data and Site conditions. Data, triggers, and Site conditions and associated responses, which would result in a change in the monitoring program, are summarized in Section 5.

3.2.2 Revisions to Monitoring Program

Several changes to the monitoring program were implemented during the 5-year remedy review period concluded in March 2010, and included the addition of newly constructed monitor and regional wells and removal of decommissioned wells. Changes to the 2005 MCP to be implemented after the September 2011 monitoring event are as follows:



- The frequency of water quality sampling of water table monitor well MW-43 is reduced from quarterly to annually based on the generally improving record of water quality observed at this location (Figure 8).
- The frequency of water quality monitoring from water table monitor well MW-50 is reduced from quarterly to semiannually based on the generally stable record of water quality observed at this location (Figure 9). Because the high and low concentrations observed in monitor well MW-54 tend to occur in September and March of each year (Figure 10), continued sampling during June and December is no longer needed to assess VOC concentration trends in this well, thus the frequency of sampling monitor well MW-54 is reduced to semiannually.
- The frequency of water quality sampling of water table monitor well MW-46 is reduced from semiannually to annually based on the generally improving record of water quality observed at this location.
- The frequency of water quality sampling of extraction wells TEW-2, EW-3, and EW-4 is reduced from semiannually to annually based on the generally stable record of water quality observed at these locations.
- The frequency of sampling of regional wells 33-G3, 33-R3, Barra 1, Chernish 1, deJong 2, Kopf 1, and Platt 1 is reduced from semiannually to annually based on the generally stable record of water quality at the Site, and the lack of detection of VOCs above their respective MCLs in these wells. No regional wells at the Site are used as a drinking water source, and this sampling frequency will not impact the ongoing evaluation of the protectiveness of the remedy for human health. Water levels in regional wells will be measured semiannually and regional well use will be confirmed at that time, and if the water use changes, the monitoring program will be modified in accordance with the contingency plan (Section 5.1).
- Based on the generally stable concentrations of 1,4-dioxane detected in regional wells, semiannual sampling for 1,4-dioxane is no longer necessary. Regional wells will be monitored annually for 1,4-dioxane as well as VOCs.
- Deep regional well Chernish 1, which has historically been sampled for 1,4-dioxane only, will be sampled annually for VOCs as well as for 1,4-dioxane.
- Monitor wells are eliminated from the sampling program where concentrations are below limits of detection for Site-related VOCs and/or are not needed for preparation of VOC



contour figures. This change affects the following monitor wells: MW-1, MW-7, MW-10, MW-12, MW-14, MW-15, MW-16, MW-29, MW-40, MW-41, MW-44, MW-53, MW-65, P-10, P-12, MW-34, MW-36, and MW-37. Figures 11 and 12 illustrate historical VOC results for these wells and their locations with respect to the VOC plume. The listed monitor wells exhibit stable water quality, and do not materially affect identification of VOC concentration contours. In addition, regional well 34-E4, which has historically been sampled for 1,4-dioxane only, can be eliminated from the sampling program because 1,4-dioxane has never been detected in this well, and other nearby wells are sufficient to define the plume boundary in this area.

- Key water table and deep zone monitor wells are sampled semiannually downgradient of the plumes, along the downgradient axes of the plumes, or where the period of record is not yet sufficient to identify a trend. The key wells include water table monitor wells MW-50, MW-54, and MW-68, and deep zone monitor wells MW-69, MW-70, MW-72, and MW-75. This program incorporates several monitor wells constructed since the previous version of the MCP. Sampling along the downgradient axes allows tracking of water quality trends at locations with the greatest potential for change.
- Deep monitor wells MW-66 and MW-67, constructed since the previous version of the MCP, are sampled annually.
- Monitor well MW-8 is replaced in the sampling program with monitor well MW-20 to monitor on-Yard VOC concentrations, since monitor well MW-8 is often dry. During the remedy review period concluded in March 2010, monitor well MW-8 was dry on 12 occasions and could not be sampled, thus continued reliance on this well for on-Yard VOC data is no longer warranted.
- Deep monitor well MW-36 is replaced in the sampling program with monitor well MW-22, as this location is closer to the current east flank of the VOC plume at the Yard (Figures 5 and 7). Site-related VOCs have not been detected in deep monitor well MW-36 since June 2000, thus its replacement in the monitoring program with MW-22 allows better delineation of the northeast flank of the deep VOC plume in this area.
- Water quality monitoring is performed at monitor well MW-64 on an annual basis to evaluate VOC concentrations west of the Yard. In conjunction with other wells in this area, monitor well MW-64 will be needed to define the boundaries of the upgradient shallow VOC plume west of the Yard (Figure 4).



- Decommissioned monitor wells MW-27, MW-28, MW-47, MW-56, and MW-57 are eliminated from the monitoring program.
- No analysis for perchlorate is performed at the Site due to the stable distribution of this compound observed in groundwater in the Site vicinity; the long history of agriculture and fertilizer use in the vicinity of the Site; and since perchlorate does not appear to be Site related as described in the Response to Comments to the 2010 RRR (Attachment 1 of H+A, 2011d).
- The scope of semiannual reporting is reduced to a data submittal format, providing the dates of the event, general Site status, and any conditions affecting the conduct of field activities. Water level and water quality data are presented in tabular format, along with remediation system operational data. Graphical presentations of water level and water quality data, along with appended laboratory analytical reports, will be provided with annual monitoring reports for each year, the scope of which will otherwise be unchanged from the 5-year remedy review period concluded in March 2010.

In addition, the scope of the monitoring program that remains unchanged from the 2005 MCP includes the following:

• Monitor wells MW-9, MW-13, MW-25, and MW-32, and piezometer P-2, will continue to be sampled on an annual basis.

These key well modifications allow the Group to collect data that are representative of current water quality conditions at the Chatham Site and evaluate the continuing effectiveness of the groundwater remedy.

3.3 SURFACE WATER MONITORING

The purposes of semiannual and annual surface water sampling are similar to the purposes of the corresponding groundwater monitoring program. Pursuant to the RAP, surface water data are collected and evaluated to ensure the continued protection of human health and the environment at the Site during implementation of the RA (DTSC, 1998); to evaluate impacts



from hypothetical human exposure to surface water downgradient from the Yard; and to provide sufficient data for an evaluation of remedy effectiveness. Semiannual and annual surface water sampling locations have been designated (Table 1; Figure 13). The technical rationale for selecting each of the surface water sampling locations has been provided (Table 1). Surface water sampling will be conducted concurrently with groundwater monitoring.

Several changes to the monitoring program were implemented during the 5-year remedy review period concluded in March 2010. The following changes to the MCP will be implemented subsequent to the September 2011 monitoring event:

- The frequency of water quality sampling from Felicita Creek surface water locations FC-8A, FC-7, and FC-4 is reduced from quarterly to semiannually based on the continued absence of detectable Site-related VOCs at FC-8A (H+A, 2011b), the generally stable record of water quality observed at surface water location FC-7 (Figure 14), and the generally representative samples collected from surface water location FC-4 during March and September sampling events, remaining far below SWRBTLs (H+A, 2011d).
- Semiannual water quality sampling from Felicita Creek surface water location FC-9A is eliminated due to the absence of detected Site-related VOCs at this location and the immediate upstream location of surface water location FC-8A since monitoring began in 1999 (H+A, 2011b).

The monitoring program is unchanged from the 2005 MCP for the following:

- Surface water sample location FC-10 will continue to be sampled on a semiannual basis.
- Surface water sample location FC-6 will continue to be sampled on an annual basis.

Surface water sampling and analysis will be conducted in accordance with SOPs detailed in the SAP and QAPP prepared for the Chatham Site (Appendices A and B). Surface water samples will be analyzed for VOCs using EPA Method 8260B. In addition, surface water samples collected from a selected subset of locations will be analyzed for 1,4-dioxane using modified EPA Method 8260B (Table 1).



3.4 REGIONAL WELL MONITORING

Selected regional wells have been incorporated into the groundwater monitoring program (Table 1; Figures 6 and 7). Sampling of regional wells included in the monitoring program has been described (Section 3.2). Baseline uses of regional wells in the monitoring program have been summarized (Table 2).

In addition to water level measurement and groundwater sampling of selected regional wells, periodic documentation of the status and uses of each regional well will be included in the monitoring program. These observations will be conducted semiannually, and recorded during water level measurement activities. Observations to be recorded include the following:

- Pumping status, including changes in pump installation, by observation during semiannual and annual monitoring;
- Water usage volume, if well is equipped with a pump and a totalizing flowmeter, by totalizer reading during semiannual and annual monitoring;
- Water use, if well is equipped with a pump, by observation semiannually if possible, otherwise by interview of well owner during semiannual and annual monitoring events; and
- Quarterly file review at the San Marcos office of the County of San Diego Department of Environmental Health, to identify any recently constructed production wells in the Site vicinity and to track any applications for well construction or destruction permits (Figure 3).

3.5 SCHEDULE

Key wells and surface water sample locations to be sampled during each regular monitoring event have been provided (Table 1). Sampling of semiannual wells and surface water sample locations will be conducted in September of each year. Sampling of annual wells and surface water sample locations will be conducted in March of each year.

The monitoring program as described herein will be implemented after September 2011, with DTSC concurrence, and will remain in effect for five years from submittal of the final RRR. The next RRR will be submitted to DTSC by September 2016. An evaluation of the effectiveness of



the RA will be conducted at that time, and may result in modification to or replacement of this MCP. If not revised, the requirements of this MCP will remain in effect for as long as monitoring is conducted under the Consent Decree (DTSC, 1999).



4.0 REPORTING

Following each monitoring event completed in accordance with this MCP, a data submittal or monitoring report, as appropriate, will be prepared and submitted for DTSC's reference and records. A Semiannual Data Submittal will be prepared following the September monitoring event for each year. An Annual Monitoring Report will be prepared following the March monitoring event for each year. The contents and schedule for each of these levels of reporting are described in this section.

4.1 SEMIANNUAL DATA SUBMITTALS

Semiannual Data Submittals will be prepared following the September monitoring events for each year. Beginning in September 2012, semiannual reporting will be provided in a status report format, providing the dates of the event, general Site status, summary of project activities performed during the period, and any conditions affecting the conduct of field activities. Monitoring activities to be documented in the Semiannual Data Submittals will include the results of water level measurement; the results of sampling and analysis of groundwater collected from the semiannual wells; and the results of surface water monitoring activities. This information will be provided in tabular format. Graphical presentations of water level and water quality data, along with appended laboratory analytical reports, will not be provided with Semiannual Data Submittals, but instead will be submitted with the annual reports. Data submittals will also summarize the operation of the groundwater treatment activities, including groundwater extraction volumes, SVE results, treatment system's respective efficiency and mass removal in tabular format. Any trigger condition and contingency implemented during a semiannual monitoring event will also be described in the data submittals. In addition, selected contingencies require that DTSC or other public or private entities be notified within 24 or 48 hours of receipt of analytical data (Section 5).



4.2 ANNUAL MONITORING REPORTS

An Annual Monitoring Report will be prepared following the March monitoring event for each year. In addition to data provided in Semiannual Data Submittals, groundwater and surface water monitoring activities conducted during the previous year will be summarized and described in the Annual Monitoring Reports, including the results of water level measurement, and the results of sampling and analysis of groundwater collected from the semiannual and annual key wells. Any significant changes in water quality since the previous monitoring event will be evaluated and briefly described. Water level elevation contour maps will be prepared for shallow and deep groundwater and provided with each Annual Monitoring Report. In addition to water level elevation contour maps, shallow and deep water quality contour maps, illustrating concentrations of trichloroethylene, tetrachloroethylene, and cis-1,2-dichloroethylene detected in groundwater, will be prepared for shallow and deep wells and provided with each Annual Monitoring Report. Water level and water quality hydrographs for selected wells will be prepared and provided with each Annual Monitoring Report. Any trends or significant changes in water levels or water guality during the previous year will be discussed, particularly with respect to the effectiveness of the groundwater RA. Any changes in the configuration of the VOC plumes over the previous year will be described and discussed. In addition to plume maps, a cross section along the plume axis, as well as a cross section perpendicular to the plume axis in the vicinity of the extraction wells, will be prepared and included in the Annual Monitoring Reports in order to illustrate the distribution of VOCs with respect to depth and lithology. Any trigger condition and contingency implemented during the previous year will also be summarized and discussed in the Annual Monitoring Reports. Annual Monitoring Reports will also describe work performed at the Site, including Site conditions affecting field activities and the results of regional production well monitoring (Section 3.4). Annual Monitoring Reports will also summarize the operation of the groundwater treatment activities, including groundwater extraction volumes, SVE results, treatment system's respective efficiency and mass removal for the previous year. Analytical data obtained during laboratory testing of groundwater samples will be appended to the Annual Monitoring Reports. Field sampling data sheets will also be appended to the Annual Monitoring Reports.



4.3 SCHEDULE

Semiannual Data Submittals prepared following the September monitoring events for each year will be submitted to DTSC within 45 calendar days of the end of September. Annual Monitoring Reports prepared following the March monitoring event for each year will be submitted to DTSC within 60 calendar days of the end of March. The timing of these two reports is different since annual reports have a greater scope and, thus, corresponding level of effort to prepare compared to much shorter semiannual data submittals.



5.0 TRIGGERS AND CONTINGENCIES

This section describes triggers for implementation of contingency action to ensure continued protection of human health and the environment and/or collection of sufficient data for ongoing evaluations. The triggers include analytical results of groundwater or surface water sampling, and observations conducted during the monitoring program described above (Section 3.0). Contingencies will be implemented if a trigger condition exists. Trigger conditions and implemented contingencies will be described in the Semiannual Data Submittal or Annual Monitoring Report prepared following that monitoring event (Sections 4.1 and 4.2). In addition, certain trigger conditions will result in agency notification upon discovery of the condition.

Contingencies have been developed to address the following monitoring priorities:

- Regional well monitoring and production well usage;
- Groundwater monitoring of the VOC plume; and
- Felicita Creek surface water monitoring.

5.1 REGIONAL WELL MONITORING AND USAGE

Triggers and contingencies have been identified for existing and hypothetical human exposure to VOC-impacted groundwater. These contingencies have been developed to ensure that human health and the environment remain protected at the Site. At present, there is a potential for human exposure to impacted surface water at Felicita Creek and to impacted groundwater at the regional wells. Felicita Creek is addressed below (Section 5.3).

TYPE	TRIGGER	CONTINGENCY	NOTIFICATION
1. Regional Wells: Potential Threat to Human Health	1a. Any VOC exceeding MCL detected in a regional well being used for drinking water supply	Immediately provide bottled water to those persons using the water for drinking purposes. Resample well within 48 hours of receipt of analytical data to confirm detection. If confirmed, evaluate possible courses of action.	Notify DTSC and well owner within 24 hours of receipt of data. Submit letter to DTSC with copy to well owner within 7 business days.
	1b. Any VOC exceeding HBCL detected in an active regional well not being used for drinking water supply (Table 3).	Resample well within 48 hours of receipt of analytical data to confirm detection. If confirmed, evaluate possible courses of action in conjunction with agencies. Move well to quarterly sampling schedule. Well remains on quarterly sampling schedule for the duration of the 5-year monitoring program.	Immediately notify DTSC and well owner within 24 hours of receipt of data. Submit letter to DTSC with copy to well owner within 7 business days.
Regional Wells: Potential for Human Exposure	1c. Change in regional well use to drinking water supply	Move well to semiannual sampling schedule for the duration of the 5-year monitoring program.	Notify DTSC within 48 hours of receipt after notice of change in well use. Submit letter to DTSC with copy to well owner within 7 business days.

In response to DTSC comments the Group is in the process of preparing an Irrigation Study Workplan. Upon completion of the work associated with the Irrigation Study, additional triggers and contingencies may be developed for regional wells and will be appended to this document.

5.2 GROUNDWATER MONITORING

Triggers and contingencies have been identified for groundwater monitoring of the VOC plume and surrounding areas. These contingencies have been developed to determine if the VOC plume is migrating laterally. Trigger conditions and their associated contingencies are summarized below:



TYPE	TRIGGER	CONTINGENCY	NOTIFICATION
2. VOC plume monitoring	2a. Any Site-related VOC exceeding MCL detected in monitor well MW-68	Resample well within 15 days of receipt of analytical data to confirm detection. If confirmed, sample regional well 4-J1 on semiannual schedule for the duration of the 5-year monitoring program. Based on results of semiannual monitoring, the Group would confer with DTSC regarding the need for a downgradient sentinel monitor well south of monitor well MW-68 if VOCs above the MCL occur over four consecutive sampling events.	Notify DTSC within 7 days of receipt of analytical data. Summarize all sampling results in Semiannual Data Submittal or Annual Monitoring Report.
	2b. Any Site-related VOC detected exceeding MCL in monitor well MW-75	Resample well within 15 days of receipt of analytical data to confirm detection. If confirmed, sample Barra 1 if not sampled during the monitoring event. Based on results of semiannual monitoring, the Group would confer with DTSC regarding the need for a downgradient sentinel monitor well south of monitor well MW-75 if VOCs above the MCL occur over four consecutive sampling events.	Notify DTSC within 7 days of receipt of analytical data. Summarize all sampling results in Semiannual Data Submittal or Annual Monitoring Report.

5.3 FELICITA CREEK SURFACE WATER MONITORING

The east fork of Felicita Creek in the northern portion of Felicita County Park represents an area where there is a potential for human exposure to VOC-impacted groundwater (H+A, 1996b). Any detection of VOCs in surface water exceeding SWRBTLs will trigger a contingency response (Environmental Health Decisions, 2010). SWRBTLs are provided in Table 4. These contingencies have been developed to ensure that human health and the environment remain protected at the Site, and to evaluate impacts from downgradient exposures to impacted surface water. Trigger conditions and their associated contingencies are summarized below:



TYPE	TRIGGER	CONTINGENCY	NOTIFICATION
3. Felicita	3a. Any VOC	Resample location and next downstream	Notify DTSC and
Creek	detected in a	sampling location within 7 days of receipt	Felicita Park chief
Detential	surface water	of analytical data to confirm detection. If	ranger within 24 hours
Threat to	exceeds its	action	Submit letter to DTSC
Human Health	SWRBTL		within 7 business
and the			days. Summarize all
Environment			sampling results in
			Semiannual Data
			Submittal or Annual
			Monitoring Report.
Felicita Creek	3b. Any	Resample location within 15 days of	Notify DTSC within
	Site-related	receipt of analytical data to confirm	7 business days of
Potential for	VOC exceeding	detection, and sample surface water	receipt of analytical
Human	10 percent of	sample location FC-9A. If confirmed,	data. Summarize all
Exposure	the SWRBTL at	add location FC-9A to semiannual	sampling results in
	surface water	sampling schedule for the duration of the	Semiannual Data
	sample location	5-year monitoring program.	Submittal or Annual
	FC-8A		Monitoring Report.


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MONITORING PROGRAM

SAMPLE LOCATION IDENTIFIER	TECHNICAL RATIONALE	WELL TYPE	ANNUAL MARCH	SEMIANNUAL SEPTEMBER
WATER TABLE				
Extraction Wells	<u>5</u>			
EW-4	On-Yard Extraction Well	WT	Х	
Monitor Wells				
MW-4	Monitor VOCs at southern portion of the Yard	WT	х	
MW-9	Monitor VOCs at southern portion of the Yard	WT	Х	
MW-13	Monitor VOCs at southern portion of the Yard	WT	Х	
MW-17	VOCs in source area of Yard	WT	Х	
MW-20	Monitor plume axis in Yard	Int	Х	
MW-25	Plume boundary, Monitor VOCs west of Yard	WT	Х	
MW-26	Control of VOCs upgradient of Chatham Yard	WT	Х	
MW-30	Monitor northeast flank of plume near extraction well EW-3	WT	Х	
MW-31	Monitor plume axis downgradient of extraction well EW-3	WT	Х	
MW-42	Monitor east flank VOCs south of Hamilton Lane	WT	Х	
MW-43	Monitor downgradient plume axis south of Hamilton Lane	WT	Х	
MW-45	Monitor downgradient southwest flank VOCs south of Hamilton	WT	Х	
MW-46	Monitor downgradient plume axis south of Hamilton Lane	WT	Х	
MW-50	Monitor plume axis downgradient of Yard	WT	Х	Х
MW-51	Control of VOCs upgradient of Chatham Yard	WT	Х	
MW-52	Monitor downgradient southeast flank VOCs	WT	Х	
MW-54	Monitor downgradient extent of VOCs	WT	Х	Х
MW-58	Monitor downgradient plume axis	WT	Х	

Please refer to Page 4 for footnotes

SAMPLE LOCATION				SEMIANNUAL
Monitor Wells (Cont'd)		MARCH	3EF TEMBER
MW-64	Monitor VOCs west of Yard	WT	Х	
MW-68	Downgradient control of shallow VOCs	WT	Х	х
<u>Piezometers</u>				
P-2	Monitor VOCs in upgradient	WT	Х	
P-11	Monitor VOCs west of Yard	WT	Х	
P-14	Monitor VOCs upgradient of Yard	WT	Х	
P-15	Monitor VOCs upgradient of Yard	WT	х	
Regional Wells				
33-R3	Monitor VOCs in active well	WT	X ^(b)	
34-N5	Monitor VOCs in active well	WT	X ^(b)	Х
deJong 2	Monitor east flank VOCs in active well	WT	X ^(b)	
Fleet 1	Monitor VOCs in active well	WT	X ^(b)	Х
DEEP GROUN	DWATER			
Extraction Well	<u>s</u>			
TEW-2	On-Yard Extraction Well	Deep	х	
EW-3	Extraction Well on Hamilton Lane	Deep	х	
Monitor Wells				
MW-21	Deep groundwater in source area of Yard	Deep	Х	
MW-22	Monitor east flank deep VOCs	Deep	Х	
MW-23	Monitor deep plume axis	Deep	х	
MW-32	Monitor deeper extent of VOCs	Deeper	Х	

MONITORING PROGRAM

Please refer to Page 4 for footnotes

MONITORING PROGRAM

SAMPLE LOCATION				SEMIANNUAL
Monitor Wells (VVELLITFE	MARCH	SEFTEMBER
<u></u>	<u> </u>			
MW-33	Lateral control deep VOCs and upgradient source	Deep	Х	
MW-38	Monitor east flank deep VOCs	Deep	Х	
MW-39	Downgradient control of deep VOCs	Deep	Х	
MW-66	Monitor deep downgradient plume axis	Deep	Х	
MW-67	Axis of deep VOCs downgradient of extraction well	Deep	Х	
MW-69	Downgradient deep zone	Deep	Х	Х
MW-70	Downgradient deep zone	Deep	Х	Х
MW-71	Downgradient deep zone	Deep	Х	
MW-72	Downgradient deep zone	Deep	Х	Х
MW-73	Downgradient deep zone	Deep	Х	
MW-74	Downgradient deep zone	Deep	Х	
MW-75	Downgradient deep zone	Deep	Х	Х
MW-76	Downgradient deep zone	Deep	Х	
Regional Wells				
33-G3	Monitor VOCs in active well	Deep	X ^(b)	
Barra 1	Monitor VOCs in active well	Deep	X ^(b)	
Grubbs 1 ^(a)	Monitor VOCs in active well	Deep	X ^(b)	Х
Chernish 1	Monitor VOCs in active well	Deep	X ^(b)	
Kopf ^(a)	Monitor VOCs in active well	Deep	X ^(b)	
Miller 1 ^(a)	Monitor VOCs in active well	Deep	X ^(b)	Х

Please refer to Page 4 for footnotes

SAMPLE LOCATION IDENTIFIER	TECHNICAL RATIONALE	WELL TYPE	ANNUAL MARCH	SEMIANNUAL SEPTEMBER
Regional Wells	(Cont'd)			
Platt 1	Monitor VOCs in active well	Deep	X ^(b)	
Schnoebelen 1	Monitor VOCs in active well	Deep	X ^(b)	Х
Shibley 1	Monitor VOCs in active well	Deep	X ^(b)	
SURFACE WA	TER			
FC-4	Monitor VOCs in baseflow to East Fork	SW	X ^(b)	х
FC-6	Monitor VOCs in baseflow to West Fork	SW	Х	
FC-7	Monitor VOCs in Felicita Creek downstream of FC-10	SW	X ^(b)	Х
FC-8A	Monitor VOCs downstream of FC-7	SW	Х	Х
FC-10	Monitor VOCs downstream of FC-4	SW	X ^(b)	Х

MONITORING PROGRAM

FOOTNOTES

- NOTES: All wells will be sampled for analysis of VOCs using U.S. Environmental Protection Agency (EPA) Method 8260B, unless otherwise indicated.
 - (a) Will be sampled only if accessible.
 - (b) Well will be sampled for 1,4-dioxane using EPA Method 8260B modified in addition to VOCs during the annual round in March.
 - WT = Water Table Wells
 - Int = Intermediate Well
 - Deep = Deep Wells
 - Deeper = Deeper Monitor Well
 - SW = Surface Water Sample
 - VOCs = Volatile organic compounds

TABLE 2

REGIONAL WATER SUPPLY WELL DATA

WELL IDENTIFIER/ STATE WELL NUMBER	YEAR INSTALLED	CASING DIAMETER TYPE	TOTAL DEPTH (ft bls)	PUMP TYPE	CURRENT STATUS
Active Wells					
3 - C2	Unknown	4 ft. dia. concrete	98.9	Submersible	Active; irrigation
4 - J1	Unknown	5 ft. dia. concrete	54.1	2 hp submersible	Active; domestic (non-consumptive household use) and irrigation
33 - B2	Before 1956	4 ft. dia. concrete	110.4	2 hp centrifugal	Active; irrigation
33 - G3	Before 1957	12-inch steel to 35 ft. bls	421.5	1.5 hp submersible	Active; irrigation
33 - R3	Before 1956	4 ft. dia. concrete	47.3	5 hp submersible	Active; irrigation
34 - E4 (deJong 1)	Unknown	3 ft. dia. concrete	28.3	<3 hp centrifugal	Active; irrigation
34 - N1	Before 1956	3 ft. dia. concrete	97.9	5 hp submersible	Active; irrigation
34 - N5	Before 1956	4 ft. X 4 ft. concrete	50.0	3 hp submersible	Active; irrigation and dewatering
Barra 1	1991	6-inch steel to 30 ft. bls, steel screen to 41 ft. bls	602	3 hp submersible	Active; irrigation
Chernish 1	1991	6-inch ID steel to 30 ft. bls	600	1/2 hp submersible	Active; irrigation

TABLE 2

REGIONAL WATER SUPPLY WELL DATA

WELL IDENTIFIER/ STATE WELL NUMBER	YEAR INSTALLED	CASING DIAMETER TYPE	TOTAL DEPTH (ft bls)	PUMP TYPE	CURRENT STATUS
Active Wells (continued)					
Cotten 1	2010	8-inch dia. steel to 30 ft. bls; 5-inch dia. steel to 310 ft. bls, slotted 210-310 ft. bls	310	Submersible	Active; irrigation
deJong 2	Unknown	5 ft. X 5 ft. concrete	40.8	Submersible	Active; irrigation
Fleet 1	Unknown	4 ft. dia. concrete	50	5 hp submersible	Active; irrigation and pond refill
Grubbs 1	2005	8-inch dia. steel to 20 ft. bls	1,012	Submersible	Active; irrigation
Kopf 1	1994	8-inch dia. steel to 23 ft. bls	300	1 hp submersible	Active; irrigation
Miller 1	1991	6-inch dia. steel to 22 ft. bls	520	5 hp submersible	Active; irrigation
Platt 1	1996	6-inch dia. PVC to 21 ft. bls	602	3/4 hp submersible	Active; irrigation
Schnoebelen 1	2002	8-inch dia. steel to 60 ft. bls	530	Submersible	Active; irrigation
Shibley 1	2002	6-inch dia. steel to 35 ft. bls	590	Submersible	Active; irrigation

TABLE 2

REGIONAL WATER SUPPLY WELL DATA

WELL IDENTIFIER/ STATE WELL NUMBER	YEAR INSTALLED	CASING DIAMETER TYPE	TOTAL DEPTH (ft bls)	PUMP TYPE	CURRENT STATUS
Inactive Wells					
3 - D1	Unknown	5.3 ft. dia. concrete	34	None	Inactive
3 - E1	Unknown	3 ft. dia. concrete	24.3	None	Inactive; dry (covered below grade)
3 - E2	Unknown	6 ft. dia. concrete	33.4	Turbine and windmill, non-functional	Inactive
34 - M1	Unknown	3 ft. dia. concrete	94.7	<3 hp submersible, hookups disconnected	Inactive
34 - E3	Unknown	6.5 ft. X 6.5 ft. concrete	60.4	None	Inactive
34 - N3	Before 1956	3 ft. dia. concrete	45	None	Inactive
Capps 1	Unknown	5 ft. dia. concrete	60	None	Inactive
deJong 3	Unknown	3 ft. dia. concrete	31.2	None	Inactive

FOOTNOTES

- ft = Feet
- ft/bls = Feet below land surface
- ft.dia.= Feet diameter

- hp = Horsepower (<) = Less than ID = Inner diameter
- PVC = Polyvinyl chloride

HEALTH-BASED CLEANUP LEVELS FOR VOLATILE ORGANIC COMPOUNDS IN GROUNDWATER

	GROUNDWATER HBCLs ⁽¹⁾	MAXIMUM CONTAMINANT LEVELS
CHEMICALS	(mg/l)	(mg/l)
Organics 1,1,1-Trichloroethane 1,1,2-Trichloro-1,2,2-trifluoroethane	4,520 51 4	0.2 1.2 0.005
1.1-Dichloroethane	115	0.005
1,1-Dichloroethylene 1,2,4-Trichlorobenzene	0.411	0.006 0.005 ⁽²⁾
1,2-Dichloroethane	34.3	0.0005
1,4-Dichlorobenzene Benzene	 4.13	0.005
Carbon Tetrachloride	0.670	0.0005
Chloroform	3.71	0.08 ⁽³⁾
cis-1,2-Dichloroethylene	1,400	0.006
Methylene chloride	304	0.005
Tetrachloroethylene	4.9	0.005
Toluene	3,750	0.15
trans-1,2-Dichloroethylene		0.01
Trichloroethylene	27.6	0.005
Trichlorofluoromethane		0.15
Vinyl chloride	0.0753	0.0005

FOOTNOTES

- (1) = HBCLs established for Site in Remedial Action Plan (DTSC, 1998).
- (2) = The California MCL for 1,2,4-trichlorobenzene was reduced from 0.07 mg/l to 0.005 mg/l in June 2003.
- (3) = The MCL for chloroform is included with total trihalomethanes. The California MCL for total trihalomethanes was reduced from 0.1 mg/l to 0.08 mg/l in June 2006.
- HBCL(s) = Health Based Cleanup Level(s)
 - mg/l = Milligrams per liter
 - DTSC = California Environmental Protection Agency, Department of Toxic Substances Control
 - MCLs = Maximum Contaminant Levels

SURFACE WATER RISK-BASED TRIGGER LEVELS FOR VOLATILE ORGANIC COMPOUNDS

	SURFACE WATER RISK-BASED TRIGGER LEVELS
COMPOUND	(micrograms per liter)
Tetrachloroethylene	154
Trichloroethylene	2,767
cis-1,2-Dichloroethylene	4,895
1,2-Dichloroethane	4,258
1,1-Dichloroethylene	345,833
1,4-Dioxane	9,126

Source: Environmental Health Decisions, 2010.



FIGURE 1. REGIONAL SITE LOCATION



May 11, 2009 - 10:30am ade - T: $\langle 2009 \langle 700-799 \rangle 724$ Chatham \langle Hydrogeology \langle Basemaps \langle 410-7015. dwg \rangle









- SHALLOW EXTRACTION WELL EW−4 🕁
- MW-31 🕱 WATER TABLE GROUNDWATER MONITOR WELL
- MW-19 ⊖ INTERMEDIATE GROUNDWATER MONITOR WELL
- P−1 🔶 GROUNDWATER PIEZOMETER
- REGIONAL WELL, IDENTIFIED BY OWNERSHIP OR STATE WELL NUMBER ABBREVIATION 34-M1 O
 - TRICHLOROETHYLENE CONCENTRATION IN MICROGRAMS PER LITER FOR GROUNDWATER SAMPLES COLLECTED MARCH 2011. 17
 - WELL WAS NOT SAMPLED IN MARCH 2011 TRICHLOROETHYLENE CONCENTRATION IN MICROGRAMS PER LITER FOR MOST RECENT GROUNDWATER SAMPLE COLLECTED IN 2010 (28) (H+A, 2011b).
 - LESS THAN; ANALYTE WAS NOT DETECTED AT OR ABOVE THE REPORTING LIMIT

- FENCE LINE, CHATHAM SITE BOUNDARY
- INTERMITTENT STREAM
- FELICITA COUNTY PARK BOUNDARY

CONTOUR LINE OF ESTIMATED EQUAL CONCENTRATION OF TRICHLOROETHYLENE IN MICROGRAMS PER LITER, DASHED WHERE APPROXIMATE

WELL WAS SCHEDULED TO BE SAMPLED BUT NOT SAMPLED BECAUSE THERE WAS AN INSUFFICIENT VOLUME OF WATER IN WELL OR OTHER OBSTRUCTION THAT PREVENTED SAMPLING.

5 - - - - -

NOTES:

AIR SPARGING WELLS, SOIL VAPOR EXTRACTION WELLS, AND ENHANCED IN-SITU BIOREMEDIATION INJECTION WELLS NOT SHOWN



NOT SAMPLED IN 2010 OR 2011 NS



- MW-66 DEEP GROUNDWATER MONITOR WELL
- EW-3 -
- 33-G3 O REGIONAL WELL, IDENTIFIED BY OWNERSHIP OR STATE WELL NUMBER ABBREVIATION
 - 110 TRICHLOROETHYLENE CONCENTRATION IN MICROGRAMS PER LITER FOR GROUNDWATER SAMPLES COLLECTED MARCH 2011.
 - (30) WELL WAS NOT SAMPLED IN MARCH 2011 TRICHLOROETHYLENE CONCENTRATION IN MICROGRAMS PER LITER FOR MOST RECENT GROUNDWATER SAMPLE COLLECTED IN 2010 (H+A, 2011b).
 - LESS THAN; ANALYTE WAS NOT DETECTED AT OR ABOVE THE REPORTING LIMIT
 - NS NOT SAMPLED IN 2010 OR 2011

- FENCE LINE, CHATHAM SITE BOUNDARY
 - INTERMITTENT STREAM
 - ----- FELICITA COUNTY PARK BOUNDARY

5----

CONTOUR LINE OF ESTIMATED EQUAL CONCENTRATION OF TRICHLOROETHYLENE IN MICROGRAMS PER LITER, DASHED WHERE APPROXIMATE

- TRICHLOROETHYLENE IN MONITOR WELL MW-32 AND EXTRACTION WELLS TEW-2 AND EW-3 ARE NOT CONTOURED; THESE WELLS ARE SCREENED APPROXIMATELY 50 FEET DEEPER THAN OTHER 'DEEP' MONITOR WELLS.
- ** WELL SCHEDULED TO BE SAMPLED IN MARCH 2011 BUT NOT SAMPLED DUE TO INABILITY TO ACCESS OR PURGE WELL (H+A, 2011b). MOST RECENT AVAILABLE CONCENTRATION SHOWN.

CHATHAM SITE ESCONDIDO, CALIFORNIA		
TRICHLOROETHYLEN DEEP WELLS MARCH 2011	IE	
HARGIS + ASSOCIATES, IN G Hydrogeology/Engineering	09/	11
	FIGURE	5
PREP BY RDC REV BY GTC RPT NO. 724.8	210-3996	A



- SHALLOW EXTRACTION WELL EW-4 ↔
- WATER TABLE GROUNDWATER MONITOR WELL MW−31 🕱
- INTERMEDIATE GROUNDWATER MONITOR WELL MW-19 ⊖
- GROUNDWATER PIEZOMETER P−1 ♦
- REGIONAL WELL, IDENTIFIED BY OWNERSHIP OR STATE WELL NUMBER ABBREVIATION 34-M1 O
- ANNUAL MONITORING LOCATION MW-4
- MW-54 SEMIANNUAL MONITORING LOCATION
 - WILL BE ANALYZED FOR 1,4-DIOXANE ANNUALLY IN ADDITION TO VOCS
- FENCE LINE, CHATHAM SITE BOUNDARY
- INTERMITTENT STREAM
- FELICITA COUNTY PARK BOUNDARY

5 CONTOUR LINE OF ESTIMATED EQUAL CONCENTRATION OF TRICHLOROETHYLENE IN MICROGRAMS PER LITER, DASHED WHERE APPROXIMATE, MARCH 2011

NOTE: AIR SPARGING WELLS, SOIL VAPOR EXTRACTION WELLS, AND ENHANCED IN-SITU BIOREMEDIATION INJECTION WELLS NOT SHOWN





- DEEP GROUNDWATER MONITOR WELL MW-66 ●
- DEEP EXTRACTION WELL EW−3 🕂
- REGIONAL WELL, IDENTIFIED BY OWNERSHIP OR STATE WELL NUMBER ABBREVIATION 33-G3 O
- ANNUAL MONITORING LOCATION MW-33
- SEMIANNUAL MONITORING LOCATION MW-67
 - WILL BE ANALYZED FOR 1,4-DIOXANE ANNUALLY IN ADDITION TO VOCS *
- ******** FENCE LINE, CHATHAM SITE BOUNDARY
 - INTERMITTENT STREAM
 - FELICITA COUNTY PARK BOUNDARY

5-CONTOUR LINE OF ESTIMATED EQUAL CONCENTRATION OF TRICHLOROETHYLENE IN MICROGRAMS PER LITER, DASHED WHERE APPROXIMATE MARCH 2011





FIGURE 8. TRICHLOROETHYLENE IN MONITOR WELL MW-43



FIGURE 9. TRICHLOROETHYLENE IN MONITOR WELL MW-50



FIGURE 10. TRICHLOROETHYLENE IN MONITOR WELL MW-54







LAKE HODGES

EXPLANATION

STREAM

_ _ _

- FELICITA COUNTY PARK BOUNDARY
- FENCE LINE, CHATHAM YARD BOUNDARY
- FELICITA CREEK **FC-6** SURFACE WATER SAMPLING LOCATION, ANNUAL
- FELICITA CREEK SURFACE WATER SAMPLING LOCATION, SEMIANNUAL FC-7
- FC-9A FELICITA CREEK SURFACE WATER SAMPLING LOCATION, SAMPLED ONLY UNDER CONTINGENCY PROGRAM
 - STREAM GAUGING LOCATION •







FIGURE 14. TRICHLOROETHYLENE, SURFACE WATER SAMPLE LOCATION FC-7



APPENDIX A

SAMPLING AND ANALYSIS PLAN

APPENDIX A SAMPLING AND ANALYSIS PLAN CHATHAM SITE ESCONDIDO, CALIFORNIA

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ACRONYMS AND ABBREVIATIONS

Below land surface
California Environmental Protection Agency, Department of Toxic Substances Control
Electrical conductivity
U.S. Environmental Protection Agency
1261 Gamble Lane
Gallons per minute
Chatham Site PRP Group
Hargis + Associates, Inc.
Monitoring and Contingency Plan
35-acre parcel including the Yard
Potentially Responsible Parties
Polyvinyl chloride
Quality assurance
Quality assurance/quality control
Quality Assurance Project Plan
Remedial Investigation
Sampling and Analysis Plan
The areal extent of any known or suspected release or threatened release of a hazardous substance, pollutant, or contaminant at the Yard
Standard Operating Procedure(s)
Volatile organic compound
Chatham Brothers Barrel Yard, 2257 Bernardo Avenue, Escondido

APPENDIX A SAMPLING AND ANALYSIS PLAN CHATHAM SITE ESCONDIDO, CALIFORNIA

1.0 INTRODUCTION

This Sampling and Analysis Plan (SAP) has been prepared by Hargis + Associates, Inc. (H+A) on behalf of the Chatham Site Potentially Responsible Parties (PRP) Group (the Group) for the Chatham Site¹ located at 2257 Bernardo Avenue, Escondido, California (the Yard) (Figures A-1 through A-3). This SAP is being submitted in accordance with the Consent Decree between the California Environmental Protection Agency, Department of Toxic Substances Control (DTSC) and the Group (DTSC, 1999), and supersedes the SAP revised and submitted to DTSC in February 2005 (H+A, 2005). This SAP will be implemented during remedial activities at the Site.

1.1 PURPOSE AND SCOPE

As described in the Remedial Action Plan approved by DTSC (DTSC, 1998), this SAP describes activities that the Group will undertake to evaluate the effectiveness of remedial action to be implemented at the Site. This SAP presents the following:

- .. The objectives of each task;
- .. Identification of all chemical parameters that will be analyzed or tested;

¹ The "Site" shall include the areal extent of any known or suspected release or threatened release of a hazardous substance, pollutant, or contaminant originating at the Yard (as defined herein). The Site includes but is not limited to a 5-acre portion of real property commonly known as the Chatham Brothers Barrel Yard located at 2257 Bernardo Avenue (hereinafter referred to as the "Yard"), Escondido, California, which is part of a 35-acre parcel (the "Property"), as well as property located at 1261 Gamble Lane (the "Gamble Lane Property"), Escondido, California.

- .. A description of the types of samples that will be taken;
- .. A description of the depth and frequency of sampling at each location;
- .. Identification of all analytical procedures to be used;
- .. General specifications for groundwater monitor wells; and
- .. Provisions for obtaining access to and obtaining samples from private property, where appropriate.

The purpose of this SAP is to describe the objectives, rationale, methods, and procedures for the various remedial action monitoring tasks to be conducted at the Site. The objective of these tasks is to monitor the lateral and vertical extent of chemicals of concern in groundwater and, where appropriate, other media in the vicinity of the Site. Standard operating procedures (SOPs) for these tasks have been provided (Attachment A-1).

Details on the quality assurance/quality control (QA/QC) procedures to be followed during the remedial action are contained in the Quality Assurance Project Plan (QAPP) (Appendix B). Health and safety procedures to be followed during activities conducted at the Site are contained in the Health and Safety Plan (H+A, 2009).

2.0 SAMPLING RATIONALE

Field activities covered by the SAP include planned, contingent, and optional tasks. Planned field activities to be conducted under this SAP include the following, although they are not listed in the order they will be performed.

- Measure Water Levels
- Conduct Groundwater Sampling
- Conduct Surface Water Sampling
- Perform Soil Vapor Sampling

The following contingent tasks have been identified, and will be conducted, if required, under provisions of the MCP:

- Install Shallow Zone Monitor Well
- Install Deep Zone Monitor Well

The following optional tasks are not anticipated to be required, but are retained for completeness in the event that the scope of the project was to be modified:

- Conduct Surface Soil Sampling (optional task)
- Conduct Subsurface Soil Sampling (optional task)
- Perform Hydraulic Testing (optional task)

The following sections describe the objectives and rationale for each task contained in this SAP.

2.1 MEASURE WATER LEVELS

The following sections describe the objectives and rationale for the measurement of water levels at the Site, including locations and frequencies.

2.1.1 Objectives

The objectives of measuring water levels are to provide data to evaluate groundwater flow conditions and to evaluate the distribution and movement of contaminants in groundwater at and in the vicinity of the Site. Water level data will be used to evaluate horizontal and vertical hydraulic gradients and the direction of groundwater flow at the Site.

2.1.2 Locations

Under this Monitoring and Contingency Plan (MCP), water levels are measured in existing monitor wells MW-1 through MW-10; MW-12 through MW-26; MW-29 through MW-46; MW-50 through MW-55; MW-58 through MW-76; piezometers P-1 through P-12; piezometers P-14 and P-15; and accessible regional wells.

2.1.3 Frequencies

Water levels will be measured semiannually in all existing monitor wells and piezometers. The frequency and number of monitor wells and piezometers measured may be modified in conjunction with DTSC. Additional details regarding the schedule for water level measurement and reporting are provided in the MCP Section 3.1.

2.2 CONDUCT GROUNDWATER SAMPLING

The following sections describe the objectives and rationale for collecting groundwater samples from monitor wells at and in the vicinity of the Site, including locations, frequencies, and analytical methods. Additional details regarding groundwater sampling are provided in the MCP Section 3.2.

2.2.1 Objectives

Groundwater monitoring is conducted to 1) evaluate containment of the higher concentration portions of the volatile organic compound (VOC) plume within the Chatham Yard; 2) demonstrate that human health and the environment at the Site remain protected; and 3) monitor water quality objectives, i.e., Maximum Contaminant Levels, outside of the Yard. The specific objectives of groundwater sampling are to:

- Evaluate remedy performance;
- Evaluate the natural attenuation portion of the groundwater remedy in the portion of the VOC plume south of Hamilton Lane;
- Evaluate the effectiveness of active remedial action (RA) in the northern portion of the plume;
- Evaluate containment of the high concentration VOC plume within the boundaries of the Property;
- Evaluate the protection of human health and the environment;
- Evaluate changes in shallow and deep water quality within the VOC plume;
- Evaluate water quality at regional groundwater wells in the vicinity of the Site;
- Evaluate potential impact from downgradient groundwater and surface water exposure to potential receptors;
- Identify any degradation products resulting from natural attenuation;
- Identify VOC plume migration laterally and vertically; and
- Implement the contingency program as discussed in the MCP Section 5.0.

Based on the evaluation of water level data and on water quality data obtained from monitor and regional groundwater wells, key wells are selected in conjunction with DTSC for groundwater sampling. Groundwater sample analytical data obtained from key wells will be used to characterize the distribution of contaminants in groundwater at the Site and to monitor the migration of contaminants in groundwater at the Site.
2.2.2 Locations

Under the MCP, groundwater samples are collected from key wells on a semiannual or annual basis (Table 1; Figures 6 and 7).

2.2.3 Frequencies

Key wells will be sampled semiannually or annually, as appropriate. Annual key wells will be sampled in March of each year. Semiannual key wells will be sampled in September of each year of the monitoring program. Specific sampling locations and other details regarding the key well program are provided in the text of the MCP (Table 1; Figures 6 and 7).

2.2.4 Analytical Methods

Key semiannual and annual wells will be analyzed for VOCs using U.S. Environmental Protection Agency (EPA) Method 8260B (Table A-1). In addition, groundwater samples collected from a selected subset of key wells will be analyzed for 1,4-dioxane using modified EPA Method 8260B (Table A-1).

2.3 CONDUCT SURFACE WATER SAMPLING

Surface water samples were collected from on-Yard and off-Yard locations during the Remedial Investigation (RI) and previous investigations conducted at the Site. As part of the monitoring program to be implemented under this MCP, surface water samples will be collected concurrently with key well sampling to determine the chemical quality of surface water at the Site. The following sections describe the objectives, locations, sample depths, and analytical methods for surface water sampling. Additional details regarding surface water sampling are provided in the MCP Section 3.3.

2.3.1 Objectives

The general objective of surface water sampling is similar to the purposes of the corresponding groundwater monitoring program. Pursuant to the RAP, surface water data are collected and evaluated to ensure continued protection of human health and the environment during implementation of the RA (DTSC, 1998); to evaluate impacts from hypothetical human exposure to surface water downgradient from the Yard; and to provide sufficient data for evaluation of remedy effectiveness.

2.3.2 Locations

A total of five surface water samples will be collected from Felicita Creek on a semiannual or annual basis. Surface water drainage pathways were identified based on data obtained during the RI and previous investigations. Specific sampling locations and other details regarding surface water sampling are provided in the MCP (Table 1; Figure 13).

2.3.3 Sample Depth

Surface water samples will be collected at depths of 0 to 2 inches below the top of the water surface.

2.3.4 Sample Frequencies

Surface water samples will be collected from Felicita Creek on a semiannual or annual basis. Details of the sampling schedule for Felicita Creek locations are provided in the MCP (Table 1; Figure 13).

2.3.5 Analytical Methods

Surface water samples will be analyzed for VOCs using EPA Method 8260B (Table A-1). In addition, surface water samples collected from a selected subset of locations will be analyzed for 1,4-dioxane using modified EPA Method 8260B.

2.4 CONDUCT SOIL VAPOR SAMPLING

Soil vapor sampling will be conducted at the Site. The following section describes the objective and rationale for soil vapor sampling. The rationale for soil vapor sampling includes locations and methods. A workplan for soil vapor sampling will be prepared and submitted to DTSC in advance of implementation of this task.

2.4.1 Objective

The objectives of soil vapor sampling are to provide additional data to further characterize the risk posed by volatilization of VOCs in groundwater to overlying soil vapor.

2.4.2 Locations

Under this task, soil vapor sampling locations would be determined in conjunction with DTSC.

2.4.3 Sample Depths

Under this task, soil vapor sampling depths would be determined in conjunction with DTSC.

2.4.4 Analytical Methods

Soil vapor samples will be analyzed for VOCs, including 1,4-dioxane, using Method TO-15.

2.5 INSTALL SHALLOW ZONE MONITOR WELL

The following sections describe the objective and rationale for the installation of a shallow zone monitor well at the Site, in the event that one or more shallow zone monitor wells are required.

2.5.1 Objective

The objective of installing an additional shallow zone monitor well, if required, is to provide data to further define the downgradient extent of VOC impact in the shallow zone at the Site. Hydrogeologic conditions will be evaluated based on lithologic data obtained during the installation of any additional shallow zone monitor well(s) and on water level and water quality data obtained from analysis of groundwater samples collected from a shallow zone monitor well.

2.5.2 Location

The location of any additional shallow zone monitor well(s), if required, would be proposed by the Group.

2.5.3 Depth

The completion interval of any shallow zone monitor well may vary based on subsurface lithology.

Shallow zone monitor wells are typically screened across or just below the water table. The length of the screened interval for shallow zone monitor wells is typically 20 feet, but screen lengths will be determined in conjunction with DTSC. The length of the screened interval may also be adjusted based on borehole lithology.

2.6 INSTALL DEEP ZONE MONITOR WELL

The following sections describe the objective and rationale for the installation of an additional deep zone monitor well, in the event that one or more deep zone monitor wells are required.

2.6.1 Objectives

The objective of installing an additional deep zone monitor well, if required, is to provide data to further define the downgradient extent of VOC impact in the deep zone. Hydrogeologic conditions will be evaluated based on lithologic data obtained during the installation of any additional deep zone monitor well(s) and on water level and water quality data obtained from laboratory analysis of groundwater samples collected from an additional deep zone monitor well.

2.6.2 Location

The location of any additional deep zone monitor well(s), if required, would be proposed by the Group.

2.6.3 Depth

Deep zone monitor wells are typically completed to a maximum depth of approximately 150 feet below land surface (bls). The completion depth of any additional deep zone monitor well(s) may vary based on subsurface lithology.

The length of the screened interval for deep zone monitor wells is typically 20 feet, but screen lengths will be determined in conjunction with DTSC. The length and depth of the screened interval may also vary based on lithology and production of groundwater from the borehole during drilling.

2.7 CONDUCT SURFACE SOIL SAMPLING

Additional surface soil sampling, if required, is considered an optional task. Soil sampling consists of collecting surface soil samples. The objective and rationale for surface soil sampling would be provided in the context of a workplan or SAP Addendum in the event that surface soil sampling is required.

2.8 SUBSURFACE SOIL SAMPLING

Additional subsurface soil sampling, if required, is considered an optional task. Soil samples collected from selected monitor well or other boreholes may be analyzed for engineering parameters to provide characterization of physical properties of soil at the Site, or for VOCs to characterize subsurface soils, if required. The objective and rationale for subsurface soil sampling would be provided in the context of a workplan or SAP Addendum in the event that subsurface soil sampling is required.

2.9 PERFORM HYDRAULIC TESTING

Hydraulic testing, if required, is considered an optional task. The objectives and rationale for hydraulic testing would be provided in the context of a workplan or SAP Addendum in the event that hydraulic testing is required.

3.0 METHODS AND PROCEDURES

The methods and procedures for the tasks included in Section 2.0 are briefly described in the following sections. Specific SOPs for many of these tasks are provided in Attachment A-1.

Borehole geophysical logs, if required, will be run in accordance with H+A SOPs and in accordance with the SOPs of the outside contractor selected to run the geophysical logs (Attachment A-1).

3.1 MEASURE WATER LEVELS

Water levels will be measured using calibrated two-wire electric water level indicators. Depth to water will be measured from surveyed reference points, if available. Water level elevations will be calculated as the difference between the surveyed or estimated reference point elevation and the depth to water for each well. Water level data will be recorded on preprinted water level data sheets (Appendix C). Water level measuring equipment will be decontaminated between measuring of wells. Methods and procedures for water level monitoring are detailed in the SOPs (Attachment A-1).

3.2 CONDUCT GROUNDWATER SAMPLING

Representative groundwater samples will be collected for chemical analysis. The temperature, pH and electrical conductivity (EC) of the purge water will be measured to ensure that they have stabilized prior to sampling. In addition, dissolved oxygen, oxidation-reduction potential, and turbidity of the purge water may be measured prior to sampling. Methods and procedures for collecting groundwater samples are detailed in the SOPs (Attachment A-1). The following sections briefly describe these methods and procedures.

3.2.1 Sample Collection

Existing and newly constructed monitor wells may be equipped with Grundfos® Redi-Flo 2 environmental electric submersible pumps for well purging. Groundwater samples will be collected through dedicated discharge tubing or using dedicated Teflon[®] bailers. The Grundfos® Redi-Flo 2 environmental pump is constructed of stainless steel and Teflon[®] components and is capable of discharging at variable rates of up to approximately 7 gallons per minute (gpm). A variable speed controller will be used to reduce the discharge rate prior to collecting samples. Groundwater samples will be collected in accordance with the SOPs (Attachment A-1). Analytical parameters, container requirements, preservatives, and holding time limits for groundwater samples have been summarized (Table A-1).

A minimum of three casing volumes of water will be purged from each monitor well prior to sampling if the well yields sufficient groundwater to remove three casing volumes within approximately 90 minutes. If the monitor well yield is insufficient, one casing volume will be purged. For deep monitor wells, if one casing volume cannot be purged within 90 minutes, the well will be purged until the water draws down to the pump intake (typically set at the top of the screen) and pumping will be discontinued. The well should be allowed to recover for 2 hours after purging has stopped. Then the well should be sampled as soon after 2 hours as possible.

3.2.2 Sample Containers, Preservation, and Transmittal

The types and volumes of sample containers used for groundwater sampling have been summarized (Table A-1).

Groundwater water sample containers will be clearly labeled with appropriate identification immediately after sample collection. Groundwater water samples for laboratory analysis will be stored on ice in an ice chest for transmittal to the analytical laboratory. A chain-of-custody record and analytical schedule will accompany each sample shipment to the laboratory. Sample control, sample handling, and chain-of-custody procedures will be performed in accordance with the SOPs (Attachment A-1).

3.2.3 Equipment Decontamination and Disposal Procedures

Prior to collecting groundwater samples, sample containers will be rinsed with sample water a minimum of three times to ensure that possible contaminants are removed, with the exception of containers that have been pretreated in the laboratory or prepared with a preservative.

Groundwater discharged during well purging and groundwater sample collection will be contained at the wellhead and transported to an on-Yard storage tank. Groundwater samples will be collected from monitor wells using bailers or pumps. Groundwater sampling using dedicated pumps will not require equipment decontamination. Nondedicated pumps and bailers used for well purging will be decontaminated in accordance with the SOPs (Attachment A-1).

3.2.4 Documentation

Documentation required for groundwater sample collection includes field data forms, sample labels, custody seals, and chain-of-custody records (Appendix C). Specific information regarding use of these records is included in the SOPs (Attachment A-1).

3.2.5 Quality Assurance

QA procedures for groundwater sample collection will be performed in accordance with the QAPP (Appendix B) and SOPs (Attachment A-1).

3.3 CONDUCT SURFACE WATER SAMPLING

Methods and procedures for collecting surface water samples are detailed in the SOPs (Attachment A-1). The following sections briefly describe these methods and procedures.

3.3.1 Sample Collection

Surface water samples will be collected for chemical analysis. EC, pH, and temperature of surface water will be measured prior to sampling. Surface water samples will be collected by hand-lowering the appropriate sample container into the upper 2 inches of the surface water. To prevent loss of preservative, it may be necessary to first fill a decontaminated jar from Felicita Creek, then fill sample vials from the jar. If a surface water sample cannot be collected by hand-lowering the appropriate sample container into the surface water, then the sample container will be attached to an extendable rod and a surface water sample will be collected.

Analytical parameters, container requirements, preservatives, and holding time limits for surface water samples have been summarized (Table A-1).

3.3.2 Sample Containers, Preservation, and Transmittal

The types and volumes of sample containers used for surface water sampling have been summarized (Table A-1). Surface water sample containers will be clearly labeled with appropriate identification immediately after sample collection. Surface water samples for laboratory analysis will be stored on ice in an ice chest for transmittal to the analytical laboratory. A chain-of-custody record and analytical schedule will accompany each sample shipment to the laboratory. Sample control, sample handling, and chain-of-custody procedures will be performed in accordance with the SOPs (Attachment A-1).

3.3.3 Equipment Decontamination and Disposal Procedures

Prior to collecting surface water samples, sample containers or nondedicated sample transfer jars will be rinsed with deionized water, followed by a rinse with sample water a minimum of three times. Decontamination is not necessary for containers that have been pretreated in the laboratory or prepared with a preservative.

3.3.4 Documentation

Documentation required for surface water sampling includes field data forms, sample labels, custody seals, and chain-of-custody records (Appendix C). Specific information regarding use of these records is included in the SOPs (Attachment A-1).

3.3.5 Quality Assurance

QA procedures for surface water sample collection will be performed in accordance with the QAPP (Appendix B) and SOPs (Attachment A-1).

3.4 CONDUCT SOIL VAPOR SAMPLING

Soil vapor sampling will be conducted at the Site. Soil vapor sampling will be conducted in accordance with DTSC Guidance (DTSC and California Regional Water Quality Control Board, Los Angeles Region, 2003) (Attachment A-2). The Group understands that a Draft Guidance Document is currently in review that may supersede the cited 2003 document (DTSC, 2010), and this updated guidance will be consulted once finalized by DTSC. The following sections briefly describe these methods and procedures. Specific locations, depths, objectives, and rationale for soil vapor sampling will be provided in the context of a workplan or SAP Addendum.

3.4.1 Sample Collection

Methods and procedures for collecting soil vapor samples are detailed in the SOPs for soil vapor sampling (Attachment A-2). Soil vapor samples will initially be collected at depths of 5 and 10 or 15 feet bls, if possible, but may vary based on depths to groundwater and bedrock at each sampling location. If it is not possible to install probes to target depths using direct-push equipment, probes will be installed by auger drilling.

The soil vapor probes will be installed using semi-permanent methodology. The semi-permanent probes will be outfitted with a small flush-mounted utility cover and an air tight

cap on the sample tubing. Nested soil vapor probes will be installed inside an auger boring with at least two nested casing/screened zones.

Soil vapor samples will be collected from the vapor probes. These soil vapor samples will either be analyzed using both a field laboratory and a fixed laboratory or using only the field laboratory. Soil gas samples will be analyzed for the standard Method TO-15 list of primary target chemical compounds. Analytical results will be presented in units of micrograms per liter. Sample collection methods, detection limits, and QA/QC will be in accordance with the referenced guidance (Attachment A-2).

Soil vapor sampling will be conducted using the following general procedures:

- All reusable sample probe installation equipment will be decontaminated prior to use.
- A purge volume test will be conducted at the first probe location, preferably where the highest VOC concentrations are expected. The flowrate will be maintained at a constant rate between 100 to 200 milliliters per minute. Samples will be collected at 1, 3, and 7 purge volumes and analyzed in the field laboratory. The sample with the highest concentration of tetrachloroethylene will be used to determine the "optimal" purge volumes for the remaining locations.
- After setting a driven probe, testing/sampling should not be conducted for 30 minutes. After setting a soil vapor probe installed using auger drilling methods, testing/sampling should not be conducted for at least 48 hours.
- Each probe will be purged using purge rate guidelines (Attachment A-2) and leak tested prior to collection of the soil vapor sample.
- If high vacuum/low flow conditions occur or no-flow conditions are observed at the target depth, the soil vapor probe can be advanced to a depth interval that is 2 feet deeper and the purging procedure repeated. If high vacuum/low flow conditions or no-flow conditions are also encountered at this deeper interval, contact the designated field oversight personnel for further direction. Low flow conditions have not previously been observed during soil vapor sampling at the Site, and are not anticipated.
- Soil vapor samples will be collected after the sample point has been properly purged.
- The sample handling and holding times will be followed (Table A-2).

3.4.2 Sample Containers, Preservation, and Transmittal

Soil vapor samples will be collected in laboratory-prepared clean glass syringes or Summa canisters (Table A-2). The required syringe or canister size will be determined in conjunction with the analytical laboratory, in order to meet required detection limits. If a mobile laboratory is used, soil vapor samples will be analyzed as soon as practicable. Summa canisters should be stored in a cool, dry location. Soil vapor sample containers will be clearly labeled with appropriate identifiers immediately after sample collection. If a fixed laboratory is used, a chain-of-custody record and analytical schedule will accompany each sample shipment to the laboratory. Sample control, sample handling, and chain-of-custody procedures will be performed in accordance with the SOPs for soil vapor sampling (Attachment A-2).

3.4.3 Equipment Decontamination and Disposal Procedures

Equipment used to drill or drive through soil and set soil vapor probes will be decontaminated in accordance with the SOPs (Attachment A-1). Rinsate water generated during decontamination will be containerized and handled in accordance with SOPs (Attachment A-1).

3.4.4 Documentation

Documentation required for soil vapor sample collection includes field data forms and chain-of-custody records (Appendix C). Information regarding use and handling of these records is included in the SOPs for soil vapor sampling (Attachment A-2).

3.4.5 Quality Assurance

QA procedures for soil vapor sample collection will be performed in accordance with the QAPP (Appendix B) and SOPs for soil vapor sampling (Attachment A-2).

3.5 INSTALL MONITOR WELLS

Methods and procedures for monitor well construction, if required, are detailed in the SOPs (Attachment A-1). The following sections briefly describe these methods and procedures.

3.5.1 Drilling and Construction

Monitor wells will be constructed using conventional hollow-stem auger or air percussion techniques, as appropriate. Air drilling techniques use pressurized air to remove rock cuttings during drilling.

3.5.1.1 Shallow Zone Monitor Well

Additional shallow zone monitor wells, if required, will be drilled using hollow-stem auger drilling techniques or, if shallow refusal is encountered, air percussion drilling technique. An approximate 10-inch diameter borehole will be advanced from land surface to the total depth of the shallow zone monitor well. The shallow zone monitor well will be constructed using 4-inch diameter polyvinyl chloride (PVC) well casing and 0.020-inch factory-slotted well screen. The length of the screened interval for any shallow zone well is typically 20 feet and may be adjusted by the on-site hydrogeologist based on the lithology encountered in the boring. The shallow zone monitor well will be filter packed with 1C or similar Lonestar sand. Screen slot size and filter pack size may be modified based on physical examination of lithologic samples. Emplacement procedures for well screen, well casing, filter pack, and annular seal are detailed in the SOPs (Attachment A-1).

3.5.1.2 Deep Zone Monitor Well

Additional deep zone monitor wells, if required, will be drilled using air percussion drilling techniques. Deep zone monitor wells are typically screened to a maximum depth of approximately 150 feet bls. The length of screened interval for deep zone monitor wells is typically 20 feet. The screened interval will be determined based on water level data obtained from existing nearby wells prior to commencing drilling, and on water production, water level, and lithologic data obtained during drilling. The screened interval may be adjusted by the on-site hydrogeologist. Steel

conductor casing may be emplaced during the installation of an additional deep zone monitor well to prevent cross-contamination, if needed. In addition, a steel surface casing may be installed to prevent soil caving during drilling. Emplacement procedures for steel conductor casing are detailed in the SOPs (Attachment A-1).

Deep zone monitor wells are typically constructed using 4-inch diameter PVC well casing and 0.040-inch factory-slotted well screen. Any additional deep zone monitor wells will be filter packed with medium aquarium or similar sand. Screen slot size and filter pack size may be modified based on physical examination of lithologic samples collected during drilling. Emplacement procedures for well screen, well casings, filter pack, and annular seals are detailed in the SOPs (Attachment A-1).

3.5.2 Well Development

Newly constructed monitor wells drilled using hollow stem auger drilling techniques will be developed initially during emplacement of the filter pack. Newly constructed monitor wells drilled using air percussion drilling techniques will be developed initially within approximately 48 hours after monitor well completion. Final development of newly constructed monitor wells will occur within approximately 2 weeks using a combination of conventional bailing, surging, air-lifting and pumping techniques. Temperature, pH, and EC will be monitored during final monitor well development in accordance with the SOPs (Attachment A-1).

Water generated during well development will be containerized at each well location and transferred to on-Yard storage tanks. Procedures for handling, characterization, and disposal of wastes are detailed in the SOPs (Attachment A-1).

3.5.3 Pump Selection and Installation

Groundwater samples may be collected from monitor wells using either bailers or electrical pumps. If pumps are used for either purging or sampling, any additional deep monitor wells may be equipped with dedicated Grundfos® Redi-Flo 2 environmental electric submersible pumps. Pumps will be set manually with Teflon[®]-lined discharge tubing and supported from the wellhead with stainless steel cable. Dedicated pumps installed in deep zone monitor wells will be set

approximately three feet above the top of the screen. Nondedicated pumps installed in shallow zone monitor wells will be set approximately two feet off the bottom of the screened interval, and will be equipped with dedicated discharge tubing.

3.5.4 Handling of Drill Cuttings and Drilling Fluid

Drill cuttings will be separated to the extent practical during drilling and construction of additional monitor wells. Drill cuttings will be collected and transferred to on-Yard storage bins. Procedures for handling, characterization, and disposal of drill cuttings are detailed in the SOPs (Attachment A-1).

3.5.5 Equipment Decontamination

Equipment will be decontaminated between drilling, sampling, and development of monitor wells in accordance with the SOPs (Attachment A-1).

Monitor well construction material, including PVC well screen and well casing, centralizers, fittings, pumps, pump discharge tubing, and other downhole equipment used to construct all additional monitor wells, will be steam cleaned or cleaned using a non-phosphate soap wash and distilled water rinse. Vendors will provide precleaned monitor well supplies wrapped in plastic. Monitor well construction supplies will be housed in a storage container at the Yard.

3.5.6 Documentation

Documentation required for monitor well and piezometer construction includes field data forms, lithologic logs, and schematic monitor well and piezometer construction diagrams (Appendix C). Information regarding use and handling of these records is included in the SOPs (Attachment A-1).

3.5.7 Quality Assurance

QA procedures for monitor well construction will be performed in accordance with the QAPP (Appendix B) and SOPs (Attachment A-1).

3.6 CONDUCT SURFACE SOIL SAMPLING

Methods and procedures for collecting surface soil samples, if required, are detailed in the SOPs (Attachment A-1).

3.7 CONDUCT SUBSURFACE SOIL SAMPLING

Methods and procedures for collecting subsurface soil samples, if required, are detailed in the SOPs (Attachment A-1).

3.8 PERFORM HYDRAULIC TESTING

Methods and procedures for aquifer testing, slug testing, and core sampling, if required, are detailed in the SOPs (Attachment A-1).

4.0 REFERENCES CITED

- California Environmental Protection Agency, Department of Toxic Substances Control (DTSC), 1998. <u>Chatham Brothers Barrel Yard, Remedial Action Plan</u>. January 1998.
- _____, 1999. Consent Decree between the Department of Toxic Substances Control and Settling Parties. February 5, 1999.
- _____, 2010. Advisory Active Soil Gas Investigation. Draft for Review, March 2010.
- California Environmental Protection Agency, Department of Toxic Substances Control (DTSC) and California Regional Water Quality Control Board, Los Angeles Region, 2003. <u>Advisory –</u> <u>Active Soil Gas Investigations</u>. January 28, 2003.
- Hargis + Associates, Inc. (H+A), 2005. <u>Remedial Design Sampling and Analysis Plan, Chatham</u> <u>Site, Escondido, California</u>. April 26, 1999; Revised February 28, 2005.

_____, 2009. <u>Site Health and Safety Plan, Remedial Design/Remedial Action, Chatham Site,</u> <u>Escondido, California, Revision 4.0.</u> March 4, 2009.

TABLE A-1

HANDLING PROTOCOL FOR GROUNDWATER AND SURFACE WATER SAMPLES

ANALYTE	EPA METHOD	SAMPLE CONTAINER	OTHER REQUIREMENTS	PRESERVATION METHOD	MAXIMUM HOLDING TIME
PRIMARY ANALYSES VOLATILE ORGANIC COMPOUNDS	8260B	3 X 40 ml VOA VIAL, TEFLON LINED SEPTUM	VIALS FILLED COMPLETELY, NO HEAD SPACE	HCI, COOL TO 4°C	14 DAYS
<u>1,4-DIOXANE</u>	8260B, MODIFIED	3 X 40 mI VOA VIAL, TEFLON LINED SEPTUM	VIALS FILLED COMPLETELY, NO HEAD SPACE	HCI, COOL TO 4°C	14 DAYS

FOOTNOTES

°C = degrees Celsius EPA = U.S. Environmental Protection Agency HCI = Hydrochloric Acid ml = Milliliter VOA = Volatile Organic Analysis

TABLE A-2

HANDLING PROTOCOL FOR SOIL AND SOIL VAPOR SAMPLES

					PRESERVATION	
ANALYTE	MATRIX	EPA METHOD	SAMPLE CONTAINER	SAMPLE VOLUME	METHOD	MAXIMUM HOLDING TIME
VOLATILE ORGANIC COMPOUNDS (Soil Vapor Sampling)	SOIL VAPOR	TO-15	SUMMA [®] CANISTER or GLASS SYRINGE	400 MILLILITER 50 MILLILITER	STORE IN COOL, DRY LOCATION	14 DAYS
(Sample Preparation per EPA Method 5035)	SOIL	8260B	EN CORE [®] FIELD SUBSAMPLING CONTAINER	MINIMUM OF 3 EN CORE [®] SAMPLERS	COOL TO 4°C	EXTRACTION OR LABORATORY PRESERVATION WITHIN 48 HOURS AFTER SAMPLE COLLECTION
Moisture Content Particle Size Distribution Specific Gravity Bulk Density	SOIL	NA	2-INCH X 3-INCH OR 6-INCH BRASS TUBE, AS NEEDED TO LINE SAMPLE BARREL	BRASS TUBE, FILLED COMPLETELY	NA	NA

FOOTNOTES

EPA = U.S. Environmental Protection Agency °C = Degrees Celsius NA = Not applicable



FIGURE A-1. REGIONAL SITE LOCATION



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EXPLANATION







ATTACHMENT A-1

STANDARD OPERATING PROCEDURES



ATTACHMENT A-1

STANDARD OPERATING PROCEDURES

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A1-1 SCHEMATIC WELL CONSTRUCTION DIAGRAM



ACRONYMS AND ABBREVIATIONS

ASTM	American Society for Testing and Materials					
bls	below land surface					
DO	dissolved oxygen					
DTSC	California Environmental Protection Agency, Department of Toxic Substances Control					
EC	electrical conductivity					
EPA	U.S. Environmental Protection Agency					
GRS	Groundwater Remediation System					
H+A	Hargis + Associates, Inc.					
ID	internal diameter					
MCP	Monitoring and Contingency Plan					
ml	milliliter					
ORP	oxidation-reduction potential					
PVC	polyvinyl chloride					
QA	quality assurance					
QC	quality control					
QAPP	Quality Assurance Project Plan					
SAP	Sampling and Analysis Plan					
SOP	standard operating procedure					
USCS	Unified Soil Classification System					
VOCs	volatile organic compounds					



ATTACHMENT A-1

STANDARD OPERATING PROCEDURES

1.0 INTRODUCTION

Field activities covered by the Sampling and Analysis Plan (SAP) include planned, contingent, and optional tasks. Planned field activities to be conducted under this SAP include the following, although they are not listed in the order they will be performed.

- Measure Water Levels
- Conduct Groundwater Sampling
- Conduct Surface Water Sampling
- Perform Soil Vapor Sampling (Note: Standard Operating Procedures (SOPs) for this task are not included since California Environmental Protection Agency, Department of Toxic Substances Control (DTSC)/California Regional Water Quality Control Board SOPs will be followed.)

These planned activities also include the following activity:

Measure Water Quality Parameters

The following contingent tasks have been identified, and will be conducted, if required, under provisions of the Monitoring and Contingency Plan (MCP):

- Install Shallow Zone Monitor Well
- Install Deep Zone Monitor Well

These contingent tasks also include the following activities:

- Lithologic Logging
- Geophysical Logging
- Handling, Storage, Characterization and Disposal of Investigation-Derived Wastes

The following optional tasks are not anticipated to be required, but are retained for completeness in the event that the scope of the project is modified.

- Conduct Surface Soil Sampling (optional task)
- Conduct Subsurface Soil Sampling (optional task)
- Perform Hydraulic Testing (optional task)

The following sections describe the SOPs previously outlined.



2.0 WATER LEVEL MEASUREMENT

2.1 GENERAL STATEMENT

Water levels will be measured in monitor wells, piezometers and regional wells using a QED® or Solinst® flat tape electric water level sounder, unless physical obstructions necessitate another method of water level measurement. Water levels may be measured as part of groundwater sample collection, water level monitoring, or, if required, hydraulic testing.

2.2 OBJECTIVE

Water levels will be measured in monitor wells, piezometers, and regional wells. Resulting depth to water data will be recorded and used in conjunction with surveyed measuring point elevation data, if available, to construct water level contour maps for the hydrogeologic units of interest. These maps will be used to interpret groundwater flow conditions and to determine horizontal and vertical gradients in monitor wells in the vicinity of the site. The water level contour maps will also be used to aid in evaluating the distribution and movement of volatile organic compounds (VOCs) in groundwater.

2.3 EQUIPMENT AND/OR INSTRUMENTATION

The QED® or Solinst® flat tape sounder is equipped with a plastic, laminated, two-wire cable with a weighted electrode attached to the end of the cable. The cable is graduated in markings every 0.01 foot.

If required for access, an electrical sounder equipped with a narrower probe may be used for water level measurement. Sounders manufactured by Slope Indicator Co. may be used at regional wells with small sounding ports. These sounders function in a similar manner to flat tape sounders.

2.4 PREPARATION

Water level indicators, including QED® or Solinst® flat tape sounders, will be calibrated periodically by comparing a water level measured with the indicator against a water level measured with a steel tape or other water level indicator and by checking the distances between the water level indicator markings with a steel tape.

The following procedures will be performed in preparation for measuring water levels in wells:

- .. Identify the wells to be measured;
- .. Identify the established measuring point for each well. The measuring point elevation will be determined by a licensed land surveyor. Measuring points not surveyed may be estimated using County of San Diego topographic maps. The same measuring point should be used for all water level measurements at each well;
- .. Review previous water level measurements for each well; and
- .. Decontaminate the water level indicator by using a nonphosphate detergent wash, followed by two tap water rinses and a distilled water rinse. For regional wells, decontaminate the water level indicator by rinsing with a dilute chlorine bleach solution followed by a distilled water rinse.

2.5 PROCEDURES

The following procedures will be used for measuring water levels in wells:

- .. Measure the depth to water from the measuring point elevation twice for each well. The variation between the two consecutive measurements must be no more than 0.02 foot.
- .. For the QED®, Solinst® or Slope Indicator® sounder, mark the water level and read the measurement from the marking on the flat tape or sounder wire.
- .. Record the depth to water, date, and time of measurement on the static water level data sheet (Appendix C). Examine previously measured water levels for the well. If the difference between the current water level measurement and the previous water level measurement is greater than approximately 2.0 feet, recheck the current measurement. The field technician will indicate the method(s) of water level measurement and any rechecked water levels on the water level measurement form.
- .. Remove water level measurement equipment and decontaminate according to procedures outlined below.

2.6 EQUIPMENT DECONTAMINATION AND WASTE DISPOSAL

Water level indicators will be decontaminated between monitor wells or piezometers to be sampled during the monitoring round by using a nonphosphate detergent and chlorine bleach wash, followed by a tap water rinse and a final, distilled water rinse. Water level indicators will be

decontaminated between monitor wells or piezometers not sampled during the monitoring round by using a distilled water rinse. Water level indicators will be decontaminated between regional wells using a chlorine bleach/water rinse and a final, distilled water rinse.

2.7 DOCUMENTATION

All water level measurements will be recorded on a static water level data sheet (Appendix C). The reported data will include depth to water in feet below the measuring point, a description of the measuring point, the date and time of the measurement, the calculated water level elevation, the method of measurement, and the initials of field personnel. Water level measurements will be reported to the nearest 0.01 foot.

Calibration of the water level indicators will be documented on a separate form (Appendix C).

2.8 QUALITY ASSURANCE

Quality Assurance (QA) of water level measurement data will be accomplished by following the procedures described in this standard operating procedure (SOP) document. Calibration information will be entered onto a calibration form. In addition, the following QA procedures for water level measurements will be implemented:

- .. Measure water levels with a calibrated water level indicator. Prior to measuring water levels, verify that the instruments are properly calibrated.
- .. At each location and/or time interval, measure water levels a minimum of two times during routine water level measurement activities. Measure water levels until two consecutive measurements are obtained that have a difference of less than 0.02 foot. An experienced field technician will determine which measurement to record. Record the measurement on the static water level data sheet (Appendix C). Measure and record water levels to the nearest 0.01 foot.
- .. Compare measurement data to previous measurements obtained at the well. For variations from previous measurements greater than 2.0 feet or for data that cannot be explained by trends, repeat the measurements. If possible, use an alternative instrument to verify the accuracy of the data. Indicate the method(s) of water level measurement, the water level indicator, and any rechecked water levels in the comments section on the static water level data sheet (Appendix C).



3.0 GROUNDWATER SAMPLE COLLECTION

3.1 GENERAL STATEMENT

Representative groundwater samples will be collected for chemical analysis. The water quality parameters temperature, pH, and electrical conductivity (EC) will also be measured to ensure that they have stabilized prior to collecting samples. Results of water quality analysis will be used to determine the chemical characteristics of the groundwater. Groundwater samples will be analyzed for VOCs using U.S. Environmental Protection Agency (EPA) Method 8260B. Groundwater samples from selected wells will also be analyzed for 1,4–dioxane using modified EPA Method 8260B.

3.2 OBJECTIVE

In general, data resulting from the collection and analysis of groundwater samples will be used to monitor the distribution of VOCs in groundwater at the site. The objectives of groundwater sample collection are specified in the text of the MCP.

3.3 EQUIPMENT AND/OR INSTRUMENTATION

Sample containers required for collection of groundwater samples for chemical analysis have been specified. Well purging equipment for shallow zone, deep zone, and deeper monitor wells will consist of either stainless steel Grundfos® Redi-flo 2 electric submersible pumps or bailers. Well purging equipment for active regional wells will consist of the submersible pump installed in each well.

3.4 PREPARATION

The project coordinator will notify the DTSC of sampling events as specified in the Consent Decree. Prior to commencing a sampling event, the following information will be determined and reviewed with all field personnel:

- .. objective of the monitoring event;
- .. analytical schedule;
- .. water quality parameters to be measured;
- .. required frequency of measurement;
- .. laboratory selected for sample analysis;
- .. level of precision required;
- .. appropriate methodologies to accomplish objective; and

The following procedures will be used during preparation for groundwater sample collection:

- .. Review project objectives, sampling location, sampling procedures, preservation, special handling requirements, packaging, shipping, analytical parameters and detection limits, and sampling schedule with all personnel;
- .. Review the health and safety procedures with field personnel;
- .. Follow site access procedures, if applicable;
- .. Inform laboratory of expected sample shipment and arrange for courier, if applicable;
- .. Obtain the appropriate sample bottles from the laboratory;
- .. Obtain from the laboratory trip blank water vials containing organic-free water for VOC analyses at a rate of three vials for each ice chest containing samples for VOC analysis. Trip blanks will be prepared by the laboratory using organic-free water. The purpose of the trip blanks is to identify potential contamination associated with container preparation and sample transport; and
- .. Determine the volume of water to be removed prior to sampling.

3.5 PROCEDURES

The following procedures will be used for the collection of groundwater samples:

- Measure depth to water in well to be sampled (Section 2.0).
- Determine the volume of water to be purged from the monitor well. One purge volume is determined by multiplying the volume of water in 1 foot of monitor well casing by the distance between the bottom of the monitor well and the water level measured in the monitor well.
- Purge the monitor well until at least three casing volumes have been removed and the field parameter measurements pH, EC, and temperature have stabilized provided that the well yields sufficient groundwater to remove three casing volumes within approximately 90 minutes. Measure the water quality parameters at least twice per each casing volume to determine whether parameters have stabilized (Section 5.0). In the event that a monitor well's yield is insufficient, one casing volume will be purged. For deep monitor wells, if one casing volume cannot be purged within 90 minutes, purge the well until the water draws down to the pump intake (typically set at the top of the screen) and discontinue pumping. The well



should be allowed to recover for 2 hours after purging has stopped. Then the well should be sampled as soon after 2 hours as possible.

- After purging is complete, collect water samples for laboratory analysis.
- Record the following information on the field data sheet:
 - .. static depth to groundwater;
 - .. time that bailing or pumping is started;
 - .. time of sample collection;
 - .. number of containers collected and analyses to be performed;
 - .. field parameter measurements for each purge volume;
 - .. field parameter measurements at time of sampling;
 - .. physical characteristics of the water including color, odor, turbidity, etc.;
 - .. total gallons removed at time of sampling; and
 - .. total gallons removed at end of sampling.
- Collect water samples in appropriate sample containers from the bailer or pump discharge.
- Attach labels to sample containers immediately after samples are collected.
- Collect headspace-free water samples for VOC analyses in preacidified 40-milliliter (ml) glass sample vials preserved with hydrochloric acid. Do not rinse the glass vials with discharge water prior to sample collection. To avoid aeration, hold the glass vial at an angle so the stream of water flows down the side. To eliminate any air bubbles, fill the vial until it forms a meniscus and replace the Teflon-lined cap. Turn the vial upside down and tap it to check for air bubbles. If there is any headspace in samples collected for VOC analyses, discard the original vial and use a new pre-acidified vial. Repeat this procedure until a sample without headspace is obtained.
- Collect three 40-ml vials for each VOC analysis for each well sampled. Place samples in a resealable plastic bag and store on ice in an ice chest immediately after collection.
- Include one trip blank sample containing organic-free water for VOC analysis to accompany each ice chest shipped each day for these analyses. The trip blanks will be prepared by the primary analytical laboratory, using organic-free water.
- Prepare split samples for DTSC or other agencies during groundwater sampling, if required, by alternately filling agency and Hargis + Associates, Inc. (H+A) sample containers in sequential order for each parameter until all containers are filled.
- Handle any trip blank water samples in a manner identical to other water samples.
- Record all pertinent data concerning each sample on the groundwater sampling information field data form (Appendix C).
- Record all pertinent data concerning any trip blank samples on the appropriate field data log form (Appendix C).
- Complete chain-of-custody record at each sample location prior to sampling at the next well.
- Prepare and finalize chain-of-custody record (Appendix C) at the completion of each sampling event.
- Package, store, and transport the samples to the laboratory at the conclusion of each sampling day. Samples will be delivered to the laboratories within approximately 24 hours of sample collection, if possible.

3.6 SAMPLE CONTAINERS, PRESERVATION, AND TRANSMITTAL

A list of the types and volumes of sample containers used for groundwater sampling has been prepared (Appendix A, Table A-1). The laboratory will prepare the 40-ml glass vials and septa used to collect samples for VOC analysis. The vials will be washed with detergent, rinsed with organic-free water, and dried 1 hour at 105 degrees Celsius. Vials to be used for VOC analysis will be preserved with hydrochloric acid. These vials will not be rinsed with sample water prior to collection of samples.

Upon collection, all samples will be sealed with custody seals, labeled, and stored on ice in ice chests until received by the laboratory. Sample shipments will contain completed chain-of-custody records stored in resealable plastic bags for shipment to the laboratory (Appendix C). If not delivered directly to laboratory personnel, each ice chest containing samples will be clearly labeled and sealed to prevent tampering. Standard sample control and chain-of-custody procedures will apply.

3.7 EQUIPMENT DECONTAMINATION AND DISPOSAL

Water generated during decontamination procedures will be containerized and stored at the Yard. Spent health and safety equipment will be containerized and stored at the Yard.

Purge water from the monitor wells will be contained at the wellhead and transported to a storage tank at the Yard. Purge water and decontaminated water will be treated using the groundwater treatment system. Spent health and safety equipment will be properly disposed.

3.8 DOCUMENTATION

A record of sample identification numbers will be maintained on standardized field data forms (Appendix C). Additional field data include a record of significant events, observations, measurements, personnel, site conditions, sampling procedures, measurement procedures, and calibration records.

All field data entries in the field notebook will be signed, dated, and kept as a permanent record. Erroneous entries will be corrected by crossing a line through the error and entering the correct information. Corrections will be initialed by field personnel making the re-entry.

Sample identification documents will be prepared so that sample identification and chain-of-custody are maintained and sample disposition is controlled. The following sample identification documents are to be used:

- .. sample identification labels (Appendix C); and
- .. chain-of-custody records (Appendix C).

Standard sample identification labels and chain-of-custody records will be used to record all information. Sample documentation forms and labels will be completed with waterproof ink. The sample documentation forms will accompany the samples to the laboratory. Copies of the sample documentation forms will be retained by the samplers and sent directly to the H+A Project Manager.

Preprinted adhesive sample labels will be secured to the sample containers by field personnel. The following information will be recorded on the sample label:

- .. sample location/identifier;
- .. depth at which sample was collected, if applicable;
- .. date and time sample was collected;
- .. analyses to be performed;
- .. preservation instructions;
- .. project number;
- .. sampler's initials;
- .. any other pertinent information; and
- .. any special instructions to laboratory personnel.

Official custody of samples will be maintained and documented from the time of sample collection until the validation of analytical results. The chain-of-custody record is the document that records the transfer of sample custody. The chain-of-custody record also serves to cross-reference the sample identifier assigned by the H+A Field Task Manager with the sample identifier assigned by the laboratory. The chain-of-custody record includes the following information:

- .. sample location/identifier;
- .. project number;
- .. sampling date;
- .. sampling personnel;
- .. shipping method;
- .. sample description;
- .. sample volume;
- .. number of containers;
- .. sample destination;
- .. preservatives used;
- .. analyses to be performed;
- .. special handling and reporting procedures; and
- .. the identity of personnel relinquishing and accepting custody of the samples.

The sampling personnel will be responsible for the samples and will sign the chain-of-custody record to document sample transferral or transport. Samples will be packaged in sealed containers for transport and dispatched to the appropriate laboratory for analysis with a chain-of-custody record accompanying each shipment. The method of transport, courier name(s), and other pertinent information will be entered on the chain-of-custody record accompanying the samples. During transport, samples will be accompanied by the chain-of-custody record.

Once received at the laboratory, laboratory custody procedures apply. It is the laboratory's responsibility to acknowledge receipt of samples and verify that the containers have not been opened or damaged. It is also the laboratory's responsibility to maintain custody and sample tracking records throughout sample preparation and analysis. A copy of the chain-of-custody record is then sent to the H+A Project Manager.

3.9 QUALITY ASSURANCE

QA for groundwater samples collected during routine groundwater monitoring will be accomplished by following the procedures described in this SOP and by monitoring laboratory QA procedures. In addition, the following field QC methods will be implemented during sample collection:

.. Include one trip blank sample containing organic-free water for VOC analyses to accompany each ice chest shipped each day for these analyses. The trip blanks will be prepared by the analytical laboratory using organic-free water. The purpose of the trip blank is to identify possible contamination associated with container preparation and sample transport.

- .. Prepare split samples for DTSC or other agencies during groundwater sampling, if required, by alternately filling agency and H+A sample containers in sequential order for each parameter until all containers are filled.
- .. Identify any trip blank samples, if required, in the same manner as all other samples. Identifiers will be determined prior to the sampling round and will be indicated to field sampling personnel prior to the start of sampling activities.



4.0 SURFACE WATER SAMPLE COLLECTION

4.1 GENERAL STATEMENT

Representative surface water samples will be collected for chemical analysis. Samples will be analyzed for VOCs using EPA Method 8260B. Samples collected from selected surface water sample locations will also be analyzed on an annual basis for 1,4-dioxane using modified EPA Method 8260B.

4.2 OBJECTIVE

In general, data resulting from the collection and analysis of surface water samples will be used to monitor the impact of VOCs to Felicita Creek. The objectives of surface water sample collection are specified in the text of the MCP.

4.3 EQUIPMENT AND/OR INSTRUMENTATION

Sample containers required for collection of surface water samples for chemical analyses will be hand-lowered 0 to 2 inches below the top of the surface water. To prevent loss of preservative, it may be necessary to first fill a dedicated or decontaminated jar from Felicita Creek, then fill sample vials from the jar. If surface water samples cannot be collected by hand-lowering the sample containers into the surface water, then the sample container will be attached to an extendible rod and a surface water sample will be collected.

4.4 PREPARATION

Prior to commencing a sampling event, the following information will be determined and reviewed with all field personnel:

- .. objective of surface water sampling;
- .. analytical schedule;
- .. required frequency of sample collection;
- .. laboratory selected for analysis of samples;
- .. level of precision required;
- .. appropriate methodologies to accomplish objective; and

The following procedures will be used during preparation for surface water sample collection:

- .. Review project objectives, sampling location, sampling procedures, preservation, special handling requirements, packaging, shipping, analytical parameters and detection limits, and sampling schedule with all personnel.
- .. Review health and safety procedures with field personnel.
- .. Follow site access procedures, if applicable.
- .. Inform laboratory of expected sample shipment and arrange for courier, if applicable.
- .. Obtain laboratory-cleaned and preserved sample vials.

4.5 PROCEDURES

The following procedures will be used for collection of surface water samples:

- Note time of sample collection.
- Hand-lower sample container or decontaminated transfer jar into surface water.
- Fill containers as appropriate.
- If unable to collect surface water sample by hand-lowering the sample container into the surface water, then an extension rod will be used to extend the sample container into the surface water.
- Record the following information on the field data sheet (Appendix C):
 - time of sample collection;
 - .. number of containers collected and analyses to be performed;
 - .. parameters of the water including pH, EC and temperature; and
 - .. physical characteristics of the water including color, odor, and turbidity.
- Attach labels to sample containers immediately after samples are collected.
- Collect surface water samples for VOC analysis in three 40-ml glass vials preserved with hydrochloric acid. Store on ice in an ice chest immediately after collection.
- Prepare split samples for DTSC or other agencies during surface water sampling, if required, by alternately filling agency and H+A sample containers in sequential order for each parameter until all containers are filled.

- Record all pertinent data concerning each sample on the surface water sampling field data form (Appendix C).
- Record all pertinent data concerning any trip blank on the appropriate field data log form (Appendix C).
- Record chain-of-custody documentation at each sample location prior to sampling at the next location.
- Prepare and finalize chain-of-custody documentation at the completion of each sampling event.
- Package, store, and transport the samples to the laboratory at the conclusion of each sampling day.

4.6 SAMPLE CONTAINERS, PRESERVATION, AND TRANSMITTAL

Upon collection, all samples will be sealed with custody seals, labeled, and stored on ice in ice chests until received by the laboratory. Sample shipments will contain completed chain-of-custody records stored in resealable plastic bags for shipment to the laboratory. If not delivered directly to laboratory personnel, each ice chest containing samples will be clearly labeled and sealed to prevent tampering.

4.7 EQUIPMENT DECONTAMINATION AND DISPOSAL

Prior to collecting surface water samples, sample containers or nondedicated sample transfer jars will be rinsed with deionized water, followed by a rinse with sample water a minimum of three times to ensure that possible contaminants are removed. Decontamination is not necessary for containers that have been pretreated in the laboratory or prepared with a preservative.

4.8 DOCUMENTATION

A record of sample identification numbers will be maintained on standardized field data forms (Appendix C). Additional field data include a record of significant events, observations, measurements, personnel, site conditions, sampling procedures, measurement procedures, and calibration records.

All entries of field data in the field notebook will be signed, dated, and kept as a permanent record. Erroneous entries will be corrected by crossing a line through the error and entering the correct information. Corrections will be initialed by field sampling personnel making the re-entry.

Sample identification documents will be prepared so that sample identification and chain of custody are maintained and sample disposition controlled. The sample identification documents to be used are:

- .. sample identification labels (Appendix C); and
- .. chain-of-custody records (Appendix C).

Standard sample identification labels and chain-of-custody documents will be used to record all information. Sample documentation forms and labels will be completed with waterproof ink. The sample documentation forms accompany the samples to the laboratory. Copies of the sample documentation forms will be retained by the samplers and sent directly to the H+A Project Manager.

Preprinted adhesive sample labels will be secured to the sample containers by field personnel. The following information will be recorded on the sample label:

- .. sample location/identifier;
- .. depth at which sample was collected, if applicable;
- ... date and time sample was collected;
- .. analyses to be performed;
- .. preservation instructions;
- .. project number;
- .. sampler's initials;
- .. any other pertinent information; and
- .. any special instructions to laboratory personnel.

Official custody of samples will be maintained and documented from the time of sample collection until the validation of analytical results. The chain-of-custody record is the document that records the transfer of sample custody. The chain-of-custody record also serves to cross-reference the sample identifier assigned by the H+A Field Task Manager with the sample identifier assigned by the laboratory. The chain-of-custody record includes the following information:

- .. sample location/identifier;
- .. project code;
- .. sampling date;
- .. sampling personnel;
- .. shipping method and date;
- .. sample description;
- .. sample volume;
- .. number of containers;
- .. sample destination;
- .. preservatives used;
- .. analyses to be performed;
- .. special handling and reporting procedures; and
- .. the identity of personnel relinquishing and accepting custody of the samples.

The sampling personnel will be responsible for the samples and will sign the chain-of-custody record to document sample transferral or transport. Samples will be packaged in sealed containers for transport and dispatched to the appropriate laboratory for analysis with a chain-of-custody record accompanying each shipment. The method of transport, courier name(s), and other pertinent information will be entered on the chain-of-custody record accompanying the samples. During transport, samples will be accompanied by the chain-of-custody record.

Once received at the laboratory, laboratory custody procedures apply. It is the laboratory's responsibility to acknowledge receipt of samples and verify that the containers have not been opened or damaged. It is also the laboratory's responsibility to maintain custody and sample tracking records throughout sample preparation and analysis. A copy of the chain-of-custody record is then sent to the H+A Project Manager.

4.9 QUALITY ASSURANCE

QA for surface water samples will be accomplished by following the procedures described in this SOP and by monitoring laboratory QA procedures. In addition, the following field quality control methods will be implemented during sample collection:

- .. Include one trip blank sample containing organic-free water for VOC analysis to accompany each ice chest shipped each day for these analyses. Trip blanks will be prepared by the analytical laboratory using organic-free water. The purpose of the trip blank is to identify possible contamination associated with container preparation and sample transport.
- .. Prepare split samples for DTSC or other agencies during surface water sampling, if required, by alternately filling agency and H+A sample containers in sequential order for each parameter until all containers are filled.
- .. Identify any trip blanks in the same manner as all other samples. Identifiers will be determined prior to the sampling round and will be indicated to field sampling personnel prior to the start of sampling activities.



5.0 WATER QUALITY PARAMETER MEASUREMENTS

5.1 GENERAL STATEMENT

Prior to collecting groundwater samples for laboratory analysis, the water quality parameters EC, pH, and temperature will be measured in water samples at each sampling location using a conductivity meter, a pH meter, and a field thermometer, respectively. In addition, dissolved oxygen (DO), oxidation-reduction potential (ORP), and turbidity may be measured prior to sampling using a DO meter or colorimetric kit, an ORP tester, and a turbidity meter, respectively. Instruments that combine some or all of these parameter measurements may also be used.

5.2 OBJECTIVE

Water quality parameters will be measured to evaluate general water chemistry of the water sample. Stabilization of the parameters EC, pH, and temperature will be indicative of representative water from the aquifer or water source of study.

5.3 EQUIPMENT AND/OR INSTRUMENTATION

Water samples will be directed through a flow-through chamber or, if necessary, placed in a transfer bottle for measurement. Field equipment consists of a conductivity meter to measure EC, a pH meter to measure pH, a field thermometer to measure temperature, a DO meter to measure DO, an ORP tester to measure ORP, and a turbidity meter to measure turbidity. Some of these measurements are available as functions of an integrated instrument or "multi-meter".

5.4 PREPARATION

The probes on the conductivity meter, pH meter, DO meter, and ORP tester will be thoroughly rinsed with distilled water prior to each use. The pH meter will be calibrated in pH 4 and pH 10 buffered solutions prior to commencing field work each day. These pH values are expected to bracket the range of pH in groundwater samples collected from monitor wells at the site. The conductivity meter will be calibrated prior to commencing field work each day. The conductivity meter will be calibrated using standard calibration solutions selected to bracket the range of conductivity expected in water samples collected at the Site. The manufacturers' instructions for use of the instruments will be followed. The field thermometer will be rinsed with distilled water prior to each use. The accuracy of the field thermometer will be determined by checking the measured reading against other thermometers, if available.

5.5 PROCEDURES

A water sample will be directed through a flow-through chamber, placed in a transfer bottle, or parameters will be measured directly at the well discharge point or flowing portion of Felicita Creek. The parameters EC, pH, temperature, DO, ORP, and turbidity at each sampling location will be measured as follows:

- .. Calibrate the pH and conductivity meters to standard solutions.
- .. Rinse the transfer bottle, if used, with sample water prior to filling. Fill the transfer bottle with sample water.
- .. Immediately submerge the probes and thermometer in the transfer bottle and record measurements after they have stabilized. Continuous readings are possible if a flow-through chamber is used.
- .. Record all field measurements in the field notebook.
- .. Compare the present measurements to measurements taken during the previous sampling round, if available. If a discrepancy exists greater than can be expected for routine changes in groundwater quality, repeat the process.
- .. After parameters are measured, rinse the transfer bottle, thermometer, and probes with distilled water if a transfer bottle is used.
- .. Discard the water sample in the transfer bottle. This water will not be used to fill sample containers.
- .. Repeat this sequence for a minimum of twice each casing volume until the difference in subsequent measurements of EC, pH, and temperature is less than 10 percent. If a flow-through chamber is used, record parameters twice for each casing volume at a minimum.

5.6 EQUIPMENT DECONTAMINATION AND WASTE DISPOSAL

The transfer bottle and the probes used for measurement of field parameters will be decontaminated before and after each measurement by rinsing with distilled water. Rinsate will be collected and handled with purge water.

5.7 DOCUMENTATION

Periodic measurements of EC, pH, temperature, DO, ORP, and turbidity for bailed or pumped wells will be recorded on the appropriate groundwater sampling information form (Appendix C). Calibration of the EC and pH meters will be documented on separate forms (Appendix C).

5.8 QUALITY ASSURANCE

QA of water quality parameter measurements will be accomplished by following the procedures described in this SOP and by following the equipment manufacturers' operating instructions. Temperature, pH, and EC will be measured during each groundwater sampling event, and DO, ORP, and turbidity may be measured. Prior to measuring water quality parameters, field personnel will verify that the instruments are properly calibrated according to procedures specified by the manufacturer. Calibration documentation for each instrument will be meantained for reference purposes (Appendix C). Reference solutions for pH and EC will be prepared and used to properly calibrate the instrument. The calibration of the pH meter and EC meter will be checked at the start of each day.



6.0 MONITOR WELL CONSTRUCTION

6.1 GENERAL STATEMENT

Monitor well construction includes procedures for the installation of shallow zone and deep zone monitor wells, if required. The drilling and completion of each monitor well will be overseen by a hydrogeologist responsible for the collection of lithologic and hydrogeologic data, selection of screened intervals, and determination of final well depth. Monitor wells will be developed using a combination of conventional air lifting, surging, bailing, swabbing, and pumping technologies, or using an alternative method approved by the project hydrogeologist.

6.2 OBJECTIVE

Data obtained from monitor wells will be used to evaluate hydrogeologic conditions, to determine water levels and direction of groundwater flow, and to characterize the chemical quality of groundwater.

6.3 EQUIPMENT AND/OR INSTRUMENTATION

Shallow zone and deep zone monitor wells, if required, will be drilled and constructed using hollow-stem auger or air percussion drilling methods, unless conditions warrant another method of construction. Wells will be developed, as appropriate, using vented surge blocks, bailing, or pumping until the discharge water is clear and sand-free.

Completed monitor wells may be further developed during aquifer test activities, if required, using test pumping equipment. Dedicated sampling pumps and polyvinyl chloride (PVC) sounding tubes may be installed after monitor well construction. A generator will be used to drive the pumps.

6.4 PREPARATION

A qualified driller will be selected to drill the wells. A qualified driller will have appropriate equipment capabilities, a California license, experience on similar projects, and documentation for health and safety training. This experience requirement shall apply both to the individual driller in the field and to the drilling company as a whole.

Prior to entering the field, H+A personnel will contact applicable agencies to obtain and comply with regulatory requirements regarding access, underground utility clearance, and permits for drilling.

6.5 PROCEDURES

6.5.1 Shallow Zone Monitor Well

Shallow zone monitor wells, if required, will be drilled using conventional hollow-stem auger drilling methods unless subsurface conditions warrant another method of construction. The borehole will have an approximate 10-inch diameter. Shallow zone monitor wells will be constructed using a single-pass completion.

A typical shallow zone monitor well will be constructed with 4-inch inner diameter (ID) PVC well casing and 0.020-inch factory-slotted well screen or alternate casing chosen by the on-site hydrogeologist. A filter pack consisting of 1C Monterey or similar sand will be installed in the annulus between the borehole and the well screen from the total depth of the well to approximately 3 to 5 feet above the top of the screened interval. An approximate 2- to 3-foot thick bentonite seal will be emplaced in the annulus above the filter pack using granular bentonite or bentonite chips. Sufficient time will be allowed for the bentonite to hydrate prior to grouting the remaining annulus. A very fine-grained sand grout filter may be emplaced in the annulus above the top of the bentonite seal. The annulus between the borehole and well casing will be grouted from the top of the bentonite seal to approximately 2 to 3 feet below land surface (bls) using bentonite grout or neat cement. The bentonite grout or neat cement will be gravity-emplaced in the annular space of the borehole. The well will be completed with a locking casing seal installed inside a steel and concrete utility vault or monument cover, depending on the monitor well location, unless regulatory requirements or site conditions warrant alternate completion. If a shallow zone well is completed in a public road or similar right-of-way, a traffic-rated utility vault will be cemented in placed at land surface, slightly above grade.

6.5.2 Deep Zone Monitor Well

Deep zone monitor wells, if required, will be drilled using air percussion drilling methods unless subsurface conditions warrant another method. Steel conductor casing may be emplaced during the installation of the deep zone monitor well to prevent cross-contamination, if warranted. In addition, a steel surface casing may be installed in order to stabilize near-surface soil during drilling. The surface casing, if required, will be installed using a hollow stem auger drilling rig or air rotary casing hammer, as available. After drilling to auger refusal or competent bedrock, the surface casing is set in place, and neat cement is gravity-emplaced in the annulus between the steel casing and the borehole.

In the event a conductor casing is required, an approximate 8-inch diameter pilot borehole will be drilled from land surface or from the base of the surface casing to the depth at which the steel conductor casing will be set. A pilot reamer will be used to enlarge the borehole diameter to

approximately 13³/₄ inches from land surface to a depth at which the conductor casing will be set. The conductor casing will be set at a depth predetermined by the project hydrogeologist.

A string of 8-5/8-inch diameter steel conductor casing with a stab-in type float valve or similar cementing shoe welded to the base will be set in the borehole. The cementing shoe will prevent borehole fluids from entering the steel conductor casing during emplacement by effectively sealing the end of the casing. The steel conductor casing will be filled with potable water during emplacement to overcome buoyancy. Steel centralizers will be spaced approximately every 40 feet in the annulus between the steel casing and the borehole. The steel conductor casing will be grouted in place with neat cement. The neat cement will consist of a mixture of 5 to 6 gallons of water per 94-pound sack of type I/II Portland cement with an accelerator or type III Portland cement. Neat cement will be mixed using a calibrated cement/grout mixer. Cement will be tremied into the annulus between the steel casing and borehole until cement returns are received at the surface. The cement will be allowed to cure for at least 12 hours before the monitor well is completed.

Typically, a 7-7/8-inch pilot borehole is used to drill from the base of the surface casing or steel conductor casing to the total depth of the monitor well. A 12-inch diameter reaming bit, if available, will be used to enlarge the diameter of the borehole prior to constructing the monitor well. After drilling the borehole to total depth, 4-inch diameter PVC well casing and factory-slotted 0.040-inch well screen will be installed from land surface to total depth. Washed and wrapped well casing and well screen will be used for the monitor well. The well screen length is typically 20 feet for deep zone monitor wells. PVC centralizers or stainless steel expandable centralizers will be placed at the bottom and at the top of the well screen in the annulus between the well screen in the annulus between the blank PVC casing and the steel conductor casing.

A filter pack of uniform-grade coarse aquarium or similar sand will be emplaced in the annulus between the well screen and the borehole from total depth to approximately 2 to 5 feet above the top of the well screen. The filter pack grain size may be modified based on physical examination of lithologic samples collected during drilling. Monitor wells may be initially developed at this stage using a combination of conventional bailing, surging, or pumping, until the discharge water clears. A bentonite seal will be emplaced in the annulus between the well casing and the borehole at the base of the steel conductor casing from the top of the filter pack to approximately 3 to 5 feet above the top of the filter pack using bentonite pellets. A very fine-grained sand grout filter may be emplaced in the annulus above the top of the bentonite seal.

The remaining annular space between the well casing and the borehole wall or steel conductor casing will be sealed with neat cement or bentonite grout emplaced using the tremie method from the top of the bentonite seal or grout filter to within approximately 2 feet of land surface. Bentonite grout or cement will be mixed using the appropriate mixing techniques and mixing ratios recommended by the manufacturer. The well will be completed with a locking casing seal installed inside a steel and concrete utility vault or monument cover, or if conductor casing is used, a lockable lid will be fabricated for the top of the conductor casing to form a well housing for the deep monitor well. If a deep zone well is completed in a road or similar right-of-way, a traffic-rated utility vault will be cemented in place at land surface, slightly above grade.

A dedicated, stainless steel Grundfos® Redi-flo 2 environmental electric submersible pump with Teflon-lined sample tubing may be installed in a deep monitor well for purging and sampling groundwater. The pump intake will be set at approximately 3 feet above the well screen of the deep zone monitor well.

6.5.3 Monitor Well Development

Initial monitor well development will be conducted during the emplacement of the filter pack to ensure that the filter pack has settled. Initial development will consist of bailing the monitor well. During bailing, the filter pack will be sounded and additional filter pack will be added, as required.

Monitor wells drilled using air percussion techniques will be initially developed within 48 hours of well completion. Final development of monitor wells will occur within approximately 2 weeks. Monitor wells will first be bailed to remove drill cuttings and sand. Monitor wells will then be surged using a vented surge block and pumped until the discharge is clear and sand-free. Water quality parameters including temperature, pH, and EC will be monitored in accordance with SOPs (Section 5.0). Development procedures may be modified due to conditions encountered at the site.

The total volume of water purged, water quality parameters measured, sand content, water levels, and the development methods used will be recorded in the field notebook.

6.6 EQUIPMENT DECONTAMINATION AND DISPOSAL

All downhole drilling equipment will be steam cleaned prior to commencing drilling operations, prior to drilling below the conductor casing, and between monitor well locations. All circulation equipment will be flushed with clear water to rinse away any residual drilling fluids prior to drilling below the conductor casing and between well locations. All rinse waters will be stored with the other waste products and will be properly disposed.

All materials generated from drilling activities will be contained, labeled, and stored in 55-gallon drums, roll-off bins, or Baker-type portable tanks. This includes all drilling fluids and cuttings, wash and rinse water, development water, and soil.

6.7 DOCUMENTATION

A log of conditions encountered during monitor well drilling will be maintained in the field notebook. The log will include brief lithologic and hydrogeologic descriptions as needed, as well as, notations on drill rig behavior and any unusual conditions encountered. A completion report will be compiled for each monitor well. The completion report will include the following:

- .. Well completion and development report for monitor wells and lithologic log form (Appendix C).
- .. Schematic well construction diagrams illustrating as-built well construction details (Figure A1-1).
- .. Field notes compiled by the on-site hydrogeologist during drilling operations.
- .. Photographs, if available.

6.8 QUALITY ASSURANCE

QA during monitor well construction will be accomplished by following the standard procedures contained in this SOP.



7.0 LITHOLOGIC LOGGING

7.1 GENERAL STATEMENT

A log of the conditions encountered during drilling of soil borings and monitor wells, if required, will be maintained. The log will include lithologic and hydrogeologic descriptions along with notations on drilling activities and conditions encountered during drilling. Lithologic logging will be conducted by experienced hydrogeologists under the direction of a California Professional Geologist.

7.2 OBJECTIVE

Lithologic logs compiled during drilling activities will be used for various purposes. Their primary use will be for the interpretation of subsurface geologic conditions. They may also be used in construction of interpretive maps or diagrams such as geologic maps, geologic cross sections, fence diagrams, structural contour maps, and isopach maps. Information recorded as part of the lithologic log will also be important in the interpretation of hydrogeologic characteristics of the soil/rock being logged, such as the ability of these materials to transmit water and adsorb and transmit chemical constituents.

7.3 EQUIPMENT AND/OR INSTRUMENTATION

Equipment used as part of lithologic logging may include any or all of the following: hand lens, dropper bottle containing dilute hydrochloric acid, Munsell color chart, sand size chart, sample collection bags, cuttings trays, wire mesh sieves, organic vapor monitoring devices, and pocket knife. Reference materials such as American Geologic Institute Data Sheets for Field Geology (Walker and Cohen, 2009), <u>Manual of Field Geology</u> (Compton, 1962), or <u>Earth Manual</u> (U.S. Department of Interior, Bureau of Reclamation, 1998) may be used.

7.4 PREPARATION

Essential field equipment and supplies will be ordered prior to commencing lithologic logging. Available references relating to the site vicinity such as lithologic logs, geologic reports, and other information from the Remedial Investigation or other previous site assessments should be reviewed to evaluate the nature of the study area geology.

7.5 PROCEDURES

A lithologic log will be compiled during drilling of soil borings and monitor wells, if required. The following procedures will be used during lithologic logging activities:

- .. Describe the soil/rock sample or drill cuttings and record in field notebook. Take into account alterations caused by the sampling or drilling process.
- .. Note unusual drilling conditions or rig behavior.

The following procedures will be used for lithologic description of soil samples or drill cutting samples:

- Textural classification of soil:
 - .. Record the approximate ratio of the following grain size fractions present in the sample: gravel, sand, silt, and clay. The size limits for each fraction will be in accordance with the Unified Soil Classification System (USCS) (American Society for Testing and Materials [ASTM], 1986). Estimate and record the predominant grain size(s) present within the gravel and sand fractions in the sample.
 - .. Provide textural classification name for the soil/sediment and classify the soil/sediment using the USCS. The root of the name is determined by the highest percentage of gravel, sand, silt, or clay fractions. The modifying terms are based on the relative percentage of the other major size fractions in the sample. A major size fraction is defined as a textural fraction that constitutes 30 percent or more of the sample, by volume. For example, a sample containing 55 percent sand, 30 percent silt, and 15 percent clay would be classified as a silty sand with clay. Add the term "with" for size fractions present at 15 percent to 30 percent of the sample, by volume. Add the term "trace" for those size fractions present at less than 5 percent of the sample by volume. Record the appropriate USCS classification on the lithologic log form.
- Color:
 - . Compare sample to Munsell color chart and provide hue and chroma values for moist soil samples. Indicate in the field notebook if the color was determined based on a dry sample. Record the Munsell color descriptor.

- Moisture Content:
 - .. For soil/sediment samples collected using drilling methods that do not involve introduction of fluids, estimate relative moisture content using the terms "dry", "moist", and "wet".
- Consistency or relative density:
 - .. Estimate the consistency or relative density of the sample based primarily on blow counts during soil sample collection, supplemented by examination of samples and on observation of the drilling characteristics of the soil/sediment. Consistency descriptors for fine-grained soils/sediments are: very soft, soft, firm, stiff, very stiff, and hard. Relative density descriptors for coarse-grained soils/sediments are: very loose, loose, medium dense, dense, and very dense. Descriptors of the degree of induration for a soil/sediment as a whole are: poorly indurated, moderately indurated, and well indurated.
- Plasticity:
 - .. Determine the degree of plasticity for fine-grained lithologic samples. Plasticity is the property in which a soil/sediment can be rapidly deformed or molded without rebounding elastically, changing volume, cracking, or crumbling (ASTM, 1986). Plasticity descriptors are: nonplastic, low plasticity, medium plasticity, and high plasticity.
- Sorting:
 - .. Estimate the degree of sorting, or overall grain size distribution, of soil/sediment samples that consist predominantly of sand-sized or larger particles. Designate by using one of the following descriptors: poorly sorted, moderately sorted, and well sorted. The descriptor "poorly sorted" applies to soils/sediments in which there is a good representation of the continuum of particle sizes. The descriptor "well sorted" applies to soils/sediments in which most particles are about the same size.
- Roundness:
 - .. Estimate the predominant roundness categories for the sand and gravel size fractions according to the roundness scale (Walker and Cohen, 2009). The roundness categories are: angular, subangular, subrounded, and rounded. The on-site hydrogeologist will record in the field notebook actions of drilling bits or auger flights that may be responsible for increasing the angularity of the sand or gravel size fractions in the sample.

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- Miscellaneous properties:
 - .. Additional properties should be reported if noted in the soil/sediment sample. These properties include the following: mineralogical composition; degree of iron or manganese staining of coarse fraction; reactance with dilute hydrochloric acid; odor; other physical properties, including soil structure and fracture spacing and width, if applicable; orientation and coatings on fractures, if applicable; presence of man-made, animal, or plant material; and organic vapor readings determined using equipment such as an organic vapor analyzer.

The following procedures will be used for lithologic description of rock cuttings:

- Classification of rock type:
 - .. Identify mineralogy of sample and fabric including the size, shape, roundness, and sorting of the grains.
 - .. Identify structural features including foliation or bedding.
 - .. Classify as igneous, sedimentary, or metamorphic and provide the geologic name, if possible.
- Weathering:
 - .. Describe the degree of weathering. Weathering descriptors are: decomposed, highly weathered, moderately weathered, and fresh. The descriptor "decomposed" applies to rock samples that have decomposed to a greater percentage of soil than rock and can be crumbled by hand pressure. The descriptor "fresh" applies to rock samples that are not visibly decomposed or discolored and the sample "rings" when struck with a rock hammer.
- Hardness:
 - .. Describe the hardness of rock samples. Hardness descriptors are: very hard, hard, soft, very soft. The descriptor "very hard" applies to samples that require several hard blows from a rock hammer to break. The descriptor "very soft" applies to samples that crumble under a moderate blow from a pick and large pieces can be broken using finger pressure.

7.6 DOCUMENTATION

The on-site hydrogeologist will compile lithologic logging descriptions and observations made during drilling activities in the field notebook. After completion of drilling activities, field notebook entries will be summarized in the following:

- .. Well drilling and completion report and lithologic log form (Appendix C); and
- .. Schematic as-built monitor well construction diagrams (Figure A1-1).

A project-specific lithologic log form has been developed. In addition to lithologic data, the lithologic log form includes:

- .. project name;
- .. date(s);
- .. boring identifier;
- .. boring location;
- .. geologist's name;
- .. drilling company's name;
- .. drill rig operator's name;
- .. drilling method;
- .. weather conditions; and
- .. space for remarks and comments.

Final lithologic logs will be prepared based on all available information. A copy of the field notebook entries for soil borings and monitor wells will be maintained in the field for reference purposes. One set of the completed documentation forms will also be maintained in the field for reference purposes. The original set of notes and forms will be filed in the H+A project files.

7.7 QUALITY ASSURANCE

QA during lithologic logging activities will be accomplished by following this SOP. In addition, the Project Manager will review all lithologic logs and drilling documentation throughout drilling operations to ensure conformity with this SOP.



8.0 GEOPHYSICAL LOGGING

8.1 GENERAL STATEMENT

Following drilling of any additional deep monitor wells, if required, to total depth, borehole geophysical logs may be obtained to provide data for evaluating lithology, groundwater conditions, and borehole conditions. Geophysical logs may include the following: acoustic televiewer, sonic, electrical resistivity, and caliper. Additional geophysical logs, such as downhole video, may be obtained depending on project requirements.

8.2 OBJECTIVE

Geophysical logs, if required, will be obtained to help locate fracture zones, define the lithology and characteristics of geologic materials, and to characterize the subsurface hydrogeology. Geophysical data will also be used to assist in the selection of screened intervals and other aspects of monitor well design such as the placement of filter pack and annular seals.

8.3 EQUIPMENT AND/OR INSTRUMENTATION

Borehole geophysical logging will be performed by a geophysical subcontractor. Equipment required will be based on the suite of logs selected. A hard copy of geophysical logs will be recorded on paper. Geophysical logs will also be stored digitally. The electrical logging equipment provided should be capable of being calibrated in the field.

Successful borehole geophysical logging operations depend on adequate planning and close supervision to ensure that equipment is operated properly, the recorded data are accurate, and the log is easily interpretable. Copies of this SOP will be kept on-site by the field hydrogeologist and will be referred to before, during, and after geophysical logging, as needed.

8.4 PREPARATION

The following procedures will be performed in preparation for geophysical logging:

- Notify the contracted logging service company at least 24 hours before the anticipated logging period. Estimate required lead time for dispatching the truck. Provide the following information:
 - .. Company name as it appears on the log header.



- .. Consultant's name; name of consultant representative, usually on-site hydrogeologist; local office and mobile telephone numbers.
- .. Borehole name/number and location.
- .. Explicit directions to site and information on site access. If access is controlled, arrange a specific time and location to meet the logging truck outside the restricted area. H+A personnel will have escort privileges.
- .. Approximate time borehole will be ready for logging and the time required for conditioning the borehole prior to logging.
- .. Approximate total depth of borehole in feet bls and approximate ground level elevation in feet mean sea level.
- .. Borehole dimensions.
- .. Geophysical logs to be obtained may include:
 - .. sonic;
 - .. electrical resistivity;
 - .. caliper;
 - .. acoustic televiewer; and
 - .. flowmeter.
- .. Notification of potential health and safety hazards.
- .. Confirmation and documentation of logging tool calibration.
- .. Name of, and request for, logging unit and operator used previously on the project.
- .. As the borehole nears completion, contact the logging service to confirm dispatch of the logging truck. Repeat the earlier information regarding site location, access, and logs to be obtained.

8.5 PROCEDURES

The following procedures will be used during borehole geophysical logging:

- .. The on-site hydrogeologist will inform the logging engineer of the desired vertical and horizontal scales. Scales should remain consistent for each logged borehole, if possible.
- .. Run a repeat section for each boring.



- .. Repeat a minimum of 50 to 100 feet.
- .. Compare the repeat section to the same interval on the total log. Explain discrepancies, generally resulting from a defective tool.
- .. Compare the logger's total depth to the driller's total depth. Large differences may indicate conditions such as the hole sloughing, driller's measurement error, or incorrect tool depth setting.
- .. Do not exceed maximum recording speeds.
- .. Watch for depth control. Curve deflections should generally be on depth with each other.

8.6 EQUIPMENT DECONTAMINATION AND DISPOSAL

Downhole logging cables and tools will be decontaminated with fresh water or a steam cleaner as they exit the borehole. All rinse waters will be stored with the other waste products and properly disposed.

8.7 DOCUMENTATION

The on-site hydrogeologist will verify that the logging engineer has accurately recorded the following information appropriately on the log header:

- .. Correctly spelled well identifier and company name.
- .. Date of logging.
- .. Depth data, including ground level, logger's total depth, and driller's total depth.
- .. Logging unit number and engineer name.
- .. Gauge or bit size.
- .. Equipment type and serial number of individual tools.
- .. Scale and scale changes, noted both on the heading and at the point of change on the log.
- .. Curve presentation, clear with no gaps or smears.
- .. All curves clearly labeled on the scale.



8.8 QUALITY ASSURANCE

QA for geophysical logging will be accomplished by following the procedures outlined in this SOP and by using the equipment calibration procedures appropriate to each logging method.



9.0 HANDLING, STORAGE, CHARACTERIZATION, AND DISPOSAL OF INVESTIGATION-GENERATED WASTES

SOPs have been developed for the handling, storage, characterization, and disposal of wastes generated during field work activities. Wastes generated during field work activities may include water, soil, and drilling fluid.

9.1 HANDLING AND STORAGE

9.1.1 Water

Water will be generated during decontamination, groundwater sampling, well development, and aquifer testing. If existing holding tanks at the Yard are insufficient, large capacity aboveground water storage tanks will be obtained and used to contain water generated during field activities.

A central staging area for decontamination of drilling and sampling equipment has been established at the Yard. Water generated during decontamination procedures will be containerized and transferred to the water storage tanks.

Water generated during well development, groundwater sampling, and aquifer testing will be contained at the wellhead and transferred to the water storage tanks.

<u>9.1.2 Soil</u>

Soil cuttings will be generated during monitor well drilling, if required. Soil cuttings will be stored in 55-gallon drums, roll off bins, or portable Baker tanks at each soil sample location. Each container will be clearly labeled with the soil boring identifier, date, and depth interval for soil cuttings contained.

9.1.3 Drilling Fluid

Drilling fluid, specifically groundwater produced during air percussion drilling, may be generated during drilling and construction of monitor wells, if required. Drilling fluid will be temporarily contained in large-capacity storage tanks located at the Yard. If produced water can be transferred without introducing solids into transfer lines, drilling-generated water can be handled and treated similarly to other wastewater generated at the Site.

9.2 CHARACTERIZATION

Waste characterization may include sample collection and laboratory analysis of soil cuttings or other solids generated during field activities. Characterization of soil cuttings may be required to determine appropriate waste disposal.

The analytical results for soil samples, if collected from soil borings or monitor wells, will be used to characterize soil generated during drilling activities.

9.3 DISPOSAL

Water generated during drilling or aquifer testing will be temporarily stored in large-capacity storage tanks at the Yard. Disposal of other wastes generated during field activities will be based upon analytical results for waste characterization samples. Water stored at the Yard may be treated using the GRS.

Water generated from groundwater sampling, monitor well development, and decontamination will be stored in on-Yard holding tanks and treated using the GRS.

Soil cuttings generated during soil sampling and drilling activities will be stored in storage containers pending evaluation of other disposal options.

The Chatham Site Potentially Responsible Parties Group will be responsible for disposal of all wastes generated during field activities.



10.0 SURFACE SOIL SAMPLE COLLECTION

10.1 GENERAL STATEMENT

As an optional task, surface soil samples would be collected, if required, using hand tools.

10.2 OBJECTIVE

Surface soil sampling objectives would be determined if this type of sampling is required and would be specified in a future workplan.

10.3 EQUIPMENT AND/OR INSTRUMENTATION

Surface soil samples would be collected using decontaminated or dedicated stainless steel trowels.

10.4 PREPARATIONS

The following items will be performed in preparation for each soil sampling event:

- .. Review project objectives with all personnel and identify locations to be sampled.
- .. Review sampling locations, sampling equipment and supplies, time of sampling, and schedule of analyses to be performed.
- .. Review health and safety procedures with all field personnel.
- .. Review appropriate permits, insurance requirements, contractual requirements, and site access procedures, if applicable.
- .. Inform laboratory of expected sample shipments.

10.5 PROCEDURES

The following procedures will be performed for collecting surface soil samples:

.. Collect surface soil samples using decontaminated or dedicated stainless steel trowels.

- .. Collect surface soil samples in clean 9-ounce glass jars, or a similar size selected in conjunction with the laboratory, using decontaminated or dedicated hand trowels.
- .. For composite samples, collect equal volumes of soil from each location. Thoroughly mix the soil in a decontaminated or dedicated stainless steel or plastic container. Once mixed, collect composite surface soil sample in clean 9-ounce glass jar, or a similar sized selected in conjunction with the laboratory, using decontaminated or dedicated hand trowel.
- .. Secure the glass jars with custody seals and attach a sample label (Appendix C). Place each sample jar in a resealable plastic bag and immediately store sample jars on ice in an ice chest.
- .. Complete appropriate chain-of-custody records and laboratory analysis request forms (Appendix C).
- .. Package and store samples and transport or transmit to laboratory within 24 hours after sample collection, if possible.

10.6 SAMPLE CONTAINERS, PRESERVATION, AND TRANSMITTAL

Surface soil samples will be collected in 9-ounce glass jars or other jars provided by the laboratory. Soil samples collected will be labeled, placed in resealable plastic bags, and immediately stored on ice in an ice chest. Soil samples will be transported or transmitted to the laboratory on ice in sealed, plastic ice chests containing a chain-of-custody record and analysis request form (Appendix C). Samples will be shipped to the laboratory each sampling day. Sample control and chain-of-custody procedures are detailed in the Quality Assurance Project Plan (QAPP) (Appendix B).

10.7 EQUIPMENT DECONTAMINATION AND DISPOSAL

Prior to the collection of each surface soil sample, the hand trowels will be washed with nonphosphate detergent, followed by a tap water rinse and a final, distilled water rinse.

10.8 DOCUMENTATION

Documentation of the soil sampling activities will include records of sampling events in the field notebook and sample identification documents.

The field notebook will be the responsibility of the field team leader. All entries will be signed and dated and the field notebook will be kept as a permanent record. The following information will be entered into the field notebook each time a soil sample is collected:

- .. sample location/identifier;
- .. depth at which sample was collected;
- .. date and time sample was collected;
- .. any detected organic vapors;
- .. analyses to be performed;
- .. sample lithologic description;
- .. any other pertinent information, including any difficulties in sampling or unusual occurrences.

Sample identification documents will be prepared so that sample identification and chain of custody are maintained and sample disposition controlled. The sample identification documents to be used are:

- .. sample identification labels;
- .. chain-of-custody records.

Standard sample identification labels and chain-of-custody records will be used to record all information (Appendix C). Sample documentation forms and labels will be completed with waterproof ink. The sample documentation forms will accompany the samples to the laboratory. Copies of the sample documentation forms will be retained by the samplers and sent directly to the H+A Project Manager.

Preprinted adhesive sample labels will be secured to the sample containers by field personnel. The following information will be recorded on the sample label:

- .. sample location/identifier;
- .. depth at which sample was collected;
- .. date and time sample was collected;
- .. analyses to be performed;
- .. project number;
- .. sampler's initials; and
- .. any special instructions to laboratory personnel.

Official custody of samples will be maintained and documented from the time of sample collection until the validation of analytical results. The chain-of-custody record is the document that records the transfer of sample custody. The chain-of-custody record also serves to cross-reference the sample identifier assigned by the H+A Field Task Manager with the sample identifier assigned by the laboratory. The chain-of-custody record includes the following information:

- .. sample location/identifier;
- .. project code;
- .. sampling date;

- .. sampling personnel;
- .. shipping method and date;
- .. sample description;
- .. sample volume;
- .. number of containers;
- .. sample destination;
- .. preservatives used;
- .. analyses to be performed;
- .. special handling procedures; and
- .. the identity of personnel relinquishing and accepting custody of the samples.

The sampling personnel will be responsible for the samples and will sign the chain-of-custody record to document sample transferral or transport. Samples will be packaged in sealed containers for transport and dispatched with a chain-of-custody record accompanying each shipment to the appropriate laboratory for analysis. The method of transport, courier name(s), and other pertinent information will be recorded on the chain-of-custody record accompanying the samples. During transport, samples will be accompanied by the chain-of-custody record.

Once received at the laboratory, laboratory custody procedures apply. It is the laboratory's responsibility to acknowledge receipt of samples and verify that the containers have not been opened or damaged. It is also the laboratory's responsibility to maintain custody and sample tracking records throughout sample preparation and analysis. A copy of the chain-of-custody record will then be sent to the H+A Project Manager.

10.9 QUALITY ASSURANCE

QA for soil samples collected during this investigation will be performed in accordance with these SOPs for collection, handling, preservation, and decontamination. In addition, the following field QC procedures may be used during soil sample collection:

.. If sample collection trowels are decontaminated before use, collect one equipment rinsate sample each day. Analyze the equipment rinsate samples for the same analytes as the soil samples. If laboratory analysis of the equipment rinsate sample indicates inadequate decontamination procedures, corrective action will be taken as detailed in the QAPP (Appendix B).



11.0 SUBSURFACE SOIL SAMPLE COLLECTION

11.1 GENERAL STATEMENT

As an optional task, soil samples may be collected from soil borings or monitor well boreholes. Shallow soil borings will be advanced with hand augers or hollow-stem auger drilling methods.

11.2 OBJECTIVE

Subsurface soil sampling objectives will be determined if this type of sampling is required and will be specified in a future workplan.

11.3 EQUIPMENT AND/OR INSTRUMENTATION

Soil samples collected to depths from land surface to approximately 20 feet bls will be collected using conventional hand augering or hollow-stem auger sampling techniques. A 2-inch diameter soil sampler lined with one 6-inch long or two 3-inch long brass sampling tubes will be used to collect soil samples from hand-augered borings. The soil sampler will be driven ahead of the hand-augered portion of the borehole to collect soil samples. A standard penetration test or modified California split-spoon sampler lined with brass sampling tubes will be used to collect soil samples from conventional hollow-stem auger soil borings or monitor well boreholes. Soil samplers will be driven ahead of the auger to collect soil samples.

Soil samples for lithologic description will be collected using a 2-inch ID or smaller split-spoon sampler without sampling tubes. Samples will be collected every 2.5 feet or at depths determined by the on-site hydrogeologist. If difficulty occurs in advancing split-spoon samplers, the boring may be advanced without collecting soil samples for logging purposes.

11.4 PREPARATIONS

The following items will be performed in preparation for each soil sampling event:

- .. Review project objectives with all personnel and identify locations to be drilled or sampled.
- .. Review sampling locations, sampling equipment and supplies, time of sampling, and schedule of analyses to be performed.
- .. Review health and safety procedures with all field personnel.



- .. Review appropriate permits, insurance requirements, contractual requirements, and site access procedures, if applicable.
- .. Inform laboratory of expected sample shipments.
- .. Obtain underground utility clearance.

11.5 PROCEDURES

The following procedures will be performed for collecting subsurface soil samples:

- .. Decontaminate 3-inch or 6-inch brass sample tubes according to procedures outlined in Section 11.7. Place clean brass tubes in resealable plastic bags and keep cool prior to use. Soil samples for lithologic description only may be collected using a sample barrel without brass tubes.
- .. Decontaminate split-spoon or single-tube sampler according to procedures outlined in Section 11.7.
- .. Place appropriate number of clean brass sample tubes into the sampler body. Store the split-tube sampler in a cool place prior to use. Attach sampler to slide hammer or drill rod and drive the sampler 6 or 18 inches into the formation, as appropriate. Record blow counts on the lithologic log form (Section 7.5).
- .. After the sampler is retrieved, carefully remove and examine the sample tubes. When more than one sample tube is used, the two lower tubes will be used for chemical analyses and lithologic evaluation, as necessary. Soil in the other tube(s) will be discarded.
- .. Seal ends of sample tubes with Teflon[®] liner and plastic end caps. Secure caps with custody seals and attach sample label. Place each sample tube in a resealable plastic bag and, for chemical analysis other than VOCs, immediately store sample tubes on ice in an ice chest.
- .. Prepare one equipment rinsate sample each day. Equipment rinsate samples are prepared using rinsate water from the distilled water rinse of the split-spoon or single-tube sampler. Analyze the equipment rinsate sample for the same analytes as the soil samples.
- .. Complete appropriate chain-of-custody records and laboratory analysis request forms (Appendix C).
- .. Package and store samples and transport or transmit to laboratory within 48 hours after sample collection.

The following procedures will be performed during core sample collection for analysis of VOCs, in order to comply with the provisions of EPA Method 5035:

- Retrieve core barrel with sample, as described above.
- Prepare En Core Sampler[®] to receive soil subsample. Hold coring body and push plunger rod down until small o-ring rests against tabs. This will assure that plunger moves freely.
- Depress locking lever on En Core[®] T-Handle. Place coring body, plunger end first, into open end of T-Handle, aligning the two slots on the coring body with the two locking pins in the T-Handle. Twist coring body clockwise to lock pins in slots. Check to ensure Sampler is locked in place. Sampler is ready for use.
- Collect soil subsample. Turn T-Handle with T-up and coring body down. This positions
 plunger bottom flush with bottom of coring body; ensure that plunger bottom is in
 position. Using T-Handle, push Sampler into soil until coring body is completely full.
 When full, small o-ring will be centered in T-Handle viewing hole. Remove Sampler from
 soil. Wipe excess soil from coring body exterior.
- Cap coring body while it is still on T-handle. Push cap over flat area of ridge and twist to lock cap in place. Cap must be seated to seal sampler.
- Remove the capped Sampler by depressing locking lever on T-Handle while twisting and pulling Sampler from T-Handle.
- Lock plunger by rotating extended plunger rod fully counterclockwise until wings rest firmly against tabs.
- Attach completed tear-off label from En Core[®] Sampler bag to cap on coring body.
- Repeat to collect 3 to 4 En Core[®] Samplers at each sample interval, depending on laboratory preference for the number of En Core[®] sub-samples to be submitted for each soil sample.
- Return full En Core[®] Samplers to ziplock bag. Seal bag and immediately put on ice in ice chest.
- Submit to analytical laboratory within 48 hours of sample collection.

11.6 SAMPLE CONTAINERS, PRESERVATION, AND TRANSMITTAL

Handling protocols for soil samples have been summarized (Table A-2).

Brass sample tubes used for collection of subsurface soil samples will be 1.5 inches to 2 inches in diameter and 3 or 6 inches in length. Soil samples collected for chemical analysis in brass sample tubes or En Core Samplers[®] will be labeled, placed in resealable plastic bags, and immediately stored on ice in an ice chest. Soil samples will be transported or transmitted to the laboratory in plastic ice chests containing a chain-of-custody record and analysis request form (Appendix C). If possible, samples will be shipped to the laboratory each sampling day. Soil samples for VOC analysis will be shipped to the laboratory within 48 hours after sample collection. Sample control and chain-of-custody procedures are detailed in the QAPP (Appendix B).

11.7 EQUIPMENT DECONTAMINATION AND DISPOSAL

Prior to the collection of each subsurface soil sample, the brass sample tubes and the split-spoon or single-tube sampler will be washed with nonphosphate detergent, followed by a tap water rinse and a final, distilled water rinse. After cleaning the soil samplers and sample tubes, they will be stored in resealable plastic bags and kept cool in an ice chest. Excess soil and decontamination fluids will be contained and properly disposed.

11.8 DOCUMENTATION

Documentation of the soil sampling activities will include records of sampling events in the field notebook and sample identification documents. The field notebook will be the responsibility of the field team leader. All entries will be signed and dated and the field notebook will be kept as a permanent record. The following information will be entered into the field notebook each time a soil sample is collected:

- .. sample location/identifier;
- .. depth at which sample was collected;
- .. date and time sample was collected;
- .. any detected organic vapors;
- .. analyses to be performed;
- .. sample lithologic description; and
- .. any other pertinent information, including any difficulties in sampling or unusual drilling occurrences.

Sample identification documents will be prepared so that sample identification and chain of custody are maintained and sample disposition controlled. The sample identification documents to be used are:

.. sample identification labels; and


.. chain-of-custody records.

Standard sample identification labels and chain-of-custody records will be used to record all information (Appendix C). Sample documentation forms and labels will be completed with waterproof ink. The sample documentation forms will accompany the samples to the laboratory. Copies of the sample documentation forms will be retained by the samplers and sent directly to the H+A Project Manager.

Preprinted adhesive sample labels will be secured to the sample containers by field personnel. The following information will be recorded on the sample label:

- .. sample location/identifier;
- .. depth at which sample was collected;
- .. date and time sample was collected;
- .. analyses to be performed;
- .. project number;
- .. sampler's initials; and
- .. any special instructions to laboratory personnel.

Official custody of samples will be maintained and documented from the time of sample collection until the validation of analytical results. The chain-of-custody record is the document that records the transfer of sample custody. The chain-of-custody record also serves to cross-reference the sample identifier assigned by the H+A Task Manager with the sample identifier assigned by the laboratory. The chain-of-custody record includes the following information:

- .. sample location/identifier;
- .. project code;
- .. sampling date;
- .. sampling personnel;
- .. shipping method and data;
- .. sample description;
- .. sample volume;
- .. number of containers;
- .. sample destination;
- .. preservatives used;
- .. analyses to be performed;
- .. special handling procedures; and
- .. the identity of personnel relinquishing and accepting custody of the samples.

The sampling personnel will be responsible for the samples and will sign the chain-of-custody record to document sample transferral or transport. Samples will be packaged in sealed containers for transport and dispatched with a chain-of-custody record accompanying each shipment to the appropriate laboratory for analysis. The method of transport, courier name(s), and other pertinent information will be recorded on the chain-of-custody record accompanying the samples. During transport, samples will be accompanied by the chain-of-custody record.



Once received at the laboratory, laboratory custody procedures apply. It is the laboratory's responsibility to acknowledge receipt of samples and verify that the containers have not been opened or damaged. It is also the laboratory's responsibility to maintain custody and sample tracking records throughout sample preparation and analysis. A copy of the chain-of-custody record will then be sent to the H+A Project Manager.

11.9 QUALITY ASSURANCE

QA for soil samples collected during this investigation will be performed in accordance with these SOPs for collection, handling, preservation, and decontamination. In addition, the following field QC procedures may be used during soil sample collection:

.. Collect one equipment rinsate sample each day. Analyze the equipment rinsate samples for the same analytes as the soil samples. If laboratory analysis of the equipment rinsate sample indicates inadequate decontamination procedures, corrective action will be taken as detailed in the QAPP (Appendix B).



12.0 AQUIFER AND SLUG TESTING

12.1 GENERAL STATEMENT

As an optional task, aquifer and slug tests may be conducted to evaluate the hydraulic parameters of the hydrogeologic unit in which a well is completed. Water level drawdown, recovery, and well discharge rates will be monitored throughout the test. The water quality parameters, temperature, EC, and pH of discharged water may also be monitored periodically.

12.2 OBJECTIVE

Aquifer and slug tests, if required, may be conducted in selected monitor wells to estimate hydraulic properties. The decision to conduct an aquifer or slug test at a selected monitor well will be based on the location of the well, the need for additional data on hydraulic characteristics, and water quality data. Aquifer testing will consist of constant discharge and recovery tests. Slug tests will consist of instantaneous discharge tests. The duration and type of tests will depend on the well design and capacity, aquifer characteristics, and the observed responses in available observation wells. Water level drawdown and recovery data will be obtained in the pumping well and observation wells that are within the radius of influence of the pumping well during aquifer testing. Water level recovery data will be obtained from the monitor well in which the slug test is performed.

12.3 EQUIPMENT AND/OR INSTRUMENTATION

Equipment used during aquifer testing includes discharge and water level measuring devices. A calibrated 5- to 55-gallon container and stopwatch or an in-line flow meter will be used to measure discharge rates. Water levels will be measured with calibrated water level indicators, and synchronized watches will be used to note the time of each measurement. Pressure transducers and electronic data loggers may also be used to record water levels. Equipment utilized during slug testing includes a bailer to remove a known volume of water.

12.4 PREPARATION

The following procedures will be performed during preparation for the aquifer and slug tests.

Constant discharge tests:

.. Measure the total depth of the well to be tested.



- .. Install submersible test pump in well at the depth determined by the on-site hydrogeologist. Install a check valve in the discharge pipe above the pump to prevent return flow after pump shutoff.
- .. Assemble all necessary forms and graph paper.
- .. Prior to the start of pumping, measure static water level in the pumping and observation wells and record measurement time on the appropriate aquifer test forms (Appendix C). If the well has been pumped for development or pump performance purposes, water levels must regain prepumping levels prior to beginning the test.
- .. Perform a limited pumping pretest to determine appropriate valve settings, to test for leaks in the discharge system, and to ensure that discharge is directed into a suitable storage tank.
- .. Prior to commencement of the test, the on-site hydrogeologist will select time increments for water level measurements and water sample collection and will determine which monitor wells will be used as observation wells.
- .. Provide a reliable portable power supply if a standard power source will not be available.
- .. Calibrate instruments for the measurement of pH, EC, and temperature, if appropriate.
- .. Prepare equipment for discharge measurement. A calibrated 5- to 55-gallon container or in an in-line flow meter will be used to monitor discharge from wells.
- .. Install a valve in the pump discharge line. Discharge will be controlled to maintain a constant flowrate.
- .. Install pressure transducers and electric data loggers and recorders in selected wells prior to initial testing.
- .. Familiarize all personnel with the aquifer test procedures.
- .. Synchronize all personnel's watches and chronometers, then start the pump.

Instantaneous discharge slug tests:

- .. Measure the total depth of the well to be tested.
- .. Prepare a bailer or slug capable of removing or displacing 10 to 50 centimeters of water inside the well casing.



- .. Position a pressure transducer of sufficient sensitivity and range to a depth below the level that the water is expected to decrease upon bailing or removal of the slug.
- .. Set transducer logging interval to 1 second or less.
- .. Measure the static water level in the well prior to placing the bailer or slug downhole. Water levels should be measured regularly during a sufficient period of time to ensure that static conditions exist at the start of the test. Calibrate the transducer to this measurement.
- .. Insert the bailer or submerge the slug in the well.
- .. Allow the water level in the well to stabilize, then measure depth to water and check the transducer calibration and the operation of the data logger.

12.5 PROCEDURES

The following procedures will be used to conduct the aquifer test.

Constant discharge tests:

- .. Start pump and maintain a constant discharge. The on-site hydrogeologist will determine when to terminate the test based on a field plot of aquifer response.
- .. In the pumping well and observation wells, measure water levels in accordance with the predetermined schedule (Table A1-1).
- .. Periodically measure discharge rate, pH, EC, and temperature, if appropriate. Adjust valve to maintain constant discharge. Record measurements on aquifer test data forms with corresponding measurement time.
- .. After the pump is turned off, begin water level recovery measurements according to the schedule given for aquifer test startup (Table A1-1). Record measurements and measurement times on the aquifer test data forms (Appendix C).
- .. The on-site hydrogeologist will determine when recovery has reached approximately 100 percent of the static water level.

Instantaneous discharge slug test:

.. After the water level in the well has stabilized with the bailer or slug in place, verify the data logger is operating and quickly lift the bailer or slug above static water level in the well.



- .. If possible, measure the water level in the well with a water level indicator several times during the first minute of recovery (Table A1-1). These measurements are used as a check on the response of the transducer.
- .. The on-site hydrogeologist will determine when the water level recovery is sufficient for the test to be terminated.

12.6 EQUIPMENT DECONTAMINATION AND DISPOSAL

Groundwater generated during aquifer testing will be stored and treated at the Yard.

12.7 DOCUMENTATION

Observations made during aquifer and slug test activities will be recorded on aquifer test data forms (Appendix C). The aquifer test data forms and field plots of aquifer test data will be included with the completion report for the monitor well (Appendix C).

12.8 QUALITY ASSURANCE/QUALITY CONTROL

QA objectives for aquifer and slug test data will be satisfied by following the procedures described in this SOP.

Upon return to the office after the field event, all aquifer and slug test mathematical computations, field data plots, and aquifer parameter computations will be checked for correctness. The applicability of the selected analytical method to the particular data set will be assessed by the H+A Project Manager.



13.0 REFERENCES CITED

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- U.S. Department of Interior, Bureau of Reclamation, 1998. <u>Earth Manual, Part I</u>. Third Edition. Washington, D.C.: U.S. Government Printing Office.
- Walker, J.D., and H.A. Cohen (eds.), 2009. <u>Geoscience Handbook: The AGI Data Sheets, 4th</u> (revised) Edition. Falls Church, Virginia: American Geological Institute.

TABLE A1-1

SCHEDULE FOR WATER LEVEL MEASUREMENTS DURING AQUIFER AND SLUG TESTING

TIME PERIOD

TIME PERIOD

AQUIFER TESTING(a)

FREQUENCY OF WATER LEVEL MEASUREMENT

1 every 30 seconds	First 5 minutes
1 every minute	Next 10 minutes
1 every 2 minutes	Next 20 minutes
1 every 5 minutes	Next 30 minutes
1 every 10 minutes	Next 60 minutes
1 every 20 minutes	Next 4 hours
1 every 30 minutes	Next 4 hours
1 every 60 minutes	For duration of pumping

SLUG TESTING(b)

FREQUENCY OF WATER LEVEL MEASUREMENT

1 every 30 seconds	First 5 minutes
1 every minute	Next 10 minutes
1 every 2 minutes	Next 20 minutes
1 every 5 minutes	Next 30 minutes
1 every 10 minutes	Next 60 minutes
1 every 20 minutes	Next 4 hours
1 every 30 minutes	Next 4 hours
1 every 60 minutes	For duration of test

- NOTE: Water levels may be measured more frequently depending on field conditions and water level response; if transducers are used, water levels will be measured on a logarithmic time basis.
- (a) The same frequency of water level measurements will be used for both the pumping and recovery phases.
- (b) Frequency of water level measurements only applies to recovery phases during slug testing.



SCHEMATIC WELL CONSTRUCTION DIAGRAM



ATTACHMENT A-2

ADVISORY – ACTIVE SOIL GAS INVESTIGATIONS CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY, DEPARTMENT OF TOXIC SUBSTANCES CONTROL & CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD JANUARY 2003



Gray Davis, Governor Winston H. Hickox, Agency Secretary California Environmental Protection Agency



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January 28, 2003

To: Interested Parties

ADVISORY - ACTIVE SOIL GAS INVESTIGATIONS

In a coordinated effort, the Department of Toxic Substances Control (DTSC) and the California Regional Water Quality Control Board – Los Angeles Region (LARWQCB) have jointly developed the "Advisory – Active Soil Gas Investigations" (see the attached). This document is to ensure that consistent methodologies are applied during active soil gas investigations to produce high quality data for regulatory decision-making. The document has been reviewed by other government organizations and by the soil gas consulting community. Their comments have been considered and, where appropriate, incorporated in the document. This is an on-going effort to streamline the characterization of gas phase contaminant sites. As additional knowledge and experience are obtained, this Advisory may be modified as appropriate.

This document is issued by DTSC and LARWQCB as an Advisory subject to review and revision as necessary. The information in this Advisory should not be considered as regulations. Mention of trade names or commercial products does not constitute the Agency's endorsement or recommendation.

If you have any questions regarding this document, please contact the joint-agency project coordinator Mr. Joe Hwong, of DTSC, at (714) 484-5406.

Sincerely,

Edwin F. Lowry Director Department of Toxic Substances Control

B. A

Dennis A. Dickerson Executive Officer California Regional Water Quality Control Board Los Angeles Region

Enclosure

The energy challenge facing California is real. Every Californian needs to take immediate action to reduce energy consumption. For a list of simple ways you can reduce demand and cut your energy costs, see our Web-site at www.dtsc.ca.gov.

ADVISORY – ACTIVE SOIL GAS INVESTIGATIONS

As a coordinated effort, this document is issued by the California Regional Water Quality Control Board – Los Angeles Region (LARWQCB) and Department of Toxic Substances Control (DTSC) as an Advisory subject to review and revision as necessary. Mention of trade names or commercial products does not constitute the Agency's endorsement or recommendation. The information in this Advisory should not be considered as regulations. In this Advisory, "Agency" should mean LARWQCB and/or DTSC.

1.0 INTRODUCTION

Active soil gas investigations are useful to obtain vapor phase data at sites potentially affected by volatile organic compounds (VOCs), including chlorinated and aromatic hydrocarbons. Active soil gas investigations may also be used to investigate sites potentially affected by methane and hydrogen sulfide, and to measure fixed and biogenic gasses (e.g., oxygen, carbon dioxide, or carbon monoxide). Among other things, the data can be used to identify the source and determine the spatial distribution of VOC contamination at a site, or to estimate indoor air concentrations for risk assessment purposes.

For site characterization, the Agency encourages both soil gas and soil matrix sampling. Typically, soil gas data are more representative of actual site conditions in coarse-grained soil formations while soil matrix data are more representative of actual site conditions in fine-grained soil formations. For evaluating the risk associated with vapor intrusion to indoor air, soil gas data are the preferred contaminant data set, where practicable. Flux chamber and passive sampling methods are not discussed in this Advisory. Any sites where such sampling methods are necessary will be addressed separately.

On February 25, 1997, LARWQCB re-issued the "<u>Interim Guidance for Active Soil</u> <u>Gas Investigation</u>" (ASGI) as guidance for investigating sites with potential VOC contamination. Unless otherwise noted in this Advisory, the active soil gas investigation should be performed in accordance with the most current ASGI.

2.0 SUPPLEMENTAL RECOMMENDATIONS

The following sections supplement the ASGI in an effort to ensure that consistent methodologies are applied during soil gas investigations to produce reliable and defensible data of high quality. All sampling probe installation, sampling, and analytical procedures, whether or not discussed below, are subject to Agency review and approval.

- 2.1 Project Management
- 2.2 Soil Gas Sampling Probe Installation
- 2.3 Purge Volume Test
- 2.4 Leak Test
- 2.5 Purge/Sample Flow Rate
- 2.6 Soil Gas Sampling
- 2.7 Analysis of Soil Gas Samples

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2.1 Project Management

2.1.1 <u>Workplan</u>: An appropriate workplan should be prepared and submitted to the Agency for review and approval at least 30 days prior to its implementation. Any variations or deviations from this Advisory should be specified in the workplan. The soil gas workplan can either be incorporated as part of a comprehensive site investigation workplan or as a stand-alone document, depending on site-specific circumstances.

2.1.2 Field Activities

- A. The Agency should be notified 10 working days prior to implementation of field activities. All necessary permits and utility clearance(s) should be obtained prior to conducting any investigations described in this Advisory.
- B. All engineering or geologic work (e.g., logging continuous soil cores, soil description) should be performed or supervised by a California Registered Professional in accordance with the Business and Professions Code, Chapters 7 and 12.5, and the California Code of Regulations, Title 16, Chapters 5 and 29.

In addition, for proposed school sites, all work performed should be under the direction and supervision of a project coordinator experienced in soil gas investigations [e.g., an Environmental Assessor as defined in Education Code Section 17210(b)].

- C. Evaluation of raw data by Agency staff may occur either in the field or in the office.
 - 1. Hard copies of the complete raw laboratory data, including handwritten data and field notes, should be provided to the Agency staff upon request.
 - 2. Adjustments or modifications to the sampling program may be required by Agency staff to accommodate changes mandated by evaluation of the data set or unforeseen site conditions.
- D. Investigation derived wastes (IDWs) should be managed as hazardous waste until proven otherwise or until specifically approved by the Agency as being non-hazardous waste. IDWs should be handled and disposed in accordance with federal, state and local requirements.

- E. Field Variations
 - 1. To expedite the completion of field activities and avoid potential project delays, contingencies should be proposed and included in the project workplan (e.g., soil matrix samples will also be collected if clayey soils [as defined in the Unified Soil Classification System (USCS)] are encountered during the proposed soil gas investigation).
 - 2. The Agency field staff should be informed of any problems, unforeseen site conditions, or deviations from the approved workplan. When it becomes necessary to implement modifications to the approved workplan, the Agency should be notified and a verbal approval should be obtained before implementing changes.
- F. <u>Soil Matrix Sampling Requirements</u>: Companion soil matrix sampling may be conducted concurrently with a soil gas investigation (in accordance with the ASGI, Section 5.0), except where extremely coarse-grained soils (as defined in USCS) are encountered or when specifically excluded by the Agency.
- 2.1.3 <u>Soil Gas Investigation Reports</u>: A soil gas investigation report including a discussion of field operations, deviations from the approved workplan, data inconsistencies, and other significant operational details should be prepared. The report may either be a stand-alone document in a format recommended by the Agency or be included within a site-specific assessment report. At a minimum, the report should contain the following:
 - A. Site plan map and probe location map at an appropriate scale as specified in the workplan (e.g., scale: one inch = 40 feet);
 - B. Final soil gas iso-concentration maps for contaminants of concern at the same scale as the site plan map;
 - C. Summary tables for analytical data, in micrograms per liter (μ g/L), in accordance with the ASGI;
 - D. Legible copies of field and laboratory notes or logs;
 - E. All analytical results and Quality Assurance/Quality Control (QA/QC) information including tables and explanations of procedures, results, corrective actions and effect on the data, in the format specified by the Agency; and
 - F. Upon request, all raw data including chromatograms and calibration data should be submitted to the Agency.

- 2.2 Soil Gas Sampling Probe Installation
 - 2.2.1 <u>Lithology</u>: Site soil or lithologic information should be used to select appropriate locations and depths for soil gas probes. If on-site lithologic information is not available prior to conducting the soil gas investigation, at least one (1) continuously cored boring to the proposed greatest depth of the soil gas investigation should be installed at the first sampling location, unless specifically waived or deferred by Agency. Depending on site conditions, additional continuously cored borings may be necessary.
 - A. Lithologic logs should be prepared for all borings (e.g., continuously cored borings, soil matrix sampling, geotechnical sampling, etc.). Note: This does not apply to direct-push soil gas probe installations.
 - B. Information gathered from the continuously cored borings may include soil physical parameters, geotechnical data and contaminant data.
 - C. If low-flow or no-flow conditions (e.g., fine-grained soil, clay, soil with vacuum readings that exceed approximately 10 inches of mercury or 136 inches of water) are encountered, soil matrix sampling using EPA Method 5035A should be conducted in these specific areas. Also see Section 4 of LARWQCB's "General Laboratory Testing Requirements for Petroleum Hydrocarbon Impacted Sites" on use of EPA Method 5035A.
 - D. If the bottom five (5) feet of a continuously cored boring is composed of clay or soil with a vacuum exceeding approximately 10 inches of mercury or 136 inches of water, the continuously cored boring should be extended an additional five (5) feet to identify permeable zones. If the extended boring is also composed entirely of clay, the boring may be terminated. Special consideration should always be given to advancing borings and ensuring that a contaminant pathway is not being created through a low permeability zone.
 - 2.2.2 <u>Sample Spacing</u>: A scaled site plan depicting potential or known areas of concern (e.g., existing or former sumps, trenches, drains, sewer lines, clarifiers, septic systems, piping, underground storage tanks [USTs], chemical or waste management units) should be provided in the project workplan. Sample spacing should be in accordance with the most current ASGI and may be modified based on site-specific conditions with Agency approval. To optimize detecting and delineating VOCs, the grid spacing should be modified to include biased sampling locations.

- 2.2.3 <u>Sample Depth</u>: Sample depths should be chosen to minimize the effects of changes in barometric pressure, temperature, or breakthrough of ambient air from the surface; and to ensure that representative samples are collected. Consideration should be given to the types of chemicals of concern and the lithology encountered.
 - A. At each sample location, soil gas probes should be installed at a minimum of one sample depth, generally at five (5) feet below ground surface (bgs), in accordance with the most current ASGI.
 - B. Samples should be collected near lithologic interfaces or based on field instrument readings (e.g., Flame Ionization Detector [FID], Photo Ionization Detector [PID]) from soil cuttings and/or cores to determine the location of maximum analyte concentrations at the top or bottom of the interface depending upon the analyte.
 - C. Multi-depth sampling is appropriate for any of the following locations:
 - Sites identified with subsurface structures (e.g., USTs, sumps, clarifiers, waste or chemical management units), subsurface sources (e.g., oil fields, artificial fill, buried animal waste), changes in lithology, and/or contaminated groundwater. Soil gas probes should be emplaced below the base of any subsurface structures, sources or backfilled materials in the vadose zone. Collection of deeper samples should be done in consultation with Agency staff;
 - 2. Areas with significantly elevated VOC concentrations detected during shallow or previous vapor sampling;
 - 3. Areas where elevated field instrument readings are encountered from soil matrix cuttings, cores or samples; or
 - 4. In the annular space of groundwater monitoring wells during construction, where an assessment of the vertical extent of soil gas contamination is necessary.
 - D. If no lithologic change or contamination is observed, default sampling depths may be selected for multi-depth sampling. For example, soil gas samples may be collected at 5, 15, 25, 40 feet bgs, etc., until either the groundwater is encountered or VOCs are not detected, whichever comes first.
 - 1. Additional samples may be necessary based on site conditions.
 - 2. For Preliminary Endangerment Assessments: When 40 feet bgs is reached, collection of deeper samples may be waived.

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However, assessment and/or characterization of the deeper vadose zone may be required in the future to protect groundwater resources.

- 2.2.4 <u>Sampling Tubes</u>: Sampling tubes should be of a small diameter (1/8 to 1/4 inch) and made of material (e.g., nylon, polyethylene, copper or stainless steel) which will not react or interact with site contaminants. For example, metal tubes should not be used for collection of hydrogen sulfide samples.
 - A. Clean, dry tubing should be utilized at all times. If moisture, water, or an unknown material is present in the probe prior to insertion, the tubing should be decontaminated or replaced.
 - B. After use at each location:
 - 1. Non-reusable (e.g., nylon or polyethylene) sampling tubes should be discarded; or
 - 2. Reusable sampling tubes should be properly decontaminated as specified in Section 2.2.7.
 - C. A drawing of the proposed probe tip design and construction should be included in the project workplan.

2.2.5 Soil Gas Probe Emplacement Methods

- A. <u>Permanent or Semi-permanent Soil Gas Probe Methods</u>: Permanent or semi-permanent soil gas probes may be installed, using a variety of drilling methods. Please note that the mud rotary drilling method is not acceptable for soil gas probe emplacement. Other drilling methods such as air rotary and rotosonic can adversely affect soil gas data during and after drilling and will require extensive equilibration times. Therefore, they are not recommended. Other soil gas probe designs and construction (e.g., soil gas wells or nested wells) may be appropriate and should be discussed with Agency staff prior to emplacement. When additional sampling is not anticipated per consultation with the Agency, such probes may be properly removed or decommissioned after completion of the soil gas investigation.
 - The probe tip should be emplaced midway within a minimum of one (1) foot of sand pack. The sand pack should be appropriately sized (e.g., no smaller than the adjacent formation) and installed to minimize disruption of airflow to the sampling tip. See Figure 1 for more information.
 - 2. At least one (1) foot of dry granular bentonite should be emplaced on top of each sand pack to preclude the infiltration

of hydrated bentonite grout. The borehole should be grouted to the surface with hydrated bentonite. With respect to deep probe construction with multiple probe depths, the borehole should be grouted between probes. One (1) foot of dry granular bentonite should be emplaced between the filter pack and the grout at each probe location. See Figure 2 for more information.

- 3. The use of a downhole probe support may be required for deep probe construction (e.g., 40 feet bgs for direct push probes).
 - Such probe support may be constructed from a one-inch diameter bentonite/cement grouted PVC pipe or other solid rod, or equivalent, allowing probes to be positioned at measured intervals.
 - b. The support should be properly sealed or solid (internally or externally) to avoid possible cross-contamination or ambient air intrusion.
 - c. The probes should be properly attached to the exterior of the support prior to placement downhole.
 - d. Alternative probe support designs should be described in the project workplan. If probe support will not be used for deep probes, justification should be included in the project workplan.
- 4. Tubing should be properly marked at the surface to identify the probe location and depth.
- 5. As-built diagrams for probes or wells should be submitted with the soil gas investigation report detailing the well identification and corresponding probe depths. A typical probe construction diagram may be submitted for probes with common design and installation.
- 6. Unless soil gas probes are removed or decommissioned, probes should be properly secured, capped and completed to prevent infiltration of water or ambient air into the subsurface and to prevent accidental damage or vandalism. For surface completions, the following components may be installed:
 - a. Gas-tight valve or fitting for capping the sampling tube;
 - b. Utility vault or meter box with ventilation holes and lock;
 - c. Surface seal; and
 - d. Guard posts.

- B. <u>Temporary Soil Gas Probe Emplacement Method</u>: In general, the drive rod is driven to a predetermined depth and then pulled back to expose the inlets of the soil gas probe. After sample collection, both the drive rod and tubing are removed.
 - 1. During installation of the probe, hydrated bentonite should be used to seal around the drive rod at ground surface to prevent ambient air intrusion from occurring.
 - 2. The inner soil gas pathway from probe tip to the surface should be continuously sealed (e.g., a sampling tube attached to a screw adapter fitted with an o-ring and connected to the probe tip) to prevent infiltration.
- 2.2.6 <u>Equilibration Time</u>: During probe emplacement, subsurface conditions are disturbed. To allow for subsurface conditions to equilibrate, the following equilibration times are recommended:
 - A. For probes installed with the direct push method where the drive rod remains in the ground, purge volume test, leak test, and soil gas sampling should not be conducted for at least 20 minutes following probe installation.
 - B. For probes installed with the direct push method where the drive rod does not remain in the ground, purge volume test, leak test, and soil gas sampling should not be conducted for at least 30 minutes following probe installation.
 - C. For probes installed with hollow stem drilling methods, purge volume test, leak test, and soil gas sampling should not be conducted for at least 48 hours (depending on site lithologic or drilling conditions) after the soil gas probe installation.
 - D. Probe installation time should be recorded in the field log book.
- 2.2.7 <u>Decontamination</u>: After each use, drive rods and other reusable components should be properly decontaminated to prevent cross contamination. These methods include:
 - A. 3-stage wash and rinse (e.g., wash equipment with a nonphosphate detergent, rinse with tap water, and finally rinse with distilled water); and/or
 - B. Steam cleaning process.
- 2.3 Purge Volume Test

To ensure stagnant or ambient air is removed from the sampling system and to assure samples collected are representative of subsurface conditions, a

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purge volume versus contaminant concentration test should be conducted as the first soil gas sampling activity at the selected purge test point. The purge volume test is conducted by collecting and analyzing a sample for target compounds after the removal of appropriate purge volumes.

- 2.3.1 <u>Purge Test Locations</u>: The purge test location should be selected as near as possible to the anticipated or confirmed contaminant source, and in an area where soil gas concentrations are expected to be greatest based on lithology (e.g., coarse-grained sediments). The first purge test location should be selected through the workplan approval process or as a field decision in conjunction with Agency staff.
- 2.3.2 <u>Purge Volume</u>: The purge volume or "dead space volume" can be estimated based on a summation of the volume of the sample container (e.g., glass bulbs), internal volume of tubing used, and annular space around the probe tip. Summa[™] canisters, syringe, and Tedlar[™] bags are not included in the dead space volume calculation. The Agency recommends step purge tests of one (1), three (3), and seven (7) purge volumes be conducted as a means to determine the purge volume to be applied at all sampling points.
 - A. The appropriate purge volume should be selected based on the highest concentration for the compound(s) of concern detected during the step purge tests. The purge volume should be optimized for the compound(s) of greatest concern in accordance with Section 2.2 of the ASGI.
 - B. If VOCs are not detected in any of the step purge tests, a default of three (3) purge volumes should be extracted prior to sampling.
 - C. The step purge tests and purging should be conducted at the same rate soil gas is to be sampled (see Section 2.5).
 - D. The purge test data (e.g., calculated purge volume, rate and duration of each purge step) should be included in the report to support the purge volume selection.

2.3.3 Additional Purge Volume Test

- A. Additional purge volume tests should be performed to ensure appropriate purge volumes are extracted if:
 - 1. Widely variable or different site soils are encountered; or
 - 2. The default purge volume is used and a VOC is newly detected.

- B. If a new purge volume is selected after additional step purge tests are conducted, the soil gas investigation should be continued as follows:
 - 1. In areas of the same or similar lithologic conditions:
 - a. Re-sample 20 percent of the previously completed probes. This re-sampling requirement may be reduced or waived in consultation with Agency staff, depending on site conditions. If re-sampling indicates higher detections (e.g., more than 50 percent difference in samples detected at greater than or equal to $10 \ \mu g/L$), all other previous probes should be re-sampled using the new purge volume.
 - b. Continue the soil gas investigation with the newly selected purge volume in the remaining areas.
 - 2. In areas of different lithologic conditions: Continue the soil gas investigation with the newly selected purge volume in the remaining areas.
- 2.4 Leak Test

Leakage during soil gas sampling may dilute samples with ambient air and produce results that underestimate actual site concentrations or contaminate the sample with external contaminants. Leak tests should be conducted to determine whether leakage is present (e.g., the leak check compound is detected and confirmed in the test sample after its application).

- 2.4.1 Leak tests should be conducted at every soil gas probe.
- 2.4.2 <u>Leak Check Compounds</u>: Tracer compounds, such as pentane, isopropanol, isobutene, propane, and butane, may be used as leak check compounds, if a detection limit (DL) of 10 μ g/L or less can be achieved. These compounds may be contained in common products such as shaving cream.
- 2.4.3 A leak check compound should be placed at any location where ambient air could enter the sampling system or where cross contamination may occur, immediately before sampling. Locations of potential ambient air intrusion include:
 - A. Sample system connections;
 - B. Surface bentonite seals (e.g., around rods and tubing); or
 - C. Top of the Temporary Soil Gas Probe (see Section 2.2.5.B).

- 2.4.4 The leak test should include an analysis of the leak check compound. If a leak check compound is detected in the sample, the following actions should be followed:
 - A. The cause of the leak should be evaluated, determined and corrected through confirmation sampling;
 - B. If the leak check compound is suspected or detected as a sitespecific contaminant, a new leak check compound should be used;
 - C. If leakage is confirmed and the problem can not be corrected, the soil gas probe should be properly decommissioned;
 - D. A replacement probe should be installed at least five (5) feet from the original probe decommissioned due to confirmed leakage, or consult with Agency staff; and
 - E. The leak check compound concentration detected in the soil gas sample should be included and discussed in the report.

2.5 Purge/Sample Flow Rate

Sampling and purging flow rates should not enhance compound partitioning during soil gas sampling. Samples should not be collected if field conditions as specified in Section 2.6.4 exist.

- 2.5.1 The purging or sampling flow rate should be attainable in the lithology adjacent to the soil gas probe.
 - A. To evaluate lithologic conditions adjacent to the soil gas probe (e.g., where no-flow or low-flow conditions), a vacuum gauge or similar device should be used between the soil gas sample tubing and the soil gas extraction devices (e.g., vacuum pump, Summa[™] canister).
 - B. Gas tight syringes may also be used to qualitatively determine if a high vacuum soil condition (e.g., suction is felt while the plunger is being withdrawn) is present.
- 2.5.2 The Agency recommends purging or sampling at rates between 100 to 200 milliliters per minute (ml/min) to limit stripping, prevent ambient air from diluting the soil gas samples, and to reduce the variability of purging rates. The low flow purge rate increases the likelihood that representative samples may be collected. The purge/sample rate may be modified based on conditions encountered in individual soil gas probes. These modified rates should be documented in the soil gas report.

2.6 Soil Gas Sampling

After the soil gas probe is adequately purged, samples should be collected by appropriate methodologies.

- 2.6.1 <u>Sample Container</u>: Samples should be collected in gas-tight, opaque/dark containers (e.g., syringes, glass bulbs wrapped in aluminum foil, Summa[™] canisters), so that light-sensitive or halogenated VOCs (e.g., vinyl chloride) will not degrade.
 - A. If a syringe is used, it should be leak-checked before each use by closing the exit valve and attempting to force ambient air through the needle.
 - B. If syringe samples are analyzed within five (5) minutes of collection, aluminum foil wrapping may not be necessary.
 - C. EPA Method TO-14A, TO-15, or an equivalent air analysis method, requires samples be collected in Summa[™] canisters.
 - D. If a Summa[™] canister is used, a flow regulator should be placed between the probe and the Summa[™] canister to ensure the Summa[™] canister is filled at the flow rate as specified in Section 2.5.2.
 - E. Tedlar™ bags should not be used to collect VOC samples.
 - F. Specific requirements for methane and hydrogen sulfide sample containers are specified in Section 2.7.9.

2.6.2 Sample Collection

- A. <u>Vacuum Pump</u>: When a vacuum pump is used, samples should be collected on the intake side of the vacuum pump to prevent potential contamination from the pump. Vacuum readings or qualitative evidence of a vacuum should be recorded on field data sheets for each sample.
- B. <u>Shallow Samples</u>: Care needs to be observed when collecting shallow soil gas samples to avoid sample breakthrough from the surface. Extensive purging or use of large volume sample containers (e.g., Summa[™] canisters) should be avoided for collection of near-surface samples [e.g., shallower than five (5) feet bgs].

2.6.3 Sample Container Cleanliness and Decontamination

- A. Prior to its first use at a site, each sample container should be assured clean by the analytical laboratory as follows:
 - 1. New containers should be determined to be free of contaminants (e.g., lubricants) by either the supplier or the analytical laboratory; and
 - 2. Reused/recycled containers: Method blank(s), as specified in Section 2.7.1.A, should be used to verify sample container cleanliness.
- B. After each use, reusable sample containers should be properly decontaminated.
 - Glass syringes or bulbs should be disassembled and baked at 240° C for a minimum of 15 minutes or at 120° C for a minimum of 30 minutes, or be decontaminated by an equivalent method.
 - 2. Summa[™] canisters should be properly decontaminated as specified by appropriate EPA analytical methods.
 - 3. During sampling activities using reused/recycled sampling containers (e.g., glass syringes, glass bulbs), at a minimum one (1) decontaminated sample container per 20 samples or per every 12 hours, whichever is more often, should be used as a method blank (as specified in Section 2.7.1.A) to verify and evaluate the effectiveness of decontamination procedures.
- C. Plastic syringes should be used only once and then properly discarded.
- 2.6.4 <u>Field Conditions</u>: Field conditions, such as rainfall, irrigation, finegrained sediments, or drilling conditions may affect the ability to collect soil gas samples.
 - A. <u>Wet Conditions</u>: If no-flow or low-flow conditions are caused by wet soils, the soil gas sampling should cease. In addition, the Agency recommends that the soil gas sampling should not be conducted during or immediately after a significant rain event (e.g., 1/2 inch or greater) or onsite watering.
 - B. If low flow conditions are determined to be from a specific lithology, a new probe should be installed at a greater depth or a new lateral location should be selected after evaluation of the site lithologic logs (See Section 2.2.1) or in consultation with Agency staff.

- C. If moisture or unknown material is observed in the glass bulb or syringe, soil gas sampling should cease until the cause of the problem is determined and corrected.
- D. If refusal occurs during drilling, soil gas samples should be collected as follows or in consultation with Agency staff.
 - 1. For sample depths less than five feet, collect a soil gas sample following the precautions outlined in Section 2.6.2.B.
 - 2. For sample depths greater than five feet, collect a soil gas sample at the depth of refusal.
 - 3. A replacement probe should be installed within five (5) feet laterally from the original probe decommissioned due to refusal. If refusal still occurs after three tries, the sampling location may be abandoned.
- 2.6.5 <u>Chain of Custody Records</u>: A chain of custody form should be completed to maintain the custodial integrity of a sample. Probe installation times and sample collection times should be included in the soil gas report.
- 2.7 Analysis of Soil Gas Samples
 - 2.7.1 <u>Quality Assurance/Quality Control (QA/QC)</u>: The soil gas analytical laboratory should comply with the project Quality Assurance Project Plan (QAPP) and follow the QA/QC requirements of the most current ASGI and the employed EPA Method. If there is any inconsistency, the most restrictive and specific requirements should prevail. The analytical data should be consistent with the Data Quality Objectives (DQOs) established for the project. The Agency staff may inspect the field and/or laboratory QA/QC procedures. Copies of the QA/QC plan and laboratory calibration data should be presented to the Agency field staff upon request.

Field QC samples should be collected, stored, transported and analyzed in a manner consistent with site samples. The following QC samples should be collected to support the sampling activity:

- A. Sample Blanks
 - 1. <u>Method Blanks</u>: Method blanks should be used to verify the effectiveness of decontamination procedures as specified in Section 2.6.3.B.3 and to detect any possible interference from ambient air.
 - 2. <u>Trip Blanks for Off-site Shipments</u>: Whenever VOC samples are shipped offsite for analysis, a minimum of one (1) trip blank

per day should be collected and analyzed for the target compounds. Trip blanks, consisting of laboratory grade ultra pure air, are prepared to evaluate if the shipping and handling procedures are introducing contaminants into the samples, and if cross contamination in the form of VOC migration has occurred between the collected VOC samples. Trip blank containers and media should be the same as site samples.

- B. <u>Duplicate Samples</u>: At least one (1) duplicate sample per laboratory per day should be field duplicate(s). Duplicate samples should be collected from areas of concern.
 - 1. Duplicate samples should be collected in separate sample containers, at the same location and depth.
 - 2. Duplicate samples should be collected immediately after the original sample.
- C. <u>Laboratory Control Samples and Dilution Procedure Duplicates</u>: Laboratory Control Samples (LCS) and Dilution Procedure Duplicates (DPD) should be done in accordance with the most recent ASGI (Sections 3.5.0 and 3.12.4, respectively).
- D. <u>Split Samples</u>: The Agency staff may request that split samples be collected and analyzed by a separate laboratory.
- 2.7.2 <u>Laboratory Certification</u>: Although the California Department of Health Services, Environmental Laboratory Accreditation Program (ELAP) does not currently require certification for soil gas analytical laboratories, the Agency recommends laboratories utilizing EPA Methods 8260B, 8021B, and 8015B for analyses of soil gas samples obtain ELAP certifications for such EPA analytical methods accordingly. The Agency or DTSC's Hazardous Materials Laboratory (HML) staff may inspect the laboratory.
- 2.7.3 <u>Detection Limits for Target Compounds</u>: Analytical equipment calibration should be in accordance with the most current ASGI. Consideration and determination of appropriate DLs should be based on the DQOs of the investigation.
 - A. The DL for leak check compounds should be $10 \mu g/L$ or less (see Section 2.4.2). The DL for oxygen (O₂) and carbon dioxide (CO₂) should be one (1) percent or less. The DLs for methane and hydrogen sulfide are specified in Section 2.7.9.
 - B. If the investigation is being conducted to delineate the extent of contamination, a DL of 1 μ g/L is appropriate for all targeted VOCs.

- C. If the soil gas data are to be used to support risk assessment activities, a DL of 1 μg/L may be appropriate for the initial screening when evaluating all targeted VOCs. If the data are non-detect for all targeted VOCs, additional sampling with lower DLs is not required. If VOCs are detected, additional sampling, using a DL of 0.1 μg/L, may be required to confirm the non-detection of carcinogenic VOCs [see the Toxicity Criteria Database of the California Environmental Protection Agency, Office of Environmental Health Hazard (OEHHA), or the Integrated Risk Information System (IRIS) Database of the United States Environmental Protection Agency]. A DL of 0.1 μg/L may be proposed and used for all carcinogenic target VOCs from the beginning of the investigation.
- D. Based on site-specific DQO needs, lower DLs may be required. Examples of sites requiring site-specifc DQO needs include, but are not limited to, chlorinated solvents sites, former industrial facilities and landfills. Several less common VOCs, not included on the ASGI-targeted compound list, may require lower detection limits [e.g., bis(chloromethyl)ether, DBCP (1,2-dibromo-3chloropropane), or ethylene dibromide] when they are known or suspected to be present.
- E. If the required DLs cannot be achieved by the proposed analytical method, additional sample analysis by a method achieving these DLs [e.g., EPA Method 8260B with selective ion method (SIM), TO-14A, TO-15] may be required. Use of these methods should comply with the QA/QC requirements as specified in Section 2.7.1.
- F. For results with a high DL reported (e.g., due to matrix interference or dilution), the laboratory should provide a written explanation. Re-sampling and analyses may be required at the appropriate DL for a specific compound.
- 2.7.4 <u>Sample Handling</u>: Exposure to light, changes in temperature and pressure will accelerate sample degradation. To protect sample integrity:
 - A. Soil gas samples should not be chilled;
 - B. Soil gas samples should not be subjected to changes in ambient pressure. Shipping of sample containers by air should be avoided; and
 - C. If condensation is observed in the sample container, the sample should be discarded and a new sample should be collected.

- 2.7.5 <u>Holding Time</u>: All soil gas samples (e.g., samples of VOCs, methane, fixed gases, or biogenic gases), with the exception of hydrogen sulfide samples, should be analyzed within 30 minutes by an on-site mobile laboratory. Hydrogen sulfide samples should be analyzed as specified in Section 2.7.9.B.2. Under the following conditions, holding times may be extended and analyses performed off-site:
 - A. Soil gas samples collected in glass bulbs with surrogates added within 15 minutes of collection may be analyzed within 4 hours after collection;
 - B. Soil gas samples collected in Summa[™] canisters may be analyzed within 72 hours after collection; and
 - C. Methane samples may be analyzed as specified in Section 2.7.9.A.2.
- 2.7.6 Analytical Methods
 - A. <u>VOC Samples</u>: All VOC samples should be analyzed using only a Gas Chromatograph/Mass Spectrometer (GC/MS) method (e.g., EPA Method 8260B, used for analysis of soil gas samples, EPA Method TO-14A or TO-15, or equivalent), except at wellcharacterized sites (e.g., VOCs are known to be present and confirmed based on previous GC/MS analyses). A non-GC/MS method (e.g., EPA Method 8021B, used for analysis of soil gas samples) may be used only for routine monitoring of VOC contamination at well-characterized sites.

If during routine monitoring, new VOC(s) were detected by a non-GC/MS method, then at least 10 percent of the samples with each newly identified VOC should be confirmed by a GC/MS method. Thereafter, routine monitoring can resume with the non-GC/MS method, including the new analyte(s).

- B. <u>Methane and Hydrogen Sulfide Samples</u>: These gas samples should be analyzed using methods specified in Section 2.7.9.
- 2.7.7 Auto samplers may be used if:
 - A. One (1) sample is introduced at a time;
 - B. The sample vials are gas-tight and never opened after the sample is added;
 - C. Proper holding times are maintained (see Section 2.7.5); and
 - D. All samples are secured and under proper custody.

2.7.8 Target Compounds

A. <u>VOCs</u>

- 1. <u>ASGI-Targeted Compounds</u>: The ASGI (dated February 25, 1997) includes 23 primary and four (4) other target VOCs. All quantifiable results should be reported.
- 2. <u>Others</u>: The estimated results of all Tentatively Identified Compounds [TICs]) or non-AGSI-targeted compounds detected should be included in the report. If TICs or non-ASGItargeted compounds are identified, contact the Agency to determine whether additional action is required (e.g., running additional standards to quantify TICs or non-ASGI compounds) and whether the use of these estimated data for risk evaluation is appropriate.
- B. <u>Leak Check Compounds</u>: All quantifiable results should be reported as specified in Section 2.4.4.E.
- C. <u>Specific Compounds</u>: Based on the site history and conditions, analyses for specific compounds may be required by the Agency staff. Examples include:
 - In areas where USTs or fuel pipelines are identified, soil gas samples should be analyzed for oxygenated compounds [e.g., methyl tertiary butyl ether (MTBE), ethyl tertiary butyl ether (ETBE), di-isopropyl ether (DIPE), tertiary amyl methyl ether (TAME), tertiary butyl alcohol (TBA), and ethanol];
 - 2. At oilfield sites where semi-VOCs or Total Petroleum Hydrocarbons (TPHs) are detected in the soil gas samples, fixed and biogenic gas (O₂, CO₂, and CH₄) data should be obtained using a Thermal-Conductivity Detector (TCD) or a hand-held instrument;
 - At petroleum contaminated sites (including oilfields), dairies, wetlands, landfills or other sites where the presence of methane and/or hydrogen sulfide is suspected, soil gas samples should be analyzed for methane and/or hydrogen sulfide;
 - 4. At sites where use of chlorinated solvents with 1,4-dioxane is suspected or known to exist, soil gas samples may be analyzed for 1,4-dioxane with a detection limit of 1 μ g/L; or
 - 5. See Section 2.7.9.A.4 below.

2.7.9 <u>Methane and Hydrogen Sulfide Sampling Programs</u>: If the presence of methane and/or hydrogen sulfide is suspected, they should also be included in the analytical plan. After evaluating the initial soil gas data, the Agency may recommend that testing for methane or hydrogen sulfide cease.

- A. <u>Methane Sampling Program</u>: Methane samples may be analyzed by a GC using modified EPA Method 8015B, EPA Method TO-3, or ASTM 3416M (EPA 3C), or by an appropriate hand-held instrument (e.g., Land Tech Gas Analyzer GA-90, Gas Emissions Monitor GEM-500, GEM-2000).
 - 1. <u>Detection Limit</u>: The DL for methane analysis should not exceed 500 parts per million by volume (ppmv).
 - Methane Sample Containers: In addition to the gas-tight sample containers previously specified in Section 2.6.1, Tedlar[™] bags may be used for collection of methane samples with a holding time of no more than 24 hours.
 - 3. <u>Methane Screening Level</u>: When methane is detected at 1,000 ppmv or more, additional sampling and/or further investigation is recommended to identify the source(s).
 - 4. At sites where methane is investigated and detected at a level of 5,000 ppmv or more, fixed and biogenic gas (O₂, CO₂, and CH₄) data should be obtained using a Thermal-Conductivity Detector (TCD) or a hand-held instrument.
 - 5. To determine that the area is pressurized by migration of gases, pressure readings of each sampling tube system should be recorded in the field logs and reported along with the methane concentration.
 - 6. <u>Special GC Requirements</u>: The GC method requires calibration curves for analytes such as methane since it is not a normal target analyte for such an analytical method.
 - 7. <u>Special Hand-Held Instruments Requirements</u>: Hand-held instruments should be calibrated in accordance with the manufacture's instructions. When a hand-held instrument is used to analyze methane samples, the Agency recommends that at least 10 percent of all positive methane samples (e.g., more than 5,000 ppmv), rounded to the nearest whole number, be confirmed by another hand-held instrument (different unit or brand) or by a GC method.
- B. <u>Hydrogen Sulfide Sampling Program</u>: Hydrogen sulfide may be analyzed by a GC using the South Coast Air Quality Management District (SCAQMD) Method 307-91 or EPA Method 16, or by an

appropriate hand-held instrument (e.g., LTX-310 calibrated for hydrogen sulfide or Jerome 631-X).

- 1. <u>Detection Limit</u>: The DL should be equal to or less than 0.5 ppmv or be sensitive enough to allow for a modeled ambient air concentration (at least one microgram per cubic meter) at the soil surface.
- 2. <u>Holding Time</u>: Hydrogen sulfide samples should be extracted directly into a hand-held analyzer within 30 minutes of collection to minimize the risk of losing the hydrogen sulfide due to reaction with active surfaces. If a hand-held instrument is not used, hydrogen sulfide samples should be analyzed as below:
 - a. Within 30 minutes of collection, using the GC procedures; or
 - b. Within 24 hours of collection, if a surrogate is added to the samples, or 100 percent duplicate samples are collected.
- 3. <u>Sample Containers</u>: The following sample containers are recommended:
 - a. Minimum one (1) liter black Tedlar[™] bag fitted with polypropylene valves or the equivalent;
 - b. 100-ml gas-tight syringe fitted with an inert valve and wrapped in aluminum foil;
 - c. Gas-tight glass bulb wrapped in aluminum foil; or
 - d. Glass-lined or silicon coated Summa™ canister.
- 4. Precautions
 - a. Since hydrogen sulfide is extremely unstable in the presence of oxygen and moisture, contact of hydrogen sulfide samples with them should be avoided.
 - b. Due to the high reactivity of hydrogen sulfide gas, contact of hydrogen sulfide samples with metallic or other non-passive surfaces should be avoided during sample collection, storage and analysis.
 - c. Care must be taken so that GC components do not react with the sample. Typically glass-lined injection ports and TeflonTM tube packed columns are used to avoid loss of hydrogen sulfide due to reaction with active surfaces.

3.0 SOIL PARAMETERS

If the soil gas data will be used in a health risk assessment, an estimation of the indoor air concentration should be performed using soil gas data with an Agency approved or modified predictable indoor air model. Default values of input parameters may be used in accordance with the approved indoor air modeling guidance and in consultation with Agency staff. If default values are not used, site-specific soil parameters should be obtained as discussed below.

To assess health risk, indoor air quality, the threat of groundwater contamination from VOCs, or to evaluate the effectiveness of a proposed remedial technology, the following soil matrix parameters should be obtained from a minimum of three (3) sample locations (at depths* corresponding to or associated with the detected VOCs) for each soil type in association with the soil gas investigation:

- 3.1 Soil description performed and presented in accordance with the Unified Soil Classification System (USCS);
- 3.2 Density;
- 3.3 Organic carbon content of the soil** (by the Walkee Black Method);
- 3.4 Soil moisture;
- 3.5 Effective permeability***;
- 3.6 Porosity; and
- 3.7 Grain size distribution analysis (curve) and evaluation of fine-grained soil content (by wet sieve analysis and any supplementary methods as necessary) to determine the percent clay, silt and sand. (The grain size distribution analysis will be used to classify the soil in accordance with the
 - U. S. Soil Conservation Service [SCS] soil type, which is the same as the
 - U. S. Department of Agriculture soil type.)
- * Samples may be collected from proposed depths at the continuously cored boring.
- ** This input parameter is required for soil matrix VOC samples only. This parameter sample should not be collected from an impacted area.
- *** As an alternative, the measurements of saturated hydraulic conductivity may be used to estimate vapor permeability.

4.0 **REFERENCES**

Additional information may be found in the following documents:

American Society for Testing and Materials (ASTM), "Standard Guide for Soil Gas Monitoring in the Vadose Zone, ASTM Standard D 5314-92," January 1993; Reapproved 2001; website <u>http://www.astm.org</u>

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U.S. Environmental Protection Agency, "U.S. EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review, EPA 540/R-94/012," February 1994; website <u>http://www.epa.gov/region09/ga/superfundclp.html</u>

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California Environmental Protection Agency (Cal/EPA), Office of Environmental Health Hazard (OEHHA), Toxicity Criteria Database; website http://www.oehha.ca.gov/risk/ChemicalDB/index.asp

United States Environmental Protection Agency, Integrated Risk Information System (IRIS) Database; website <u>http://www.epa.gov/iris/</u>

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FOR MORE INFORMATION

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Figures – Soil Gas Probe Emplacement Methods



APPENDIX B

QUALITY ASSURANCE PROJECT PLAN


APPENDIX B

QUALITY ASSURANCE PROJECT PLAN

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- B-6 U.S. ENVIRONMENTAL PROTECTION AGENCY DATA QUALIFIERS

FIGURES

Figure

 B-1
 REGIONAL SITE LOCATION
 410-8370 A

 B-2
 YARD LOCATION
 410-8371 A



ACRONYMS AND ABBREVIATIONS

DQOs	Data Quality Objectives
DTSC	California Environmental Protection Agency, Department of Toxic Substances Control
EPA	U.S. Environmental Protection Agency
the Group	Chatham Site PRP Group
H+A	Hargis + Associates, Inc.
MSDs	Matrix Spike Duplicates
PARCC	Precision, Accuracy, Representativeness, Completeness, and Comparability
PRP	Potentially Responsible Parties
QA	Quality assurance
QAPP	Quality Assurance Project Plan
QC	Quality control
RA	Remedial Action
RPD	Relative Percent Difference
the Site	[See Footnote 1, page 1]
SOPs	Standard Operating Procedures



APPENDIX B

QUALITY ASSURANCE PROJECT PLAN

1.0 INTRODUCTION

This Quality Assurance Project Plan (QAPP) update has been prepared by Hargis + Associates, Inc. (H+A) on behalf of the Chatham Site Potentially Responsible Parties (PRP) Group (the Group) for the Chatham Site¹ located at 2257 Bernardo Avenue, Escondido, California (Figures B-1 and B-2). This QAPP update has been prepared to document the quality assurance/quality control (QA/QC) program conducted in support of current Remedial Action (RA) activities being carried out at the Site. The original Chatham Site QAPP was prepared in December 1993 to support Remedial Investigation / Feasibility Study activities at the Site (H+A, 1993). A QAPP Addendum was subsequently prepared in October 1998 to support soil excavation and removal at the Site, which has since been completed (H+A, 1998 and 2000; DTSC, 2000). This QAPP update is intended to supersede the 1993 QAPP, and the 1998 QAPP Addendum. This QAPP has been prepared in general accordance with U.S. Environmental Protection Agency (EPA) guidelines (EPA, 1996, 2000, 2001, and 2002).

This QA/QC program will be implemented to support RA activities conducted pursuant to the requirements of the Consent Decree between the California Environmental Protection Agency, Department of Toxic Substances Control (DTSC) and the Group (DTSC, 1999). Under the Consent Decree, the Group continues to implement the selected groundwater remedy described in the DTSC-approved Remedial Action Plan (DTSC, 1998).

This appendix describes the data quality management and QA oversight for the field tasks.

¹ The "Site" shall include the areal extent of any known or suspected release or threatened release of a hazardous substance, pollutant, or contaminant originating at the Yard (as defined herein). The Site includes but is not limited to a 5-acre portion of real property commonly known as the Chatham Brothers Barrel Yard located at 2257 Bernardo Avenue (hereinafter referred to as the "Yard"), Escondido, California, which is part of a 35-acre parcel (the "Property"), as well as property located at 1261 Gamble Lane (the "Gamble Lane Property"), Escondido, California.



2.0 DATA QUALITY MANAGEMENT

The data quality management program is designed to ensure that QC procedures are adhered to from data collection to report preparation. Data obtained will be used to prepare data submittals summarizing field activities, to prepare technical memoranda and monitoring reports, and to make decisions with regard to other RA activities. Data quality management will be initiated prior to data collection by implementing QC procedures established to ensure that data are obtained and analyzed in a manner consistent with QA objectives and are representative of the actual Site conditions. The following sections summarize field and laboratory data quality management and assessment for RA activities at the Site.

2.1 DATA MANAGEMENT

Field and laboratory data will be managed as they are obtained and compiled. Field data will be obtained and compiled in field notebooks or on the appropriate field data forms (Appendix C). Laboratory data will be compiled in the data report packages. Tables will be prepared based on these data for use in data submittals and monitoring reports. Field sampling data sheets and laboratory analytical reports will be included in separate appendices within monitoring reports submitted to DTSC. Use of these standard data reporting forms and tables will ensure that data are presented in a consistent manner.

2.1.1 Field Data

Field notebooks and copies of field data forms will be retained in the project file or as electronic files on the project files server. These data files will contain original data and field notes. Files will be well organized, indexed, verified, and accessible.

Field sampling files will be compiled for groundwater sampling activities. Other field data files will be compiled for soil vapor sampling and any other RA activities that may be required at the Site.

2.1.2 Analytical Data

Analytical data files will be established for RA activities. These data files will be well organized, indexed, verified, and accessible. Analytical data will include original chain-of-custody records, and laboratory data packages assembled by each laboratory performing analyses. These laboratory data packages, including laboratory QC data, will be provided by the laboratory in electronic format. The original chain-of-custody records, copies of field data forms, and the laboratory data packages will be maintained in the H+A project file.



2.2 DATA ASSESSMENT

Data generated from sampling events will be assessed to determine if they meet QC criteria. The quality and appropriate use of data obtained during RA activities will be determined based on the results of routine assessment of 100 percent of the data. Standard Operating Procedures (SOPs) for data assessment have been developed to ensure that these activities are performed in a consistent manner (Section 4.0, Standard Operating Procedures for Data Assessment) (Table B-1).

Analytical data generated during RA activities will be assessed for precision, accuracy, representativeness, completeness, and comparability (PARCC) parameters. Assessment of analytical data will be performed under the supervision of the H+A Project Manager. Laboratories are required to submit analytical results that are supported by sufficient information to enable the reviewer to fully evaluate data quality.

The following activities will occur during the analytical data assessment process:

- Review of chain-of-custody records
- Review of sample holding times
- Review of trip blank and, if required, rinsate blank results
- Review of laboratory reagent blank, spike, surrogate, and duplicate sample results

Data assessment results will be used to flag questionable analytical results and to assign data qualifiers. The results will also be used as a basis to request revised analytical data reports from the laboratory and to initiate corrective action. In addition, results will be used to determine corrective action required for field sampling personnel.

The results of data assessment, including the activities described above and data qualified, will be compiled for each sampling event. These results will be kept on file with a memorandum that explains the reasons for data qualifications and that indicates corrective action to be implemented.

Analytical results will be entered into the project portal database from analytical data reports and/or electronic files provided by the laboratory. The database will be used to ensure that data are organized and easily accessible. Data qualifiers assigned during data assessment will also be entered into the database.



2.3 PRECISION, ACCURACY, REPRESENTATIVENESS, COMPLETENESS, AND COMPARABILITY PARAMETERS

Throughout RA activities, routine procedures will be used to assess PARCC parameters depending on the Data Quality Objectives (DQOs) for the sampling event. DQOs are prepared for field tasks and are described in the SOPs for the respective tasks (Appendix A). QA objectives have also been summarized for anticipated and optional RA activities (Table B-2). Descriptions of the PARCC parameters to be evaluated during data assessment are described in the following sections.

2.3.1 Precision

Precision is a measure of the agreement or reproducibility among replicate measurements. Examination of precision is a means to evaluate the reproducibility of measurements under a given set of conditions. Precision is expressed as the relative percent difference (RPD) between duplicates of the same sample. Duplicates consist of internal laboratory duplicates. Internal laboratory duplicates include sample duplicates and/or matrix spike duplicates (MSDs), depending on the analytical method. Analytical results from laboratory duplicates and laboratory MSDs provide data on laboratory precision. The RPD between duplicate sample results is calculated using the following equation:

$$RPD = 2 \frac{(D1-D2)}{(D1+D2)} \times 100$$

where RPD = relative percent difference;

D1 = first sample value; and

D2 = second sample value (duplicate).

The calculated laboratory RPDs are evaluated and compared to established precision control limits which will be at or below those specified in the respective method. Unacceptable precision values, as defined by the appropriate method, will be noted in the project file. Data associated with unacceptable laboratory precision results will be qualified, and recommendations for corrective action will be discussed with the laboratory, as appropriate.

2.3.2 Accuracy

Accuracy is the degree of agreement between a measured value and an accepted reference or true value. Accuracy can be expressed numerically as the percent recovery of a spiked sample. A sample spike is prepared in the laboratory by adding a known concentration of one or more compounds to one sample in each analytical batch. The spike compounds are chosen from the list of analytes detectable by the method being evaluated. Analytical results from spiked samples provide data on matrix interferences.

Accuracy for the analytical measurement system is defined as the percent recovery for a spiked sample. The percent recovery is calculated as follows:

where P = percent recovery;

- A = measured concentration in spiked sample (sample + spike);
- B = measured concentration in sample; and
- C = known concentration of spike compound.

The calculated percent recovery results are compared to accuracy control limits, which will be established to be at or below those specified in the respective method.

Unacceptable accuracy results, as defined by the appropriate method, will be noted in the project file. Data associated with unacceptable laboratory accuracy results will be qualified, and recommendations for corrective action will be discussed with the laboratory and/or field personnel, as appropriate.

Accuracy may be qualitatively assessed by evaluating blank contamination. Compounds detected in laboratory blanks, trip blanks, and if required, rinsate blanks will be evaluated during the assessment procedures. Data associated with unacceptable blank results will be qualified, and recommendations for corrective action will be discussed with the laboratory and/or field personnel, as appropriate.

2.3.3 Representativeness

Representativeness is the reliability with which a measurement or measurement system reflects the true conditions under investigation. Representativeness is influenced by the number and location of the sampling points, sampling timing and frequency during monitoring events, and field and laboratory sampling procedures.

Representativeness is a qualitative parameter that is addressed by describing sampling techniques and the rationale used to select sampling locations. Sample location selection may be determined based on existing data, instrument surveys or observations, or may be randomly selected. Data used to select sample locations may include water level measurements, water and soil sample results, geologic descriptions such as lithologic logs, and interpretations of study area hydrogeologic conditions.

If applicable, data used in RA activities that were not obtained by the project team will be evaluated against standards outlined in this section for a particular type of sample collection to the extent they are relied upon. For example, water levels measured during a previous investigation at a particular monitor well will be assigned a high level of confidence if the data are accompanied by information on the type of water level measuring device used, the measuring point identification, pumping status of the measured monitor well, and construction details of the



monitor well. If any of this information is missing, the recorded historical water level may be assigned a lower level of confidence or may be rejected for the analysis of historical conditions.

Historical chemical data regarding the nature of groundwater conditions at the Site will be similarly evaluated against the standards developed in this section to the extent they are relied upon. Unless information is available regarding the date and method of sample collection, the firm that collected the sample, the analytical methods employed, and the QA/QC procedures used, the data point will be assigned a lower level of confidence.

Historical information regarding subsurface conditions is often obtained from driller's logs for regional wells. The quality of these driller's logs varies from well to well and from driller to driller. Each driller's log to be used in interpretive evaluations will be judged on the basis of field experience at the Site and on review of existing Site-specific literature regarding subsurface conditions.

2.3.4 Completeness

Completeness is defined as a comparison of the number of valid data points obtained from a measurement effort to the total number needed to meet the project goals. Data completeness incorporates sample loss and data acceptability.

Analytical data completeness is described as the ratio of acceptable analytical results to the total number of results requested. A completeness value of less than 90 percent indicates that corrective action is necessary to limit the number of incomplete or unacceptable results and to avoid similar problems in future sampling events.

Criteria for incomplete or unacceptable results may include vials broken during shipment or at the laboratory and data qualified as unusable during data assessment procedures. Analytical data completeness is calculated using the following equation:

$$C = ($$
number of acceptable results $) \times 100$
total number of requested results

where C = percent completeness.

2.3.5 Comparability

Comparability is a qualitative parameter that expresses the confidence with which one data set can be compared to another. Comparability is dependent on consistency in sampling conditions and on selection of sampling procedures, sample preservation methods, analytical methods, and expressed units of data.

The comparability requirements for field measurement, sampling, and analysis activities are met by complying with SOPs established during sample collection and analysis.



3.0 QUALITY ASSURANCE OVERSIGHT

The H+A Project Manager is responsible for coordinating and/or conducting QA oversight. QA oversight is accomplished by verifying that established QC procedures are followed; by conducting a field procedure audit to ensure that the data being collected are reliable, of good quality, and are representative of Site conditions; by identifying deficiencies and ensuring that corrective actions are implemented when necessary; and by reporting project status to project management on a regular basis.

3.1 FIELD PROCEDURE AUDITS

The Project Manager may schedule periodic reviews of field procedures during RA activities to evaluate the execution of procedures.

The field procedure review would consist of observations and comparison to SOP documentation for the respective field activities. Specific deficiencies if observed will be noted with recommendations for corrective action and follow-up will be discussed at this time. Depending on the severity of the deficiencies, adherence to corrective action recommendations may be verified by a follow-up field review of that deficiency.

3.2 CORRECTIVE ACTION

Results of field and laboratory data assessment and field procedure audits will be used to identify deficiencies so that required corrective action may be initiated. Field data deficiencies and recommendations for corrective action will be discussed with the field personnel during the audit debriefing. The Project Manager will direct the implementation of appropriate corrective action by field personnel. Depending on the severity of the deficiencies, adherence to corrective action recommendations may be verified and documented by a follow-up audit.

Analytical data deficiencies will be discussed with the laboratory and corrected as soon as possible. Laboratory performance deficiencies will be discussed with the Project Manager, and recommendations will be made for corrective action. Depending on the severity of the deficiencies, adherence to corrective action recommendations may be verified by a follow-up audit. Corrective actions taken will be addressed and summarized in the memoranda, which will be retained in H+A project files and summarized in the technical memoranda and/or monitoring reports.



4.0 STANDARD OPERATING PROCEDURES FOR DATA ASSESSMENT

Chemical quality data for samples analyzed using various EPA methods will be reviewed during data assessment activities to determine the quality of the data and to assess its use according to the DQOs established for the specific field sampling activity. This SOP has been prepared to ensure that data assessment activities are performed in a consistent manner.

Data assessment procedures will be performed on all analytical data collected as part of routine project activities.

4.1 DATA ASSESSMENT PROCEDURES

Data assessment procedures include evaluation of the following categories of support documentation associated with analytical data:

- Sample holding times
- Preservation procedures
- Analytical methods and data reporting (Tables B-3 and B-4) (reporting limits for soil vapor samples will be provided in the workplan to be submitted under separate cover)
- Trip blanks and laboratory reagent blanks
- Matrix spike recovery
- Rinsate blanks, if required
- Matrix spike duplicate analysis
- Data trending

Standard procedures will be used to perform routine data assessment of chemical quality data reported by the laboratory and to assign H+A data qualifiers (Table B-5). The H+A data qualifiers were developed to differentiate data qualified by H+A through data assessment procedures from data qualified through data assessment performed by the analyzing laboratory and/or other agency.

Data assessment will be performed using laboratory reports.

4.1.1 Holding Times

A comparison will be made between the sampling date and the date of laboratory analysis for each sample submitted to the laboratory. The analytical results, including less than detection limit results, for samples identified as exceeding the required holding time will be qualified with "E" and will be documented in the summary memorandum or monitoring report.



4.1.2 Analytical Methods and Data Reporting

The laboratory report will be checked against the sample Chain-of-Custody Record to verify that appropriate analytical results were reported for all samples submitted and that the analytical methods requested in sample documentation were used by the laboratory. Instances of requested analyses not included in the laboratory report, due to occurrences such as breakage in the laboratory, misidentification of samples, missing or incomplete analyses, or use of incorrect analytical methods, will be documented in the summary memorandum or monitoring report.

4.1.3 Trip Blanks and Laboratory Reagent Blanks

The laboratory reports will be reviewed to determine whether any analytes were detected in any of the trip blanks or laboratory reagent blanks or, if required, rinsate blanks, associated with the sampling event and analysis procedures. The results of the data search will be documented in the summary memorandum or monitoring report. If an analyte is detected in a blank sample, the following procedures will be performed to identify data subject to qualification:

- Compile a list of blank samples in which analytes were detected including method of analysis, analyte concentration, batch number of water used to prepare the blank, if available, dates of blank sample collection and analysis, and specific laboratory instrument used for blank sample analysis, if applicable.
- For analyte detections in trip blanks, review the laboratory reports for all water samples in which the analyte was detected that were listed on the same Chain-of-Custody Record as the blank sample. Review laboratory reports and identify all detections of the analyte in water samples that were submitted with the blank. Compile a list of identified water sample analytical results for qualification.
- For analyte detections in laboratory reagent blanks, review analytical reports and identify all detections of the analyte in water samples that were analyzed in the same analytical batch. Compile a list of identified water sample analytical results for qualification.
- Assign data qualifiers to the compiled list(s) of results as follows:
 - If the concentration of the analyte detected in a water sample is less than or equal to the concentration in the associated blank, qualify the data with a "U".
 - If the concentration of the analyte detected in a water sample is greater than the concentration in the associated blank but is less than or equal to five times the blank concentration, qualify the data with an "E".
 - If the concentration of the analyte in a water sample is greater than five times the blank concentration, the data is acceptable and will be qualified with an "S".
- Document the review of blank samples and list data qualified in the summary memorandum or monitoring report.



4.1.4 Matrix Spike Recovery

Matrix spike recovery data in the laboratory report will be compared with the acceptable range of percent recovery for each analyte, as specified in the QA section of the laboratory report. If a matrix spike recovery percentage is less than the minimum acceptable percent recovery or greater than the maximum acceptable percent recovery, the following procedures will be used to identify data subject to qualification:

- Compile a list of analyte matrix spike recoveries that are less than the minimum acceptable percent recovery or greater than the maximum acceptable percent recovery, along with sample identifiers and date of spike sample analysis.
- Review the analytical reports to identify all water samples analyzed for the same analyte, for the same analytical method, and on the same date of matrix spike analysis. Compile a list of identified analytical results for qualifications. Do not include less than detection limit results.
- Assign the data qualifier "E" to all analytical results on the compiled list.
- Document the review of matrix spike recovery data and list data qualifiers in the summary memorandum for the data assessment or in the monitoring report.

4.1.5 Matrix Spike Duplicates

Matrix spike duplicate data in the laboratory report will be compared against the acceptable RPDs specified in the QA section of the laboratory report. If a matrix spike duplicate analysis for an analyte exceeds the acceptable RPD for the analyte, the following procedures will be used to identify data subject to qualification:

- Compile a list of analytes for which matrix spike duplicate RPDs are greater than the acceptable RPD for that analyte, including sample identifier of the matrix spike duplicate sample and date of matrix spike duplicate analysis.
- Review the analytical reports to identify all water samples analyzed for the same analyte, using the same method, on the same date of matrix spike duplicate analysis. Compile a list of identified analytical results for qualification. Do not include less than detection limit results.
- Assign the data qualifier "E" to all analytical results on the compiled list.
- Document the review of matrix spike duplicate analyses and list data qualified in the summary memorandum or monitoring report.



4.1.6 Data Trending

Groundwater quality data for a particular sampling event will be compared to previous chemical quality data collected at that same location to identify any analytical results that may require qualification for which no field and/or laboratory quality control problem was identified during the assessment process. This additional review is necessary to alert the user to data that are not representative of the Site. Review of previous analytical results for samples collected from a particular site may include one or all of the following:

- Review of long-term and/or short-term chemical quality hydrographs for all analytes analyzed at the sampling location.
- Review of chemical quality hydrographs for other sampling locations in the same and adjacent hydrogeologic units in the immediate vicinity of the sampling location evaluated.
- Review of maps showing areal distribution of the concentrations of the analyte in the same hydrogeologic unit.
- Review of water level hydrographs, water level contour maps, and pumpage records from nearby regional wells.

Individuals familiar with the hydrogeological conditions at the Site will evaluate this information and identify a list of data that may require qualification. This list will be reviewed by the Project Manager prior to assignment of data qualifiers. Laboratory personnel may be contacted during the review process to ensure that the data subject to review were correctly reported. Analytical results with no associated quality control problem will be assigned the data qualifier "E" if the concentration of the sample subject to review is less than one order of magnitude higher or lower than the expected concentration of the analyte at the sampling location and is clearly outside the historic water quality trends at the Site. Analytical results with no associated quality control problem will be assigned the data qualifier "U" if the concentration of the sample subject to review is greater than or equal to one order of magnitude higher or lower than the expected concentration; is clearly outside of the historic water quality trends at the Site; exhibits a concentration for an analyte not previously detected at the Site; or does not indicate an analyte that is routinely detected at the Site. The results of the review of data based on trend analysis will be documented in the summary memorandum or monitoring report.

4.2 CORRECTIVE ACTION

Corrective actions may be required at any point in the data assessment process. Problems with laboratory or field QC data or analytical results should be relayed as soon as possible by H+A to the Laboratory Manager. The laboratory will be instructed to check raw data and computations, as necessary, to identify any problems due to data transposition, reported units of measurement, or calculation errors. The laboratory may be instructed to re-run a partial sample if sample holding time limits have not been exceeded. The laboratory will issue an amended analytical report if any previously reported data are found to be in error. If major QC problems are identified during data assessment procedures, the Project Manager may request that additional samples be collected from a sample location for laboratory analysis in order to confirm the original results.



4.3 REPORTING

The Project Manager will review the list of all data to be qualified and approve data qualifiers. Analytical results found to be satisfactory based on the data assessment process will be qualified with an "S". H+A data qualifiers, excluding those data qualified with an "S", will appear in tables summarizing the results of water quality analyses.

EPA data qualifiers, with the exception of "U", will appear in tables summarizing the results of water quality analyses (Table B-8). H+A uses a "less than sign" or "negative value" (< or -), to indicate that an analyte was not detected and, therefore, use of EPA's "U" qualifier is not required.

Data with H+A "E" or EPA "J" qualifiers may be used for general Site characterization purposes. These data will not be used for Site decision-making purposes, such as determining the presence or absence of contaminants, determining the effectiveness of remedial actions, assessing the cleanup status of an aquifer, or assessing the attainment of cleanup goals in an aquifer. Data with H+A "U" or EPA "R" qualifiers will not be used for either Site characterization or Site decision-making purposes.



5.0 REFERENCES

- California Environmental Protection Agency, Department of Toxic Substances Control (DTSC), 1998. <u>Remedial Action Plan, Chatham Brothers Barrel Yard, Escondido, California</u>. January 1998.
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- _____, 2000. Letter from H. Jeche to C. McLaughlin, Chatham Site PRP Group, Re: Final Construction Completion Report, Remedial Action, Chatham Site, Escondido, California, dated April 10, 2000. November 13, 2000.
- Hargis + Associates, Inc. (H+A), 1993. <u>Final Remedial Investigation/Feasibility Study Scoping</u> <u>Document and Work Plan, Chatham Brothers Barrel Yard, Escondido, California,</u> <u>Volume III, Quality Assurance Project Plan</u>. December 3, 1993.
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- U.S. Environmental Protection Agency (EPA), 1996. <u>EPA SW 846, Third Edition, Test Methods</u> <u>for Evaluating Solid Waste</u>. Update 1, July 1992; update IIA, August 1993; update II, September 1994; update IIB, January 1995; update III, December 1996.
- _____, 2000. <u>Guidance for the Data Quality Objectives Process</u>; Document Control No. EPA QA/G-4. August 2000.
- _____, 2001. <u>EPA Requirements for Quality Assurance Project Plans;</u> Document Control No. EPA QA/R-5. March 2001.
- _____, 2002. <u>EPA Guidance for Quality Assurance Project Plans;</u> Document control No. EPA QA/G-5. December 2002.

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TABLE B-1 ANALYTICAL DATA ASSESSMENT CHECKLIST

Laboratory	r <u> </u>
Reviewed	By:
Review Da	ite:
Project Na	me:
Project #:	

Category:_____ Method:_____ Parameters:_____

SAMPLE ID#	LABORATORY ID#	<u>SAMPLE</u> TYPE	MATRIX	PARAMETER	QC BATCH ID#	DATE SAMPLED	<u>DATE</u> EXTRACTED/PREP	DATE ANALYZED

TABLE B-1 ANALYTICAL DATA ASSESSMENT CHECKLIST

QUESTION		YES	NO	NA	ASSESSMENT FINDINGS	ASSIGNED QUALIFIER	ASSOCIATED DATA
I. Doc	umentation Verification & Holding Times						
A.	Was the sampling date, sample ID, sample description, and project number on the COC record verified with those on the laboratory analytical report?						
B.	Were the analytical methods specified on the COC record and laboratory work order verified with those on the laboratory analytical report?						
C.	Were the correct sample preservation methods used? Note preservation.						
D.	Were the holding times met for all samples?			- - - - -			
E.	Are the "totals" listed for isomers and metabolites correctly added?			· · ·			

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TABLE B-1 ANALYTICAL DATA ASSESSMENT CHECKLIST

							ASSIGNED	ASSOCIATED
QUESTIO	N		YES	NO	NA	ASSESSMENT FINDINGS	QUALIFIER	DATA
Ш.	Blanks	s, Spikes, and Surrogates						
	A. 1.	Were any analytes detected in the trip blanks? Note the presence of these analytes in the trip blank and their concentrations.						
	2.	Were any of the analytes present in the trip blanks detected in any of the samples? Note these analytes and concentrations.						
	B. 1.	Were any analytes detected in the reagent or method blanks? Note the presence of these analytes in the reagent or method blanks and their concentrations.						
	2.	Were any of the analytes present in the reagent or method blanks detected in any of the samples? Note these analytes and concentrations.						
	C. Ai cr	re check standards or LCS within the laboratory acceptance iteria?						
	D. Ai ac	re the spike recovery results within the laboratory sceptance criteria?						
	E	quation: % Recovery =						
	(<u>c</u>	Spike concentration						

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TABLE B-1 ANALYTICAL DATA ASSESSMENT CHECKLIST

QUESTIO	N	YES	NO	NA	ASSESSMENT FINDINGS	ASSIGNED QUALIFIER	ASSOCIATED DATA
	E. Are RPDs between the spike and spike duplicate within the laboratory acceptance criteria?						
	Equation: RPD =						
	(<u>Spiked sample result - Duplicate spike result</u>) x 100 Average result						
	F. Are the surrogate recovery results within the laboratory acceptance criteria?						
III.	Reportable Detection Limits						
	A. Are the RDLs the same as laboratory established RDLs?						
	B. Are any analytes reported at less than the RDL?						
				•			
	C. Are the RDLs consistent with the dilution factor reported?						
IV	Trending						
	A. Are data comparable to past concentration trends? Note and evaluate any apparent anomalies. Use order of magnitude as a guideline.						



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TABLE B-1 ANALYTICAL DATA ASSESSMENT CHECKLIST

					ASSIGNED	ASSOCIATED
QUESTION	YES	NO	NA	ASSESSMENT FINDINGS	QUALIFIER	DATA

ID	=	Identifier
COC	=	Chain of Custody
LCS	=	Laboratory Control Standards

RPDs Relative percent differences RDLs = Reportable detection limits

FIELD PROCEDURES AND QUALITY ASSURANCE OBJECTIVES

PROCEDURE	EQUIPMENT CHECK AND/OR CALIBRATION	OPERATIONAL PROCEDURE	PERSONNEL	DATA STORAGE SYSTEM	PRECISION	ACCURACY
Water Level Elevation Measurement	Electric water level sounder, steel tape, pressure transducer	SOP and manufacturer instructions for equipment	Field technician, Hydrogeologist	Hard copy, Electronic data	0.01 foot	<u>+</u> 0.1 foot
Water Sample Collection (excludes determination of electrical conductivity, pH, temperature, dissolved oxygen, oxidation-reduction potential and turbidity)	Pumps, sample bottles, shipping containers, transmittal forms, chain-of-custody records, field forms	SOP	Hydrogeologist, field technician	Hard copy	NA	NA
Well Discharge	Container/stopwatch, in-line flow meter	SOP	Hydrogeologist, field technician	Hard copy	5 percent of the discharge rate	<u>+</u> 10 percent
Electrical Conductivity	Conductivity meter, field form	SOP and manufacturer instructions for equipment	Hydrogeologist, field technician	Hard copy	<u>+</u> 5 umhos when scale units are x1	<u>+</u> 10 umhos when scale units are x1
рН	pH meter, field form	SOP and manufacturer instructions for equipment	Hydrogeologist, field technician	Hard copy	<u>+</u> 0.05 pH unit	0.5 pH unit
Temperature	Field thermometer, field form	SOP	Hydrogeologist, field technician	Hard copy	<u>+</u> 0.1°C	<u>+</u> 0.5°C
Dissolved Oxygen	Dissolved oxygen meter or colorimeter equipped with dissolved oxygen filter; field form	SOP and manufacturer instructions for equipment	Hydrogeologist, field technician	Hard copy	<u>+</u> 0.1 ppm	<u>+</u> 0.5 ppm
Oxidation-Reduction Potential	Oxidation-Reduction Potential Tester	SOP and manufacturer instructions for equipment	Hydrogeologist, field technician	Hard copy	<u>+</u> 5 millivolts	<u>+</u> 10 millivolts



TABLE B-2 (Cont'd) FIELD PROCEDURES AND QUALITY ASSURANCE OBJECTIVES Page 2 of 3

PROCEDURE	EQUIPMENT CHECK AND/OR CALIBRATION	OPERATIONAL PROCEDURE	PERSONNEL	DATA STORAGE SYSTEM	PRECISION	ACCURACY
Turbidity	Turbidity meter	SOP and manufacturer instructions for equipment	Hydrogeologist, field technician	Hard copy	1 NTU	5 NTU
Soil Vapor Sample Collection	Steel probe, inert tubing, vapor collection syringe, air pump, Summa canister, shipping containers, transmittal forms, chain-of-custody records, field forms	SOP	Hydrogeologist, engineer, field technician, laboratory technician	Hard copy	NA	NA
Well Drilling and Construction	Pumps, casing	SOP	Field task manager, hydrogeologist	Hard copy	NA	NA
Lithologic Logging	Field Form	SOP	Hydrogeologist	Hard copy	NA	NA
Geophysical Logging	Downhole camera, acoustic televiewer, flowmeter, caliper probe, electric logging tools	SOP and manufacturer instructions for equipment	Hydrogeologist	Hard copy, electronic data files	NA	NA
Surface and Subsurface Soil Sample Collection	Hand trowels, split-spoon sampler, single tube sampler, Pitcher tube sampler, brass sample sleeves, Encore [®] sampler, shipping containers, transmittal forms, chain-of-custody records, field forms	SOP	Hydrogeologist, field technician	Hard copy	NA	NA
Air Monitoring	Photo-Ionization Detector, Flame Ionization Detector, Organic Vapor Analyzer, Explosimeter, Oxygen Detector, Chemical Detection Tubes, field forms	SOP and manufacturer instructions for equipment	Hydrogeologist, engineer, field technician	Hard copy	Instrument- specific	Instrument- specific

HARGIS + ASSOCIATES, INC.

TABLE B-2 (Cont'd) FIELD PROCEDURES AND QUALITY ASSURANCE OBJECTIVES Page 3 of 3

FOOTNOTES:

- SOP = Standard operating procedure NA = Not applicable
- (+) = Plus or minus
- umhos = Micromhos
 - °C = Degrees Celsius
 - ppm = Parts per million
 - NTU = Nephelometric Turbidity Unit

ANALYTICAL METHODS AND DETECTION LIMITS VOLATILE ORGANIC COMPOUNDS

		REPORTING DETECTION LIMITS			
COMPOUND	ANALYTICAL METHOD	Water (ug/l)	<u>Soil (ug/kg)</u>		
Acetone	EPA 8260B	10	50		
Benzene	EPA 8260B	0.5	5		
Bromobenzene	EPA 8260B	1.0	5		
Bromochloromethane	EPA 8260B	1.0	5		
Bromodichloromethane	EPA 8260B	1.0	5		
Bromoform	EPA 8260B	1.0	5		
Bromomethane	EPA 8260B	1.0	5		
2-Butanone	EPA 8260B	10	50		
n-Butylbenzene	EPA 8260B	1.0	5		
sec-Butylbenzene	EPA 8260B	1.0	5		
tert-Butylbenzene	EPA 8260B	1.0	5		
Carbon tetrachloride	EPA 8260B	0.5	5		
Chlorobenzene	EPA 8260B	1.0	5		
Chloroethane	EPA 8260B	1.0	5		
Chloroform	EPA 8260B	1.0	5		
Chloromethane	EPA 8260B	1.0	5		
2-Chlorotoluene	EPA 8260B	1.0	5		
4-Chlorotoluene	EPA 8260B	1.0	5		
Dibromochloromethane	EPA 8260B	1.0	5		
1,2-Dibromo-3-chloropropane	EPA 8260B	5.0	10		
1,2-Dibromoethane	EPA 8260B	1.0	5		
Dibromomethane	EPA 8260B	1.0	5		
1,2-Dichlorobenzene	EPA 8260B	1.0	5		
1,3-Dichlorobenzene	EPA 8260B	1.0	5		
1,4-Dichlorobenzene	EPA 8260B	1.0	5		
Dichlorodifluoromethane	EPA 8260B	2.0	5		
1,1-Dichloroethane	EPA 8260B	1.0	5		
1,2-Dichloroethane	EPA 8260B	0.5	5		
1,1-Dichloroethylene	EPA 8260B	1.0	5		
cis-1,2-Dichloroethylene	EPA 8260B	1.0	5		
trans-1.2-Dichloroethylene	EPA 8260B	1.0	5		
1,2-Dichloropropane	EPA 8260B	1.0	5		
1,3-Dichloropropane	EPA 8260B	1.0	5		
2,2-Dichloropropane	EPA 8260B	1.0	5		
1,1-Dichloropropene	EPA 8260B	1.0	5		
cis-1,3-Dichloropropene	EPA 8260B	0.5	5		
trans-1.3-Dichloropropene	EPA 8260B	0.5	5		
Ethylbenzene	EPA 8260B	0.5	5		
Ethyl Tert-butyl ether (ETBE)	EPA 8260B	1.0	5		
Trichlorotrifluoroethane (Freon 113)	EPA 8260B	2.5	5		
Hexachlorobutadiene	EPA 8260B	1.0	5		
2-Hexanone	EPA 8260B	10	50		
Isopropylbenzene	EPA 8260B	1.0	5		
· · · ·					

ANALYTICAL METHODS AND DETECTION LIMITS VOLATILE ORGANIC COMPOUNDS

		REPORTING DETECTION LIMITS		
COMPOUND	ANALYTICAL METHOD	Water (ug/l)	<u>Soil (ug/kg)</u>	
4-Isopropyltoluene	EPA 8260B	1.0	5	
4-Methyl-2-pentanone	EPA 8260B	10	50	
Methylene Chloride	EPA 8260B	5.0	5	
Methyl tertiary butyl ether (MTBE)	EPA 8260B	1.0	5	
Naphthalene	EPA 8260B	1.0	5	
n-Propylbenzene	EPA 8260B	1.0	5	
Styrene	EPA 8260B	1.0	5	
1,1,1,2-Tetrachloroethane	EPA 8260B	1.0	5	
1,1,2,2-Tetrachloroethane	EPA 8260B	1.0	5	
Tetrachloroethylene	EPA 8260B	1.0	5	
Toluene	EPA 8260B	0.5	5	
1,2,3-Trichlorobenzene	EPA 8260B	1.0	5	
1,2,4-Trichlorobenzene	EPA 8260B	1.0	5	
1,1,1-Trichloroethane	EPA 8260B	1.0	5	
1,1,2-Trichloroethane	EPA 8260B	1.0	5	
Trichloroethylene	EPA 8260B	1.0	5	
Trichlorofluoromethane	EPA 8260B	1.0	5	
1,2,3-Trichloropropane	EPA 8260B	1.0	5	
1,2,4-Trimethylbenzene	EPA 8260B	1.0	5	
1,3,5-Trimethylbenzene	EPA 8260B	1.0	5	
Vinyl chloride	EPA 8260B	0.5	5	
m,p-Xylene	EPA 8260B	1.0	5	
o-Xylene	EPA 8260B	0.5	5	
tert-Butanol (TBA)	EPA 8260B	1.0	5	
tert-Amyl methyl ether (TAME)	EPA 8260B	1.0	5	
di-Isopropyl ether (DIPE)	EPA 8260B	1.0	5	
Acrolein*	EPA 8260B	50		
Acrylonitrile*	EPA 8260B	50		
1,4-Dioxane	EPA 8260B Modified	2.0	10	

FOOTNOTES

ug/I = Micrograms per liter

ug/kg = Micrograms per kilogram

- (--) = Not applicable
- (*) = Requested analytes in separate analytical run
- EPA = U.S. Environmental Protection Agency

HARGIS + ASSOCIATES, INC.

ANALYTICAL METHODS AND DETECTION LIMITS SOIL PROPERTIES

PROPERTY

ANALYTICAL METHOD

Walkely Black Method

REPORTING DETECTION LIMIT

Total Organic Carbon

Total Porosity Grain Size Distribution Dry Bulk Density Hydraulic Conductivity Moisture Content Grain Density

API RP40 ASTM D422/4464 ASTM D2937 ASTM D5084 ASTM D2216 ASTM D854 0.5 mg/kg

0.5 (a) 0.1 micron (a) 0.01 % (a) ---0.1% (a) 0.01 g/cc (a)

FOOTNOTES

- (a) = Precision of test method
- % = Percent
- API = American Petroleum Institute
- ASTM = American Society for Testing and Materials
- mg/kg = Milligrams per kilogram
- g/cc = Grams per cubic centimeter

HARGIS + ASSOCIATES, INC. DATA QUALIFIERS

- S Analytical result is satisfactory; no quality control problems were identified
- E The associated quantity is estimated because quality control criteria were not met for the following reasons:
 - Project accuracy goals were not achieved
 - Potential blank contamination
 - Analytical holding times were exceeded
 - Project precision goals were not achieved
 - Data trending problems; no other quality control problem was identified
- U The associated quantity may be unusable according to the data quality objectives for the activity for one of the following reasons:
 - Probable blank contamination
 - Data trending problems; no other quality control problem was identified

U.S. ENVIRONMENTAL PROTECTION AGENCY DATA QUALIFIERS

- J The associated numerical value is an estimated quantity because quality control criteria were not met.
- R Quality control indicates that data are unusable (compound may or may not be present). Resampling and/or reanalysis is necessary for verification.
- Q No analytical result.
- N Presumptive evidence of presence of material (tentative identification).



FIGURE B-1. REGIONAL SITE LOCATION





APPENDIX C

FIELD DATA FORMS



APPENDIX C

FIELD DATA FORMS

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FIGURES

Figure

- C-1 SAMPLE IDENTIFICATION LABEL
- C-2 SLOW-RECHARGING WELL PROCEDURE

TABLE C-1 STATIC WATER LEVEL DATA SHEET

MONTH, YEAR: PROJECT NUMBER:

WELL	DATE	ТІМЕ	METHOD OF	SOUNDER	DEPTH TO WATER FROM REFERENCE POINT (feet hmp)	REFERENCE POINT ELEVATION (feet msl)	PREVIOUS DEPTH TO WATER (feet hmp)	CHANGE IN WATER LEVEL (feet)		COMMENT	3	INITIAL S
TEW-2	DATE		MER CORCEMENT			646.68	(ioor omp)	(1001)	IS PUMP ON? Totalizer:	IF NOT, DO NO	DT TAKE WLs, CALL PM TARGET:	
EW-3						649.55			IS PUMP ON? Totalizer:	IF NOT, DO N GPM:	DT TAKE WLs, CALL PM TARGET:	
EW-4						652.28			IS PUMP ON? Totalizer:	IF NOT, DO N GPM:	DT TAKE WLs, CALL PM TARGET:	
MW-01						663.57						
MW-02						652.42						
MW-03						653.55						
MW-04						651.64						
MW-05						664.19						
MW-06						647.83						
MW-07						648.55						
MW-08						651.67						
MW-09						650.92						
MW-10						640.99						
MW-12						644.16						
MW-13						645.56						
MW-14						646.34						
MW-15						645.88						
MW-16						643.36						
MW-17						656.84						

TABLE C-1 STATIC WATER LEVEL DATA SHEET

WELL	DATE	TIME	METHOD OF MEASUREMENT	SOUNDER IDENTIFIER	DEPTH TO WATER FROM REFERENCE POINT (feet bmp)	REFERENCE POINT ELEVATION (feet msl)	PREVIOUS DEPTH TO WATER (feet bmp)	CHANGE IN WATER LEVEL (feet)	COMMENTS	INITIALS
MW-18						663.87				
MW-19						652				
MW-20						651.08				
MW-21						657.51				
MW-22						650.96				
MW-23						652.26				
MW-24						675.81				
MW-25						661.09				
MW-26						670.82				
MW-29						663.95				
MW-30						646.22				
MW-31						637.03				
MW-32						651.42				
MW-33						662.48				
MW-34						662.63				
MW-35						671.59				
MW-36						640.73				
MW-37						644.87				
MW-38						680.23				
MW-39						650.21				
TABLE C-1 STATIC WATER LEVEL DATA SHEET

WELL	DATE	TIME	METHOD OF MEASUREMENT	SOUNDER IDENTIFIER	DEPTH TO WATER FROM REFERENCE POINT (feet bmp)	REFERENCE POINT ELEVATION (feet msl)	PREVIOUS DEPTH TO WATER (feet bmp)	CHANGE IN WATER LEVEL (feet)	COMMENTS	INITIALS
MW-40						631.95				
MW-41						619.03				
MW-42						619.88				
MW-43						628				
MW-44						620.70				
MW-45						615.25				
MW-46						596.05				
MW-50						656.85				
MW-51						680.32				
MW-52						563.24				
MW-53						562.04				
MW-54						509.79				
MW-55						683.26				
MW-58						570.87				
MW-59						681.40				
MW-60						677.02				
MW-61						676.70				
MW-62						680.72				
MW-63						679.14				
MW-64						679.18				

TABLE C-1 STATIC WATER LEVEL DATA SHEET

WELL	DATE	TIME	METHOD OF MEASUREMENT	SOUNDER IDENTIFIER	DEPTH TO WATER FROM REFERENCE POINT (feet bmp)	REFERENCE POINT ELEVATION (feet msl)	PREVIOUS DEPTH TO WATER (feet bmp)	CHANGE IN WATER LEVEL (feet)	COMMENTS	INITIALS
MW-65						609.56				
MW-66						569.07				
MW-67						654.94				
MW-68						480.50				
MW-69						598.75				
MW-70						509.02				
MW-71						621.90				
MW-72						574.02				
MW-73						607.30				
MW-74						591.78				
MW-75						480.21				
MW-76						619.66				
IW-1						680.40			Not threaded portion, extension	
IW-2						681.54			Not threaded portion, extension	
IW-3						682.91			Not threaded portion, extension	
IW-4						676.20			Not threaded portion, extension	
IW-5						677.21			Not threaded portion, extension	
IW-6						678.50			Not threaded portion, extension	
IW-7						679.68			Not threaded portion, extension	
IW-8						680.68			Not threaded portion, extension	

TABLE C-1 STATIC WATER LEVEL DATA SHEET

WELL	DATE	TIME	METHOD OF MEASUREMENT	SOUNDER	DEPTH TO WATER FROM REFERENCE POINT (feet bmp)	REFERENCE POINT ELEVATION (feet msl)	PREVIOUS DEPTH TO WATER (feet bmp)	CHANGE IN WATER LEVEL (feet)	COMMENTS	INITIALS
IW-9						682.04			Not threaded portion, extension	
IW-10						657.47			Top of threaded Casing	
IW-11						657.09				
IW-12						656.73				
IW-13						651.19				
IW-14						651.33				
IW-15						682.58				
IW- 16						655.87				
IW-17						657.57				
P-01						663.95				
P-02						659.71				
P-03						652.64				
P-04						652.29				
P-05						651.45				
P-06						650.56				
P-07						654.76			SVE on; Piped	
P-08						654.49			SVE on; Piped	
P-09						638.81				
P-10						650.09				
P-11						661.48				

TABLE C-1 STATIC WATER LEVEL DATA SHEET

WELL	DATE	TIME	METHOD OF MEASUREMENT	SOUNDER IDENTIFIER	DEPTH TO WATER FROM REFERENCE POINT (feet bmp)	REFERENCE POINT ELEVATION (feet msl)	PREVIOUS DEPTH TO WATER (feet bmp)	CHANGE IN WATER LEVEL (feet)	COMMENTS	INITIALS
P-12						681.61				
P-14						677.50				
P-15						663.58				
EW						649.71				
TEW-1						650.81				
3-C2						594.90			PUMP ON/OFF	
3-D1						501.36				
3-E2						474.75			NO PUMP	
4-J1						459.84			PUMP ON/OFF	
33-B2						676			PUMP ON/OFF	
33-G3						636.94			Totalizer: PUMP ON/OFF	
33-R3						580.49			Totalizer: PUMP ON/OFF	
34-E3						625			NO PUMP	
34-E4						611			PUMP ON/OFF	
34-M1						629			Pump disconnected?	
34-N1						579.01			PUMP ON/OFF	
34-N3						569.98			NO PUMP	
FC- Old Firehouse						566.67			Top of surveyed stake in creek bed	
34-N5						558.92			Totalizer: PUMP ON/OFF	

TABLE C-1 STATIC WATER LEVEL DATA SHEET

WELL	DATE	TIME	METHOD OF MEASUREMENT	SOUNDER	DEPTH TO WATER FROM REFERENCE POINT (feet bmp)	REFERENCE POINT ELEVATION (feet msl)	PREVIOUS DEPTH TO WATER (feet bmp)	CHANGE IN WATER LEVEL (feet)	COMMENTS	INITIALS
Barra 1						498			Totalizers: N PUMP ON/OFF	
									S	
Capps 1						628				
Chernish 1						529.20			Totalizer: PUMP ON/OFF	
deJong 2						595.60			PUMP ON/OFF	
deJong 3						595			NO PUMP	
Fleet 1						491			Totalizer: PUMP ON/OFF	
Grubbs 1						585			Totalizer: PUMP ON/OFF	
Kopf 1						565			PUMP ON/OFF	
Miller 1						654			PUMP ON/OFF	
Platt 1						549			PUMP ON/OFF	
Schnoebelen 1						607			Totalizer: PUMP ON/OFF	
Shibley 1						615				
SVE-1s						656.77				
SVE-1d						656.77				
SVE-2s						655.96				
SVE-2d						655.96				
SVE-3s						655.23				
SVE-3d						655.23				
SVE-4s						654.26				

TABLE C-1 STATIC WATER LEVEL DATA SHEET

WELL	DATE	TIME	METHOD OF MEASUREMENT	SOUNDER IDENTIFIER	DEPTH TO WATER FROM REFERENCE POINT (feet bmp)	REFERENCE POINT ELEVATION (feet msl)	PREVIOUS DEPTH TO WATER (feet bmp)	CHANGE IN WATER LEVEL (feet)	COMMENTS	INITIALS
SVE-4d						654.26				
SVE5s						653.33				
SVE-5d						653.33				
SVE-6s						654.66				
SVE-6d						654.66				
SVE-7s						654.16				
SVE-7d						654.16				
SVE-8s						653.63				
SVE-8d						653.63				
SVE-9s						653.89				
SVE-9d						653.89				
SVE-10s						653.26				
SVE-10d						653.26				
SVE-11s						653.20				
SVE-11d						653.20				
SVE-12s						648.47				
SVE-12d						648.47				
SVE-13s						651				
SVE-13d						651				

TABLE C-1 STATIC WATER LEVEL DATA SHEET

R = WL was recovering at time of measurement P = Well was pumping at time of measurement CP = Well was pumping cyclically at time of measurement <u>Comments</u>: Explain any difficulties, observations, and wells unable to measure. Also explain any instance where there is a change in depth to water greater than 2 feet. **GRS System Status: Check the GRS to ensure it is operating before you start the round. Operating is defined as the following:**

- 1) Check the control panel at the treatment system shed. Three green lights should be on, one for each of the extraction wells (TEW-2, EW-4, and EW-3). If any of these lights are out, immediately contact the PM.
- Open each extraction well vault to record and verify the current pumping rate. Prior to beginning the water level round, you must confirm with the PM what the target extraction rate is for each well. If the current extraction rate differs from the target rate by 0.5 gpm or greater, immediately contact the PM.
 Water levels should not be collected on any wells (monitor or regional) until the above steps are completed and documented in the field notes.
- WLs = Water levels
- PM = Project manager
- SVE = Soil vapor extraction
- GRS = Groundwater Remediation System
- bmp = Below measuring point
- msl = Mean sea level
- gpm = Gallons per minute

TABLE C-2 WATER LEVEL INDICATOR CALIBRATION DOCUMENTATION FORM

PROJECT NUMBER:

DATE	TIME	WATER LEVEL INDICATOR TYPE	WATER LEVEL INDICATOR NUMBER	CALIBRATION	CALIBRATED BY (INITIALS)	REMARKS
					(

TABLE C-3

HARGIS + AS	SOCIATES, IN	1C.	СНА	IN-OF	-C	US	ТО	DY	R	E(20	R		N	D	AN	AL	.YS	3IS	RI	ΕQ	UE	S	r F	OF	8 M		DATE	I			PAGE OF	
PROJECT NAME	Ξ				PR	OJEC	T No	./TA	SK	No.			c	SA ON	MP	LE VERS	;		A RE	NALY	'SIS Stei)		CON R/		TED RATIC (ppb)	N	e H	SPEC	CIAL LING	G	LABORATORY INFORMATION	/ V
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QA MANAGER					Fa	ix No																											
SAMPLER (SIGN	IATURE)				SAI	VPLE	R (P	RIN	(ED))																							
			SAN	IPLE		MATI	 RIX	Ι	Pl	RES	ER	-																					
LAB	SAMPI	LE -	COLLE	CTION	_								_																				
ID	ID		Date	Time	Soil	around - water	water	ΗCI	80NH	NaOH	H2SO4	ce																				REMARKS	
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Company			Compa	ny			-		initial and date 3. Indicate numbe				nbe	r of	sam	iple	con	tain	ers i	n an	alys	is re	eque	st					,	0.07	122 (000) 400-0000		
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ORIGINAL: LABORATORY YELLOW: QA MANAGER

PINK: FIELD/TASK MANAGER

HARGIS + ASSOCIATES, INC.

TABLE C-4 GROUNDWATER SAMPLING INFORMATION

DATE:						TASK	K :						WE		
Time	Static D	TW	(ft below refere	ence point)	Casing Volu	me (CV) (gallon	is)	3 CV (gall	ons)			Weather Condit	<u>tions</u>	Initials	
Casing Total	Depth		(ft below refer	ence point)	Purging Dev	vice		Sampling Dev	vice	T	ime _	Ten	np	Begin Purge	End Purge
Water Colum	าท		(feet)		Pump: Dep	th (ft brp)	_Туре	Volta	ge <u> </u>	S	Skies_			Gallons Purged	CVs Purged
Casing Capa	icity (Diameter	")	(gallor	ns per foot)	Monitor Wel	I Recharge Rate	e: Slow	Fa	st	V	Vind (r	mph)F	From	DTW (ft brp)	Time
Time	Depth to Water	Volume Purged (Gallons)	Casing Volumes Purged	Temp.	pН	EC	RAMETERS O.R.P.	 D.O. (mg/l.)		Pump Frequen Hz	ісу			COMMENTS	
		(Calions)	i diged	()		(3/cm)		(IIIg/L)	(110)	112					
SAMPLE CC ANALYS	DLLECTION SA	AMPLE TIME_ QUANTITY	TYP	<u> </u>	AIR MON NOTES (IITORING PID/F Color, odor, sa	FID ppm: VAL nd and silt cor	JLT htent, factors p	BKGD ossibly affecting	samples,	E condit	BREATHING ZO tion of vault, well	NE head, sampl	DISCHARGE W	/ATER
					·										
DUPLICATE	S / SPLITS / B ete appropriate	LANKS? e forms.	Y	Ν	·										

DTW = Depth to water; (") = inches; HP = Horsepower; mph = Miles per hour; ft = feet; brp = Below reference point; ° = Degrees; EC = Electrical conductivity; S/cm = Siemens per centimeter; ORP = Oxidation-reduction potential; mV = Millivolt; DO = Dissolved oxygen; mg/L = milligrams per liter; NTU = Nephelometric turbidity units; Hz = Hertz; PID = Photoionization detector; FID = Flame ionization detector; BKGD = Background

Table C-4 Groundwater Sampling Information.doc

TABLE C-5 SURFACE WATER SAMPLING FIELD DATA FORM

PROJECT ID: ____

SAMPLER'S INITIALS:

DATE: _____

LOCATION	TIME	TEMPERATURE °C/°F	рН	EC (uS/cm)/ (mS/cm)	ESTIMATED Q (gpm)	COMMENTS

SAMPLE COLLECTION INFORMATION:

Circle Analyses Requested: VOCs by EPA 8260B (all)

Check QA/QC Samples: _____ Split: _____ Duplicate (ID = _____)

_____ Field Blank (ID = _____)

ID = Identifier °C/°F = Degrees Celcius/Degrees Fahrenheit EC = Electrical conductivity uS/cm / mS/cm = MicroSiemens per centimeter/milliSiemens per centimeter Q = Stream flow

gpm = Gallons per minute VOCs = Volatile organic compounds EPA = U.S. Environmental Protection Agency QA/QC = Quality assurance/quality control

PROJECT _____

TABLE C-6INSTRUMENT CALIBRATION LOG FOR GROUNDWATER SAMPLING: EC METER

		EC SOLUTION	TEMPERATURE	EC READING	CORRECTION	METER		
DATE	LIME	()	OF SOLUTION	()	FACTOR	IYPE	COMMENTS	INITIALS

EC = Electrical conductivity

PROJECT _____

TABLE C-7 INSTRUMENT CALIBRATION LOG FOR GROUNDWATER SAMPLING: pH METER

DATE	TIME	pH BUFFER		pH READING		COMMENTS	
DATE		(uriits)	OF BUFFER	(units)	FACTOR	COMMENTS	INITIALS

PROJECT _____

TABLE C-8INSTRUMENT CALIBRATION LOG FOR GROUNDWATER SAMPLING: DISSOLVED OXYGEN METER CALIBRATION
(AIR METHOD)

DATE	TIME	METER MODEL	TEMP (°C)	ELEVATION (ft msl)	SOLUBILITY OF OXYGEN	ALTITUDE CORRECTION FACTOR	CALIBRATION VALUE ^(a) (mg/l)	COMMENTS	INITIALS

(a) Calibration value determined by multiplying solubility value by altitude correction factor

°C = Degrees Celsius ft msl = Feet mean sea level mg/l = Milligrams per liter



TABLE C-9 BLANK SAMPLE LOG FORM

PROJECT NUMBER:_____

MONTH/YEAR:_____

PAGE _____OF_____

DATE	TYPE BLANK (Trip or Rinsate)	SAMPLE IDENTIFIER	TIME	PREPARATION LOCATION	ANALYTICAL METHOD	BLANK WATER SOURCE & DATE	BATCH NUMBER	COMMENTS AND SAMPLING CONDITIONS	INITIALS



TABLE C-10

AIR MONITORING INSTRUMENT CALIBRATION RECORD (OR PUMP LEAK CHECK)

INSTRUMENT:

PROJECT NUMBER:

SERIAL NUMBER: _____

DATE/TIME	PURE AIR? YES NO	CALIBRATION GAS (PPM @ SPAN)	INSTRUMENT CALIBRATION VALUE (PPM @ SPAN)	BATTERY/ LEAK CHECK (GOOD/BAD)	CALIBRATED BY	REMARKS

PPM = Parts per million





TABLE C-11

AIR MONITORING LOG FORM

Instrument:

Serial Number: _____

Detector Tube Chemical Name/Number_____

TIME	STAFF INITIALS	LOCATION/ WELL ID	ZONE	PID	O ₂	LEL	H ₂ S	СО

Page 1 of 1

ID = Identifier

 $PID = Photoionizaton detector O_2 = Oxygen$

LEL = Lower Explosive Limit

 $H_2S = Hydrogen sulfide$ CO = Carbon monoxide Project No: _____

Date:

SAMPLE

DATE: _____

JOB NUMBER:

PERSONNEL:

						INSTALLA
SAMPLE TIME	PROBE SET TIME	DEPTH (feet bls) DRIVEN/SAMPLED	AUGER Y/N	PROBE PUSH/HAMMER (P) / (H)	EVACUATION VOLUME (min:s or cc)	SAMPLE VOLUME (cc)
					((

TABLE C-12 SOIL GAS FIELD SAMPLING DATA

WEATHER: _____

LOCATION: _____

CONTRACTOR PERSONNEL:

AMBIENT

TEMP.

IDENTIFIER VACUUM NOTES/OBSERVATIONS (ºF)

bls = Below land surface

min:s or cc = minutes:seconds or cubic centimeters

HARGIS + ASSOCIATES, INC.



			Project No.	
		Project Nam	e	
	COMPLETI	ON REPORT FOR WELL		
Drilling Co	mpany:			
Driller:				
Drill Rig:				
Date drillin	g started:			
Date drillin	g completed:			
Description	n of drilling			
A. GENE	RAL			
Locatio	on:			
Locatio	on coordinates: x	у	-	
Total d	epth of borehole:			feet bls
Boreho	ble diameter:	inches, from	to	feet bls
		inches, from	to	feet bls
Lost ci	rculation zones:			
Litholo	gy logged by:			
B. CONS	TRUCTION			
Condu	ctor Casing			
Type:	_		, O.[D.:
Wall th	ickness:	, from	to	feet bls
Centra	lizers/Shoe:			

C.

	Project No.			
	Project I	Name		
COMPLETI	ON REPORT FOR WEL	L		
Well Casing				
Туре:			, O.D.: _	
Wall thickness:	, from	to		feet bls
Туре:			, O.D.: _	
Wall thickness:	, from	to		feet bls
Well Screen				
Туре:			, O.D.: _	
Wall thickness:	, from	to		feet bls
Туре:			, O.D.: _	
Wall thickness:	, from	to		feet bls
Centralizers/Shoe:				
GROUT AND CEMENTING RE	ECORD			
Annular space:				
Type of cement/grout:				
Method of emplacement:				
Approximate number of yards/b	bag:			
Comments:				
Annular space:				
Type of cement/grout:				
Method of emplacement:				
Approximate number of yards/b	bag:			
Comments:				

			Project No	
		Project Name)	
	COMPLETION REPO	DRT FOR WELL		
D.	GRAVEL PACK			
	Туре:	, from	to	feet bls
	Volume emplaced:	, Method emplace	əd:	
	Туре:	, from	to	feet bls
	Volume emplaced:	, Method emplace	∋d:	
	Grout Filter			
	Туре:	, from	to	feet bls
	Volume emplaced:	_, Method emplace	e:	
	Bentonite Seal			
	Туре:	, from	to	feet bls
	Volume emplaced:	_, Method emplace	əd:	
E.	DEVELOPMENT RECORD			
	Date:			
	Procedure:			
	Duration: minutes			
	Procedure:			
	Duration: minutes			
	Pumping duration: minutes			
	Average pump discharge rate:	gpm		
	Drawdown at end of pumping:	_ feet bls		
	Field parameters (initial): pH	, Condu	ctivity	(umhos),
	Temperature (°C), Turbidity			
	Field parameters (final): pH	, Condu	ctivity	(umhos),
	Temperature (°C), Turbidity			

F.

TABLE C-13 WELL COMPLETION AND DEVELOPMENT REPORT

	Project No
	Project Name
	COMPLETION REPORT FOR WELL
F.	PUMP INSTALLATION DATA
	Pump installer:
	Installation date:
	Pump purpose/type:
	Pump model/specs:
	Pump setting:
	Pump purpose/type:
	Pump model/specs:
	Pump setting:
	Surface completion (hole vault type, etc.):
G.	REFERENCE ELEVATIONS
	Land surface elevation: feet msl
	Measuring point elevation: feet msl
	Description of measuring point:
	Date surveyed:, by:

H. COMMENTS AND NOTES RE DRILLING WELL CONSTRUCTION OPERATIONS



TABLE C-13 WELL COMPLETION AND DEVELOPMENT REPORT

Project No.	
•	

Project Name _____

MONITOR WELL PLACEMENT FORM

Proposed Well ID:	Actual Well ID:
Date:	Ву:
Street Address or APN:	
City/Town:	
Nearest Cross Street:	
Thomas Brothers Reference:	
Owner/Jurisdiction:	
County Permit No. :	
USA Alert Ticket:	
Comments:	

Sketch Map

Α.

Β.

		Project No.	
	Project Name _		
DEVELOP	MENT REPORT FOR WELL _		
DEVELOPMENT REPORT			
Well Type:			
Development Company:			
Developer/Helper:			
Development Rig:			
Date of Development:			
H+A Field Notebook:			
H+A Personnel:			
Description of Development:			
Total Well (Driller):			foot ble
Depth to bottom of well before (development:	<u> </u>	foot bis
Bottom: soft medium hard		<u> </u>	
Depth to water before develop	nent:		feet his
Procedure:			
Duration: minutes, 0	Comment:		
Procedure:			
Duration: minutes, 0	Comment:		
Procedure:			
Duration: minutes, C	Comment:		
Procedure:			
Duration: minutes, 0	Comment:		

	Project No
	Project Name
	DEVELOPMENT REPORT FOR WELL
	Procedure:
	Duration: minutes, Comment:
	Pumping duration: minutes
	Field parameters (initial): pH, Conductivity (umhos),
	Temperature (°C), Turbidity
	Average pump discharge rate: gpm Gallons purged:
	Depth to water at end of pumping: feet bls, Drawdown feet
	Specify Capacity: gpm/ft
	Field parameters (final): pH, Conductivity (umhos),
	Temperature (°C), Turbidity
	Depth to bottom of well after development: feet bls
	Bottom: soft, medium, hard
	Depth to water after development and recovery: feet bls
	Measured: hours after final pumping
C.	PUMP INSTALLATION DATA
	Pump installer:
	Installation date:
	Pump purpose/type:
	Pump model/specs:
	Pump setting:
	Pump purpose/type:
	Pump model/specs:
	Pump setting:
	Comments:

TABLE C-13 WELL COMPLETION AND DEVELOPMENT REPORT

	Project No
	Project Name
	DEVELOPMENT REPORT FOR WELL
D.	SURVEY DATA
	Surveyor:
	Date surveyed:
	Land surface elevation: feet msl
	Measuring point elevation: feet msl
	Location coordinate: x y
	Description of measuring point:
E.	COMMENTS

FOOTNOTES

- °C = degrees Celsius
- bls = Below land surface
- msi = Mean sea level
- O.D. = Outer Diameter
- umhos = Micromhos
 - ID = Identifier
 - H+A = Hargis + Associates, Inc.
 - APN = Assessor's Parcel Number

TABLE C-14 LITHOLOGIC LOG FORM

BO	REH	OLE ID:		LOO	CATION:		PAGE 1 OF
PR	OJEC	CT NO.:		PR	DJECT NAME:	LOGGEI	D BY:
WE	ATH	ER:					DATE(S):
DR	ILLIN	IG METH	IOD, E	QUIPN	/ENT:		HOLE DIA.:
DR	ILLIN	IG CONT	RACT	OR:	OPERATOR	:	
SA	MPLI	NG MET	HOD, I	EQUIP	MENT:		
SU	RFA	CE ELEV	ATION	:	ft/msl TOTAL DEPTH: ft/bls	DTW:	ft/bmp
RE	MAF	RKS:					
SAMPLES	CORE RECOVERY	DEPTH (feet bls)	GRAPHIC LITHOLOGY	USCS GROUP SYMBOL	LITHOLOGIC DESCRIPTION Textural classification (modifier, root), Munsell color descript moisture content, consistency or relative density, plasticity, sorting, roundness, miscellaneous properties.	or (value), grain size,	NOTES, REMARKS, OBSERVATIONS
		0					
		0 —	İ I				
		. <u></u>					

TABLE C-14 LITHOLOGIC LOG FORM

BO	REH	OLE ID:		LOC	CATION:		PAGE OF
PR	OJE	CT NO.:		PRO	DJECT NAME:	LOGGE	D BY:
WE	ATH	ER:					DATE(S):
SAMPLES	CORE RECOVERY	DEPTH (feet bls)	GRAPHIC LITHOLOGY	USCS GROUP SYMBOL	LITHOLOGIC DESCRIPTION Textural classification (modifier, root), Munsell color descrip moisture content, consistency or relative density, plasticity, sorting, roundness, miscellaneous properties.	tor (value), grain size,	NOTES, REMARKS, OBSERVATIONS

ft/bls = Feet below land surface; ft/bmp = Feet below measuring point; DIA = Diameter; USCS = Unified Soil Classification System

TABLE C-15 WATER LEVEL RECORD SHEET

		PUMF	PED WELL				
						Page	_ of
MEASURING	POINT:	ft (above l	and surface)	ELEV OF MEAS	S PT:	ft (ab	ove mean sea level)
WELL LOCAT	ION/COORDINA	ATES:					
STATIC WATE	R LEVEL:		DATE/TIMI	E:			
DATE/TIME	TIME SINCE PUMPING STARTED (minutes)	DEPTH TO WATER (feet)	DRAWDOWN (feet)	TIME SINCE PUMPING STOPPED (minutes)	t/t'	PUMPING RATE	REMARKS (INCLUDE METHOD OF MEASUREMENT)

 $\begin{array}{l} ft = feet; \mbox{ ELEV OF MEAS PT} = \mbox{ Elevation of measuring point}; \\ t = elapsed time since start of pumping; t' = elapsed time from end of pumping \end{array}$



TABLE C-16 WATER LEVEL RECORD SHEET

		OBS	SERVATION \	NELL		
						Page of
RESPONSE T	O PUMPING AT	WELL:		DISTANCE TO	PUMPING V	VELL (feet):
MEASURING	POINT:	ft (above	land surface)	ELEV OF MEAS	S PT:	ft (above mean sea leve
WELL LOCAT	ION/COORDIN/	ATES:				
STATIC WATE	R LEVEL:		DATE/TIMI	E:		
DATE/TIME	TIME SINCE PUMPING STARTED (minutes)	DEPTH TO WATER (feet)	DRAWDOWN (feet)	TIME SINCE PUMPING STOPPED (minutes)	t/t'	REMARKS (INCLUDE METHOD OF MEASUREMENT)

ft = feet; ELEV OF MEAS PT = Elevation of measuring point;

t = elapsed time since start of pumping; t' = elapsed time from end of pumping

FIGURE C-1 SAMPLE IDENTIFICATION LABEL

Sample ID Date Tin
Analyze for:



FIGURE C-2 SLOW-RECHARGING WELL PROCEDURE



APPENDIX D

MONITOR WELL, PIEZOMETER, EXTRACTION WELL, REGIONAL WELL AND FELICITA CREEK (FC SERIES) ANALYTICAL DATA AUGUST 1986 TO JULY 2011 (PROVIDED ON CD ONLY)