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21 January 2014

Mr. Roger Papler
California Regional Water Quality Control Board
San Francisco Bay Region
1515 Clay Street, Suite 1400
Oakland, CA 94612

Subject: Off-Site Study Area
Monitoring Well Installation Work Plan
Intersil/Siemens Site
Cupertino, California

Dear Mr. Papler:

On behalf of General Electric Company (GE) and SMI Holding LLC (SMI), ERM-West, Inc. (ERM) has prepared this *Off-Site Study Area Monitoring Well Installation Work Plan* (Work Plan) for performing subsurface investigation within the Off-Site Study Area of the Intersil/Siemens Site in Cupertino, California (the site, Figure 1). While this Work Plan has not been formally requested by the California Regional Water Quality Control Board (RWQCB) and the United States Environmental Protection Agency (USEPA), GE and SMI are proposing to proactively implement this work in the near term to provide baseline groundwater conditions in the Off-Site Study Area.

The focus of this investigation will be to further characterize the extent and distribution of chlorinated volatile organic compounds (VOCs) in A zone (resaturated) groundwater and provide for Off-Site Study Area plume monitoring.

SITE BACKGROUND

Groundwater investigations at the former Intersil and former Siemens facilities began in 1983. A groundwater extraction system has generally been operating continuously at the former Intersil facility since its installation in 1987. Groundwater is currently extracted from four wells (E9AR, W10A, W12A, and W18MA); as noted in the recent annual reports, VOC influent concentrations in these wells have generally reached asymptotic conditions. A groundwater extraction system has

been operating at the former Siemens facility since July 1986 and groundwater is currently extracted from eight extraction wells (2-EP, 2-EPA, LF-6A, H-5B, LF-12A, SW-7, EX-1-RL, and H-1A).

Groundwater investigations in the Off-Site Study Area began in 1986. Currently, there are three groundwater monitoring wells screened in the A4 depth interval north of Homestead Road (QH-1A, S-1A, and LS-1A). Trichloroethene (TCE) has not been detected in wells QH-1A and LS-1A since the early to mid-1990s. TCE concentrations in well S-1A have remained similar for the past few years, ranging from 36 to 61 micrograms per liter (µg/L) between 2006 and 2012.

Groundwater extraction from the Off-Site Study Area began in the B zone in 1990. Groundwater is currently extracted from two B zone wells (LQ-2B and LR-1B). Groundwater extracted in the Off-Site Study Area is pumped to the former Siemens facility for treatment (PEI and ARCADIS, 2011c)[1].

A detailed description of the history of remedial activities can be found in the Five-Year Status Reports from AMEC and LFR (1995[2], 2000[3], and 2005[4]) and AMEC and ARCADIS U.S., Inc. (ARCADIS), (2009[5]).

Recent Off-Site Study Area Investigation Summary

In 2011, pursuant to a request from the RWQCB and the USEPA, SMI conducted additional investigation on the northern portion of the former Siemens facility. The Northside Investigation indicated the presence of elevated VOC concentrations at the northeastern property

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1 Pristine Earth, Inc. and ARCADIS U.S., Inc. (PEI and ARCADIS). 2011b. *Offsite Study Area Investigation Report, Intersil/Siemens Site, Cupertino, California*. 28 September 2011.

2 LFR. 1995. *Five-Year Remedial Action Status Report and Effectiveness Evaluation*. 31 July 1995.

3 AMEC and LFR. 2000. *Five-Year Status Report for Period January 1995 through June 2000. Intersil/Siemens Site, Cupertino, CA*.

4 AMEC and LFR. 2005. *Five-Year Status Report for Period January 2000 through June 2005. Intersil/Siemens Site, Cupertino, CA*.

5 AMEC Geomatrix, Inc., and ARCADIS U.S., Inc. 2009. *Five-Year Status Report for Period January 2005 through June 2009, Intersil/Siemens Site, Cupertino, CA*. 20 November 2009.

boundary (PEI and ARCADIS, 2011a)[6]. ARCADIS used the results of the Northside Investigation in planning additional characterization of the A zone groundwater within the Off-Site Study Area.

The most recent investigations at the former Siemens facility and Off-Site Study Area (membrane interface probe [MIP] and grab groundwater samples collected in 2011) as referenced in the *Northside Investigation Report* (PEI and ARCADIS, 2011a) and *Offsite Study Area Investigation Report* (PEI and ARCADIS, 2011b) show groundwater impacts in varying depths within the A zone aquifer. The results of those investigations, which are summarized below, were used to develop this Work Plan for installation of additional monitoring wells.

Hydrostratigraphy

When investigation at the former Intersil and Siemens facilities began in the 1980s, the water table in the A zone was approximately 100 feet below ground surface (bgs). Since the 1990s, the water table rose approximately 40 to 50 feet. As a result of this water table rebound, the formerly unsaturated A zone sediments became saturated. The resaturation of the former vadose zone sediments of the A zone prompted re-evaluation of groundwater at the site.

Three principal groundwater zones have been defined beneath the former Intersil and Siemens facilities, each of which is separated by less permeable aquitards. These water-bearing zones are identified as A, B, and C zones. The shallowest zone, the A zone, is further subdivided into A1, A2, A3, and A4 depth intervals. A detailed description of the hydrostratigraphy is provided in the *Hydrogeologic Framework Report* (AMEC and ARCADIS, 2011)[7].

The *Offsite Study Area Investigation Report* (PEI and ARCADIS, 2011b) describes interbedded sands, silts, and clays within the A1 depth interval along the northern property boundary of the former Siemens facility that appear to extend off site. Other conclusions regarding

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[6] PEI and ARCADIS. 2011a. *Northside Investigation Report, 10950 North Tantau Avenue, Cupertino, California*. 15 June 2011.

[7] AMEC and ARCADIS. 2011. *Hydrogeologic Framework Report, Intersil/Siemens Site, Cupertino, California*. February 2011.

off-site conditions based on cone penetration test (CPT) borings (PEI and ARCADIS, 2011b) include:

- The interbedded sands, silts, and clays within the A1 depth interval along the northern property boundary of the former Siemens facility continue in the Off-site Study Area along the northern edge of Homestead Road;
- Sand content increases in the A2 depth interval in the northern off-site areas relative to the southern locations;
- The A3 depth interval consists predominantly of coarse-grained sand and gravel, with slightly higher amounts of finer-grained materials at certain eastern boring locations; and
- Although penetration of the A4 depth interval was difficult, where accessible, a coarse-grained sand and gravel interval was observed.

Volatile Organic Compounds in Off-Site Study Area A Zone

The *Offsite Study Area Investigation Report* (PEI and ARCADIS, 2011b) documents VOC occurrence based on MIP data at CPT locations shown on Figure 2 in the Off-Site Study Area. A summary follows:

- A1 Depth Interval – Elevated electron capture data (ECD) responses from the MIP tool is indicative of occurrence and relative concentrations of VOCs. ECD responses were most frequently observed within the A1 depth interval, which was associated with fine-grained sand or gravels within a clayey matrix. The highest concentration of VOCs were observed along Homestead Road, and decreased by two orders of magnitude when moving towards the north, along Lorne Way.
- A2 Depth Interval – No elevated ECD responses were observed within the A2 depth interval, with the exception of certain locations on Lorne Way (MIP-OS-8 and MIP-OS-10). Low concentrations of VOCs were observed in the tested locations, with the highest detection of 16 µg/L noted at a location on Sparrow Way (600 feet north of the site).
- A3 Depth Interval – Elevated ECD responses were observed at five of the MIP boring locations (MIP-OS-2, -4, -5, -8, and -9; Figure 2). Grab groundwater samples collected from each of the five MIP boring locations from depths where elevated ECD responses were observed and from two step-out HydroPunch locations HP-OS-14 and HP-OS-15 had VOCs at low concentrations or below detection limits

in samples from MIP-OS-4, MIP-OS-8, and HP-OS-15. The two easternmost boring locations, MIP-OS-5 and MIP-OS-9, and the northernmost location, HP-OS-14, contained TCE concentrations ranging between 54 and 200 µg/L and cis-1,2-dichloroethene (cis-1,2-DCE) concentrations ranging between 3.2 and 240 µg/L. MIP-OS-2, located along Homestead Street, contained a TCE concentration of 130 µg/L.

- A4 Depth Interval – Elevated ECD responses were observed at two of the four MIP borings (MIP-OS-1 and MIP-OS-8). Groundwater concentrations collected at these two locations, and two step-out locations HP-OS-12 and HP-OS-13, were either not detected or detected below their respective maximum contaminant levels.

The result of the Off-Site Study Area investigation was used to develop this Work Plan for characterizing the extent and distribution of VOCs in the A zone groundwater.

PROJECT OBJECTIVES

The objectives of this investigation are to:

- Further characterize the extent and distribution of VOCs in the A zone groundwater within the downgradient Off-Site Study Area; and
- Install additional monitoring points for the purposes of tracking and monitoring of the VOCs in groundwater.

This Work Plan proposes to install a total of 10 monitoring wells in the various depth intervals within the A zone within the Off-Site Study Area and collect a groundwater sample from each well. The proposed locations are based on the grab groundwater results collected during the 2011 Off-Site Study Area investigation activities summarized in the Recent Investigations Section above (PEI and ARCADIS, 2011b) and the 2012[8] annual groundwater sampling event (AMEC and ARCADIS,

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[8] The groundwater concentrations collected in 2013 are comparable to the 2012 results presented in this Work Plan. The results of the 2013 sampling will be submitted in the Annual Self-Monitoring Report due to the RWQCB before 30 January 2014.

2013)[9]. Figure 2 shows the locations of the proposed monitoring wells. Proposed construction details for the monitoring wells are provided on Table 1; actual well construction will be based on conditions encountered in the field. Appendix A presents figures for the A1, A2, A3, and A4 depth intervals, showing each of the proposed wells and the 2011/2012 concentrations of TCE and cis-1,2-DCE posted for available locations. These results were the basis for the selection of the proposed well locations that are discussed below.

Proposed Additional Monitoring Wells

Description of location, depth, and the rationale for the additional proposed monitoring wells follows:

- MW-OS-1A1 - A1 depth interval monitoring well located along Homestead Avenue between MIP-OS-1 and MIP-OS-11. TCE and cis-1,2-DCE were detected at MIP-OS-1 (880 µg/L and 240 µg/L, respectively) at 53 to 55 feet bgs and not detected at MIP-OS-11 (Figure A-1; Appendix A). This monitoring well is intended to delineate the extent of the western edge of the plume and also serves to track and monitor VOCs in groundwater in the Off-Site Study Area.
- MW-OS-2A1 – A1 depth interval monitoring well located along Homestead Avenue between MIP-OS-3 and MIP-OS-4. TCE and cis-1,2-DCE were detected at MIP-OS-3 at 48 to 52 feet bgs and MIP-OS-4 at 50 to 53 feet bgs (Figure A-1; Appendix A). This monitoring well will track and monitor the eastern portion of the extent of VOCs in groundwater in the Off-Site Study Area.
- MW-OS-2A3 and MW-OS-2A4 – A3 and A4 depth interval monitoring wells located along Homestead Avenue between MIP-OS-3 and MIP-OS-4. As noted above, TCE and cis-1,2-DCE were at MIP-OS-3 at 48 to 52 feet bgs (A1 interval). No samples were collected in the A3 and A4 depth intervals (Figures A-3 and A-4; Appendix A). Therefore, the proposed monitoring wells will address the data gap in the A3 and A4 depth intervals and also track and monitor VOCs in groundwater in the Off-Site Study Area.

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[9] AMEC and ARCADIS. 2013. *Annual Self-Monitoring Report, January 1 through December 31, 2012, Intersil/Siemens Site, Cupertino, California, Site Cleanup Order No. 90-119.* 30 January 2013.

- MW-OS-3A1 – A1 depth interval monitoring well located along Lorne Way between MIP-OS-7 and MIP-OS-8. TCE and cis-1,2-DCE were detected at MIP-OS-7 at 51 to 53 feet bgs. TCE and cis-1,2-DCE were detected at MIP-OS-7 (15 µg/L and 6.4 µg/L, respectively) and not detected at MIP-OS-8 (Figure A-1; Appendix A). This monitoring well is intended to delineate the eastern extent of VOCs and will track and monitor VOCs in groundwater in the Off-Site Study Area.
- MW-OS-3A3, and MW-OS-3A4 – A3 and A4 depth interval monitoring well located along Lorne Way between MIP-OS-7 and MIP-OS-8. TCE and cis-1,2-DCE were detected at MIP-OS-7 within the A1 interval. No samples were collected in the A3 and A4 depth intervals at this location. TCE and cis-1,2-DCE was not detected at MIP-OS-8 in the A3 and A4 depth interval (Figures A-3 and A-4; Appendix A). Therefore, the proposed wells are to address the data gap in the A3 and A4 depth intervals at MIP-OS-7 and delineate the eastern edge of the plume. The monitoring wells will also track and monitor VOCs in groundwater in the Off-Site Study Area.
- MW-OS-4A3 and MS-OS-4A4 - A3 and A4 depth interval monitoring wells located at Redwing Avenue, next to HP-OS-13. Although VOCs were not detected at HP-OS-13 in the A4 depth interval, the proposed nested well serves to track and monitor the northern extent of VOCs in groundwater in the Off-Site Study Area, which is estimated to be to the south, in the vicinity of the A4 well S-1A.
- MW-OS-5A3 – A3 depth interval monitoring well located along Sparrow Court, north of HP-OS-14. TCE and cis-1,2-DCE were detected in the A2 (16 µg/L and 6.6 µg/L) and A3 (54 µg/L and 3.2 µg/L) depth intervals at HP-OS-14. Therefore, the proposed monitoring well is intended to delineate the northern extent of VOCs and track and monitor VOCs in groundwater in the Off-Site Study Area.

Pre-Installation Activities

The following activities will be conducted prior to and at the start of field activities:

- Coordinate with the property owner and tenants for access;
- Update the site specific Health and Safe Plan including obtaining copies of subcontractor health and safety plan(s).

- Obtain boring and well permits from Santa Clara Valley Water District.
- Prepare a traffic control plan to address traffic control during the proposed activities.
- Obtain encroachment permits to drill on the city streets from City of Sunnyvale Public Works Department.
- Mark proposed monitoring well locations.
- Contact Underground Services Alert (USA) at least 48 hours prior to the initiation of intrusive activities and coordinate with USA member companies to locate underground facilities in proximity to planned well locations.
- Clear each location for subsurface utilities by a private utility-locating company using industry-accepted methodologies and tools.
- Manually or vacuum-clear each borehole to a minimum depth of 5 feet bgs.

Well Installation and Development Activities

The boreholes at all proposed monitoring well locations will be drilled using a hollow stem auger drill rig to facilitate soil coring and sampling. Soil cores will be collected using a split-spoon sampler at 5-foot centers, and continuous coring to bracket the proposed screened interval. All drilling and field screening methodology will be performed in accordance with SOP 1 (Appendix B).

Monitoring wells will be installed within the proposed general location areas as shown on Figure 2, taking into account all applicable restrictions, including overhead obstacles, surface restrictions, subsurface utilities, and the discretion of the City of Sunnyvale for the approval of drilling locations.

Well Installation and Construction

The proposed monitoring well installations will be constructed as described on Table 1 and consistent with the methods presented in SOP 1 (Appendix B). Based on the current understanding of site conditions and geology, the monitoring wells are anticipated to be constructed with 10 feet of 2-inch-diameter, machine-slotted, PVC well screen (0.020-inch openings) and 2-inch-diameter, Schedule 40, blank PVC

casing set from the top of the screened interval to ground surface. All well casing and screen joints will be flush-threaded, and no glues or solvents will be used.

The selection of screen intervals will depend on the stratigraphy and where saturated conditions are encountered within the respective A zone depth intervals. Final monitoring well depths and screened intervals may be modified based on conditions encountered during drilling. Grout inspection will be performed in accordance with permit requirements.

Well Development

Monitoring well development will be performed as soon as practical after well installation, but not sooner than 48 hours following placement of the grout seal. Development of wells will be conducted consistent with SOP 1 (Appendix B).

Groundwater Sampling

Following installation and development of the proposed monitoring wells, one round of water level measurement and groundwater sampling will be performed to determine dissolved VOC concentrations.

Following development of all the monitoring wells, water level measurements will be collected and groundwater samples will be collected using the HydraSleeve™ sampling method. These activities will be performed consistent with the methodologies presented in SOP 2 – Groundwater Sampling (Appendix B).

Equipment Decontamination and Investigation-Derived Waste

Prior to boring advancement, all drilling equipment, downhole drilling tools, and sampling devices will be decontaminated consistent with SOPs 1 and 2 (Appendix B). In addition, decontamination rinsate, soil cutting wastes, and groundwater generated from sampling will be handled consistent with the mentioned SOPs.

Monitoring Well Survey

Each monitoring well and boring location will be surveyed by a land surveyor licensed in the state of California in accordance with the Geotracker database requirements. All monitoring wells will be surveyed for location, ground surface elevation, and measuring point elevation.

DATA EVALUATION AND REPORTING

After completion of the proposed monitoring well installation and groundwater sampling activities, ERM will prepare a summary report. This report will include a description of activities, tabular and graphical presentations of results, and conclusions and recommendations based on these results.

Schedule

The anticipated sequential schedule following Work Plan approval is as follows:

- Permitting, subcontracting: 5 weeks
- Monitoring well installation and development: 2 weeks
- Groundwater lab analyses: 6 weeks
- Data summary: 6 weeks

If you have any questions regarding this letter, please do not hesitate to contact us.

Sincerely,

Heather Balfour, P.E.
Project Manager

Ben Leslie-Bole
Partner-in-Charge

HDB/BLB/ks/0201040.01SGB
enclosures:

Figure 1 – Site Location Map
Figure 2 - Site Map and Proposed Monitoring Well Locations
Table 1 - Proposed Monitoring Well Construction Details
Appendix A - Figures for the A1, A2, A3, and A4 Depth Intervals
Appendix B - Standard Operating Procedures
Standard Operating Procedure No. 1 – Drilling Methods
Standard Operating Procedure No. 2 – Groundwater Sampling Methods

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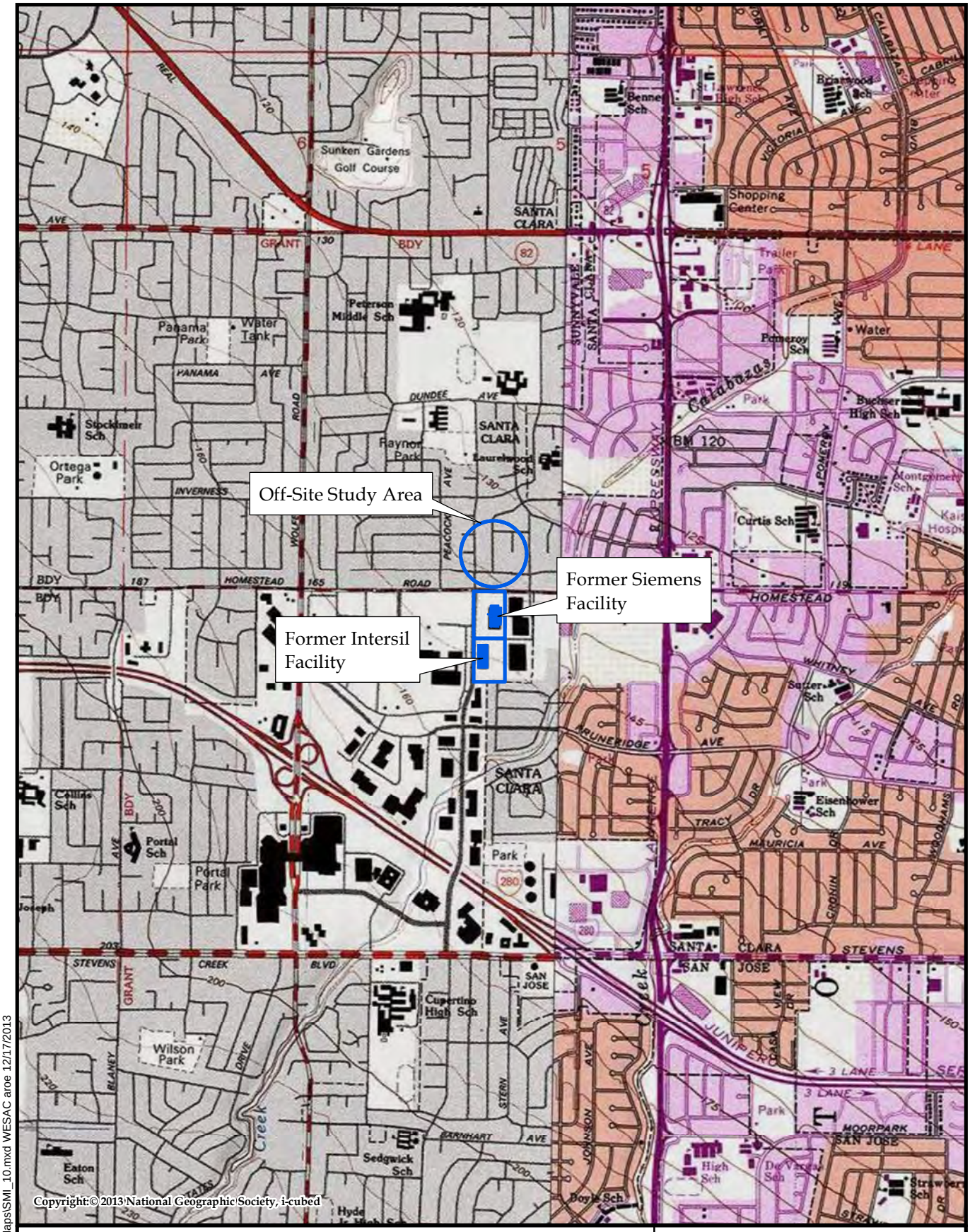
Figures



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Scale in Feet

ERM

FIGURE 1
SITE LOCATION MAP
FORMER SIEMENS AND INTERSIL FACILITIES, AND OFF-SITE STUDY AREA
CUPERTINO, CALIFORNIA

PREPARED BY: aroe (ERM)

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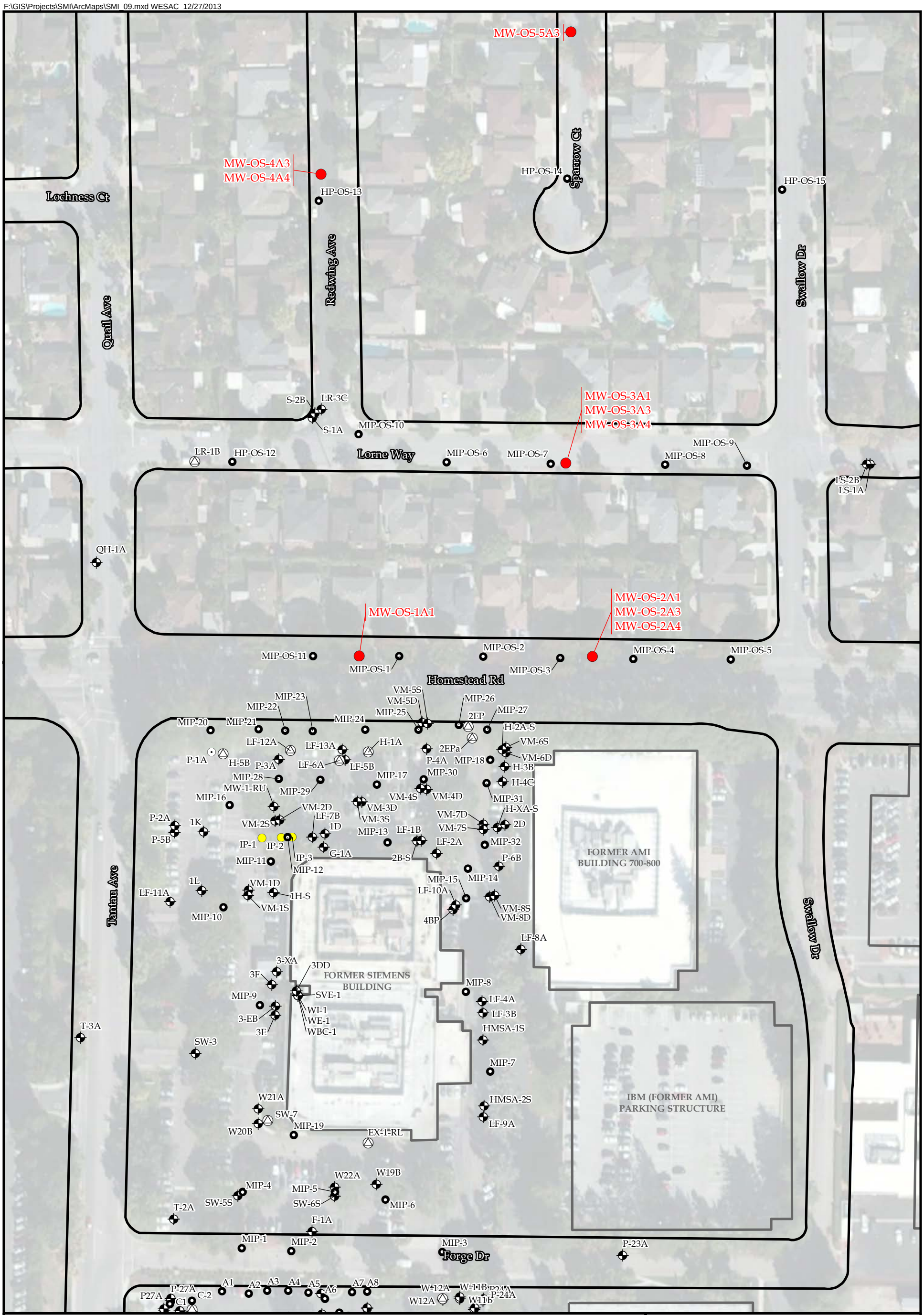

Legend

- Proposed Monitoring Well
- Groundwater Extraction Well
- Injection Point
- MIP Well
- Monitoring Well
- Piezometer
- Building Outlines
- City Block

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Scale in Feet

Off-Site Study Area, Monitoring Well Installation Work Plan
Intersil/Siemens Site
Cupertino, California

FIGURE 2

SITE MAP AND
PROPOSED MONITORING
WELL LOCATIONS

ERM

PREPARED BY:
Jorge.Acevedo

JOB NO. 0201040.01SGB
FILE: SMI_09

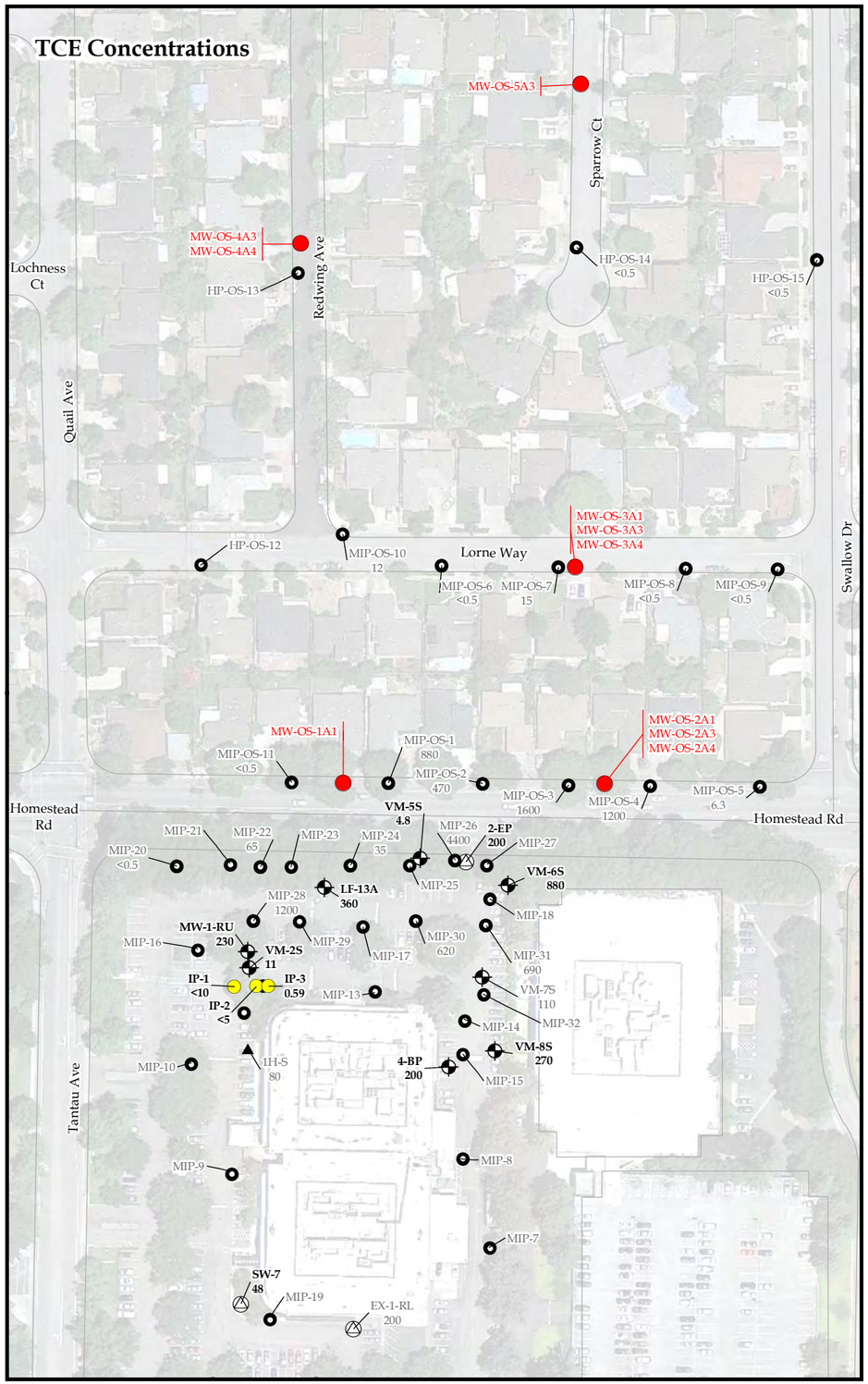
Tables

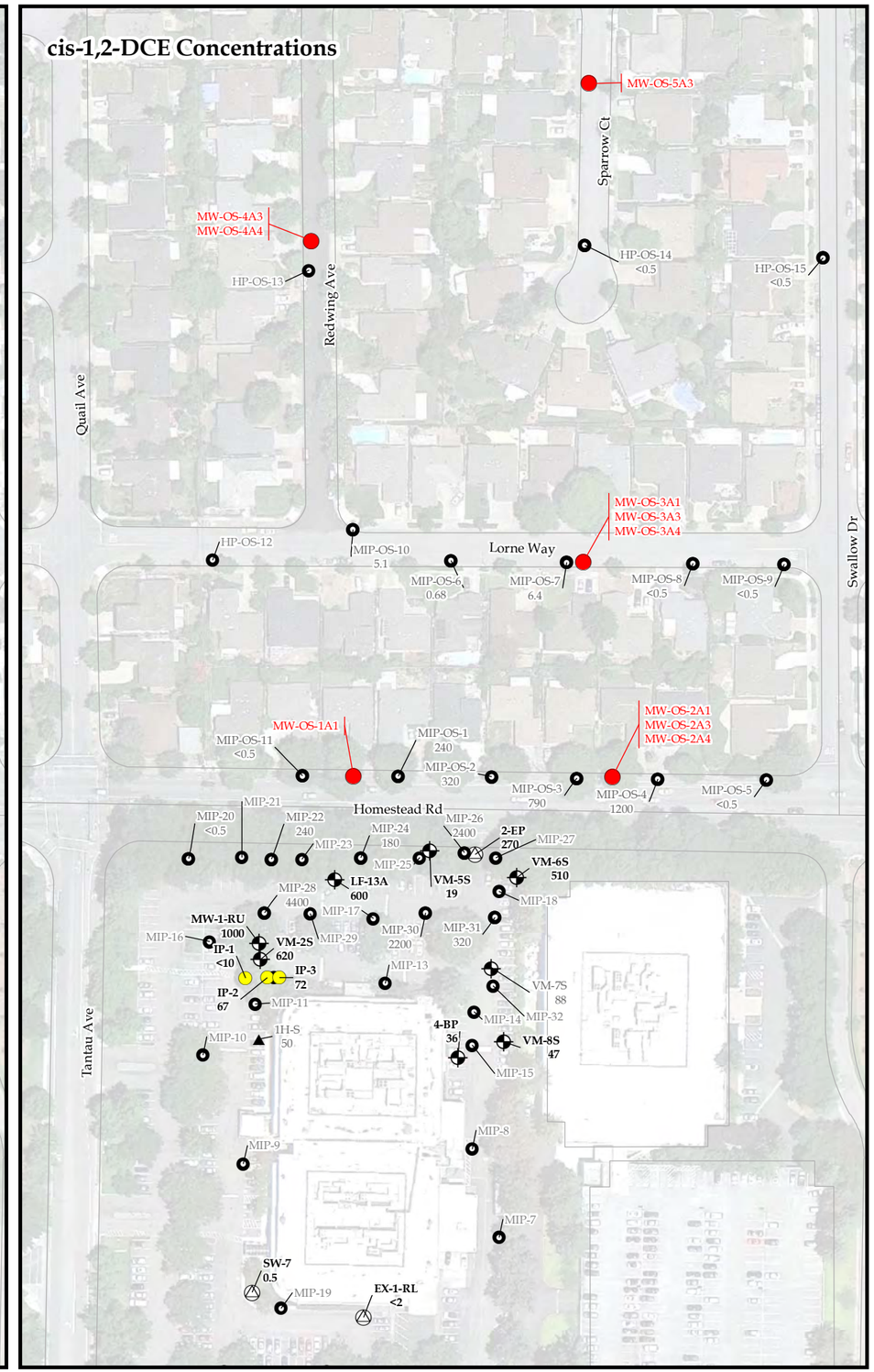
Table 1
Proposed Monitoring Well Construction Details
Off-Site Study Area
10950 Homestead Avenue
Cupertino, California

Well Name	Well Location	Reference Location	Zone	Annulus (inches)	Grout Interval (feet bgs)	Bentonite Seal (feet bgs)	Filter Interval (feet bgs)	Screen Interval (feet bgs)
MW-OS-1A1	Along Homestead Road	Between MIP-OS-11 and MIP- OS-1	A1	6	0-45	45-48	48-61	50-60
MW-OS-2A1	Along Homestead Road	Between MIP-OS-3 and MIP-OS-4	A1	6	0-45	45-48	48-62	50-60
MW-OS-2A3	Along Homestead Road	Between MIP-OS-3 and MIP-OS-4	A3	6	0-62	62-78	78-91	80-90
MW-OS-2A4	Along Homestead Road	Between MIP-OS-3 and MIP-OS-4	A4	6	0-105	105-108	108-121	110-120
MW-OS-3A1	Along Lorne Way	Near MIP-OS-7	A1	6	0-45	45-48	48-62	50-60
MW-OS-3A3	Along Lorne Way	Near MIP-OS-7	A3	6	0-62	62-78	78-91	80-90
MW-OS-3A4	Along Lorne Way	Near MIP-OS-7	A4	6	0-105	105-108	108-121	110-120
MW-OS-4A3	Along Redwing Avenue	Near MIP-OS-13	A3	6	0-75	75-78	78-92	80-90
MW-OS-4A4	Along Redwing Avenue	Near MIP-OS-13	A4	6	0-92	92-108	108-121	110-120
MW-OS-5A3	Along Sparrow Court	Near MIP-OS-14	A3	6	0-75	75-78	78-91	80-90

Notes:
bgs = Below ground surface
The well specifications are estimated and the actual specification will be determined based on observations in the field.

Appendix A
Figures for the A1, A2, A3, and A4 Depth Intervals





Legend

- Proposed Monitoring Well
- Groundwater Extraction Well
- Injection Point
- MIP and/or Depth Discrete Grab Groundwater Sample
- Monitoring Well
- Piezometer
- Passive Vent Well for the Former SVE System
- Soil Boring
- Soil Vapor Extraction Well

Note:

100 Denotes October 2012 Sample

100 Denotes 2011 Sample

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Scale in Feet

Off-Site Study Area, Monitoring Well Installation Work Plan
Intersil/Siemens Site
Cupertino, California

FIGURE A-1
2011/2012 TCE AND CIS-1,2-DCE CONCENTRATIONS
A1 DEPTH INTERVAL

ERM

PREPARED BY:
RK (ERM)

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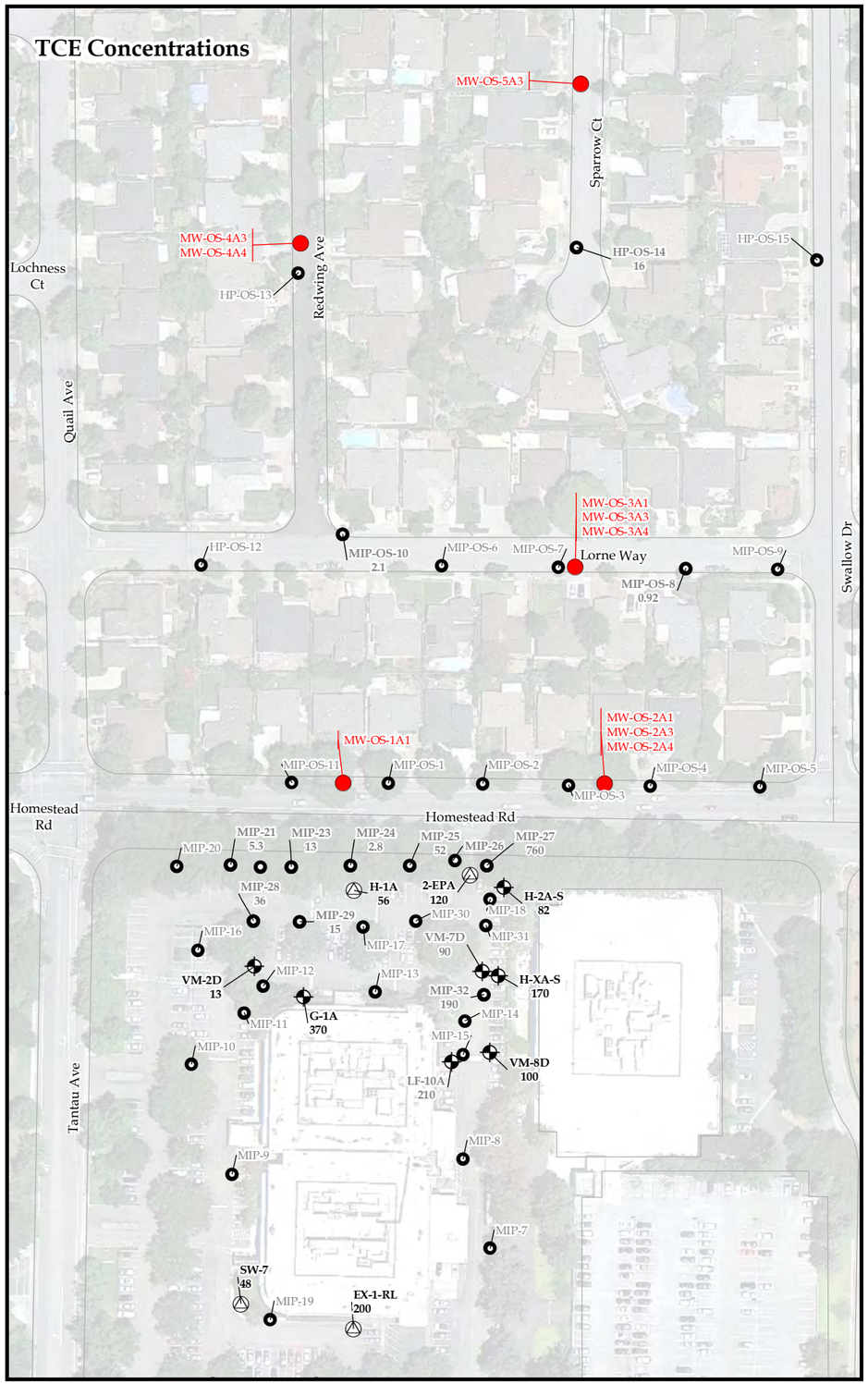

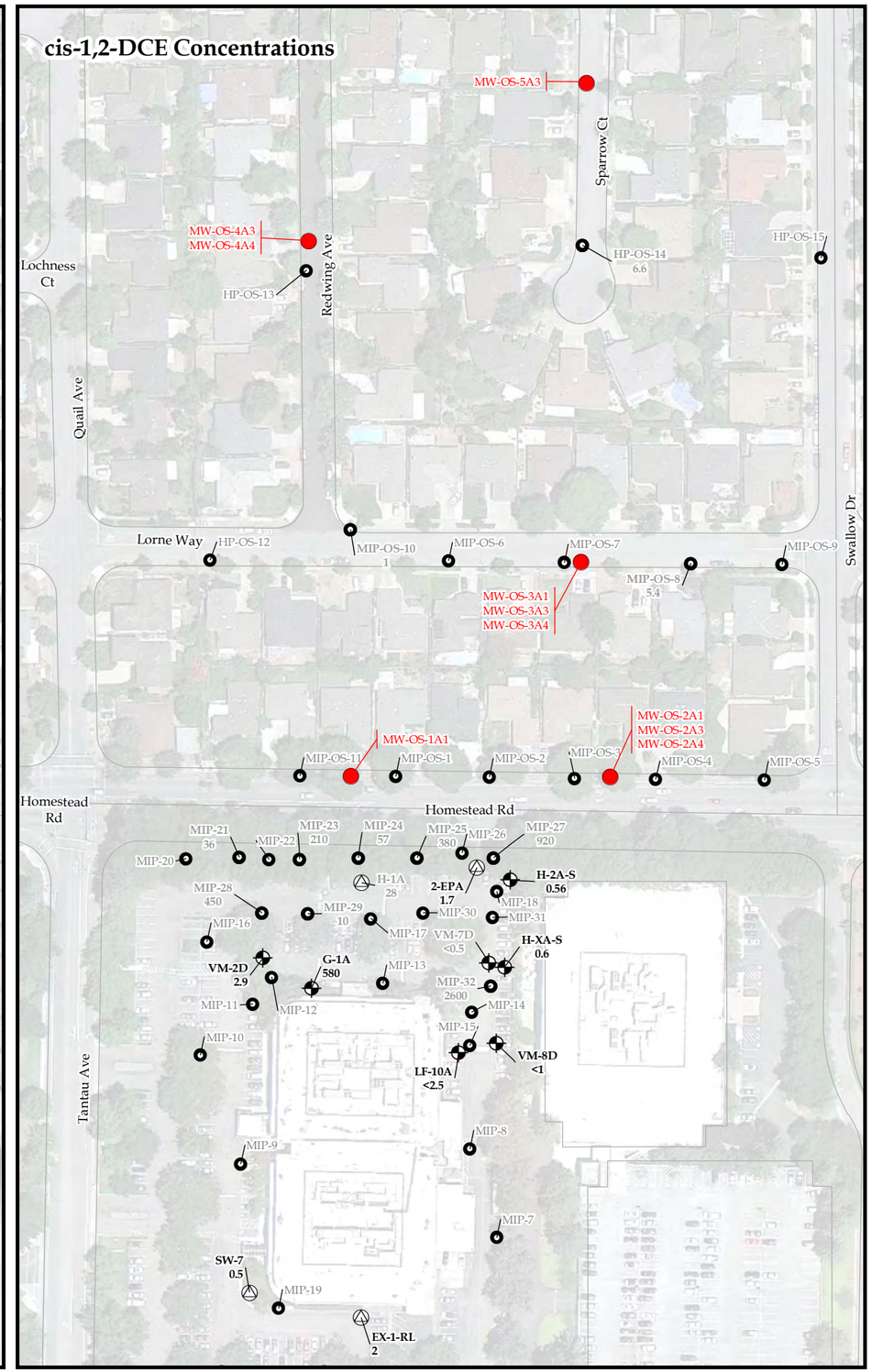

Legend

- Proposed Monitoring Well
- Groundwater Extraction Well
- Injection Point
- MIP and/or Depth Discrete Grab Groundwater Sample
- Monitoring Well
- Piezometer
- Passive Vent Well for the Former SVE System
- Soil Boring
- Soil Vapor Extraction Well

Note:
100 Denotes October 2012 Sample
100 Denotes 2011 Sample

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Scale in Feet

Off-Site Study Area, Monitoring Well Installation Work Plan
Intersil/Siemens Site
Cupertino, California

FIGURE A-2
2011/2012 TCE AND CIS-1,2-DCE CONCENTRATIONS
A2 DEPTH INTERVAL

ERM

PREPARED BY:
aroe (ERM)

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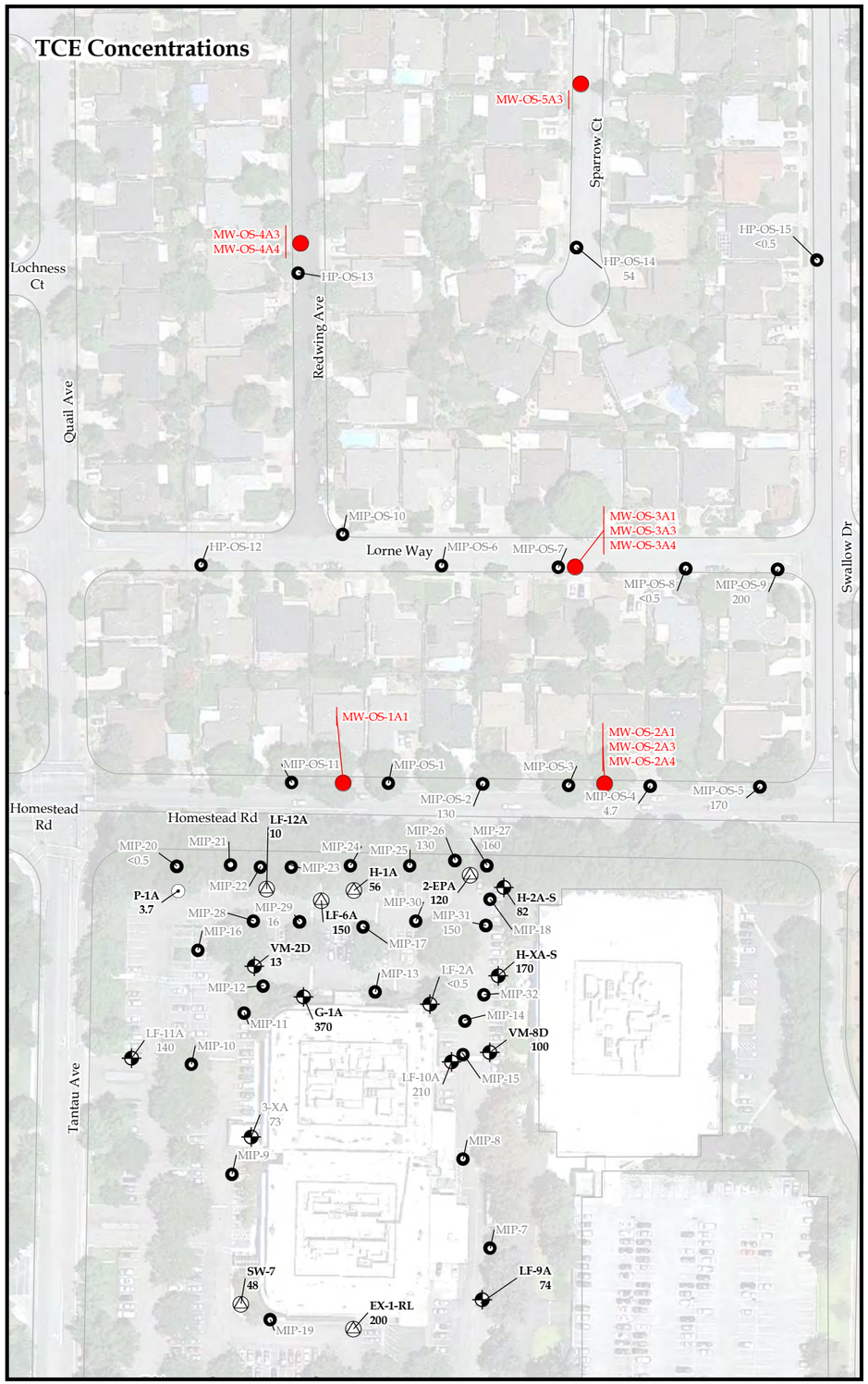

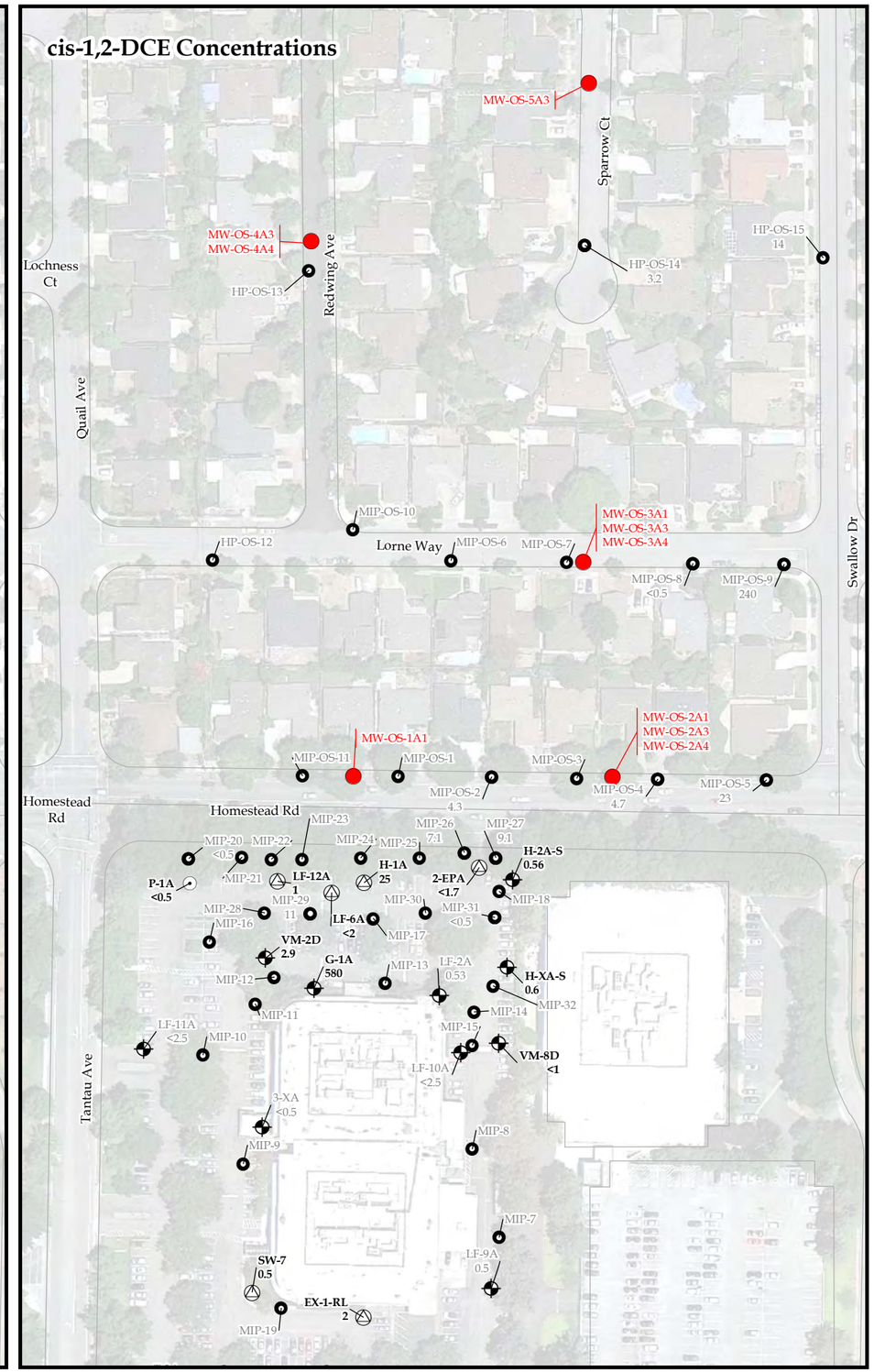

Legend

- Proposed Monitoring Well
- Groundwater Extraction Well
- Injection Point
- MIP and/or Depth Discrete Grab Groundwater Sample
- Monitoring Well
- Piezometer
- Passive Vent Well for the Former SVE System
- Soil Boring
- Soil Vapor Extraction Well

Note:
100 Denotes October 2012 Sample
100 Denotes 2011 Sample

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Scale in Feet

Off-Site Study Area, Monitoring Well Installation Work Plan
Intersil/Siemens Site
Cupertino, California

FIGURE A-3
2011/2012 TCE AND CIS-1,2-DCE CONCENTRATIONS
A3 DEPTH INTERVAL

ERM

PREPARED BY:
aroe (ERM)

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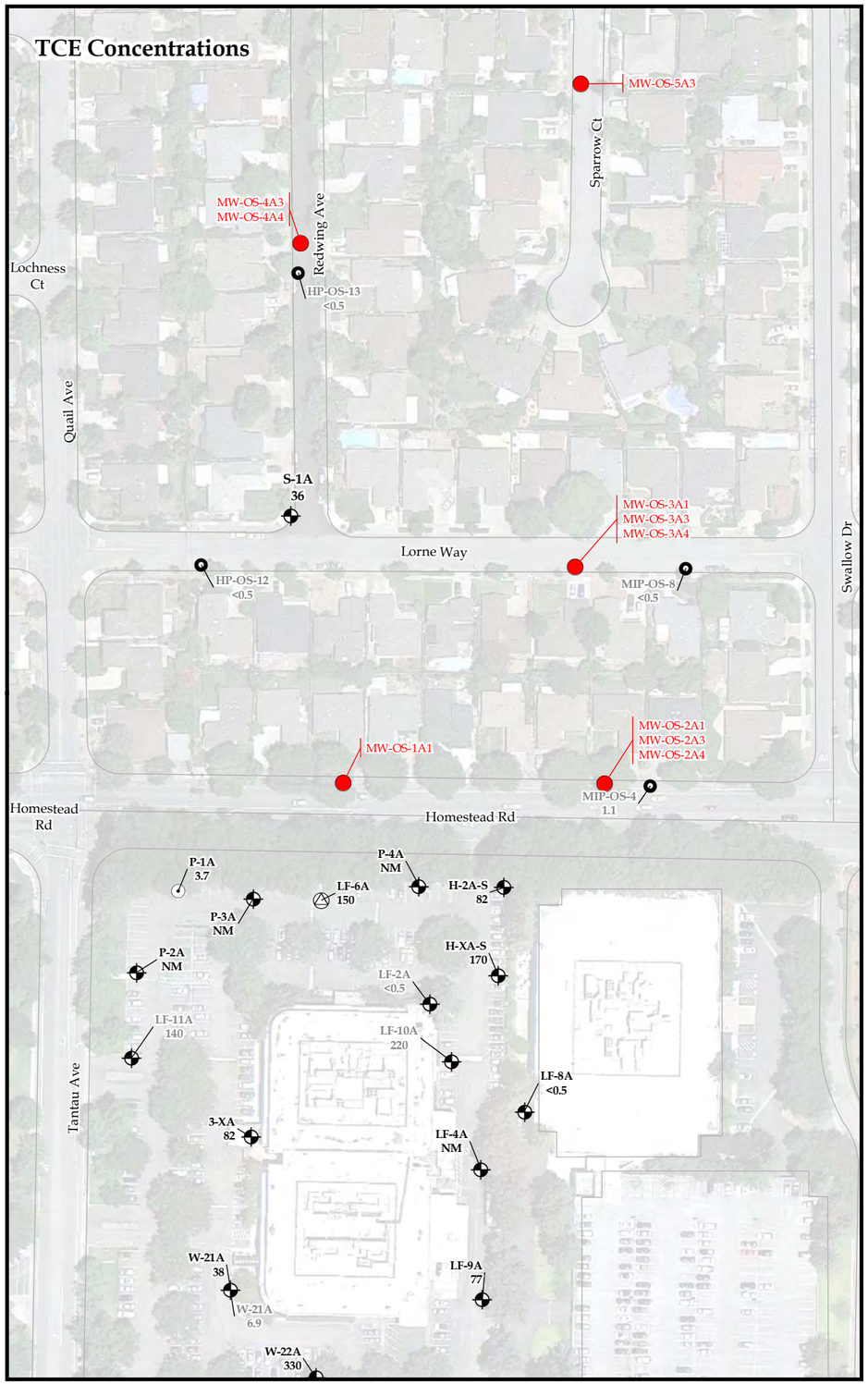

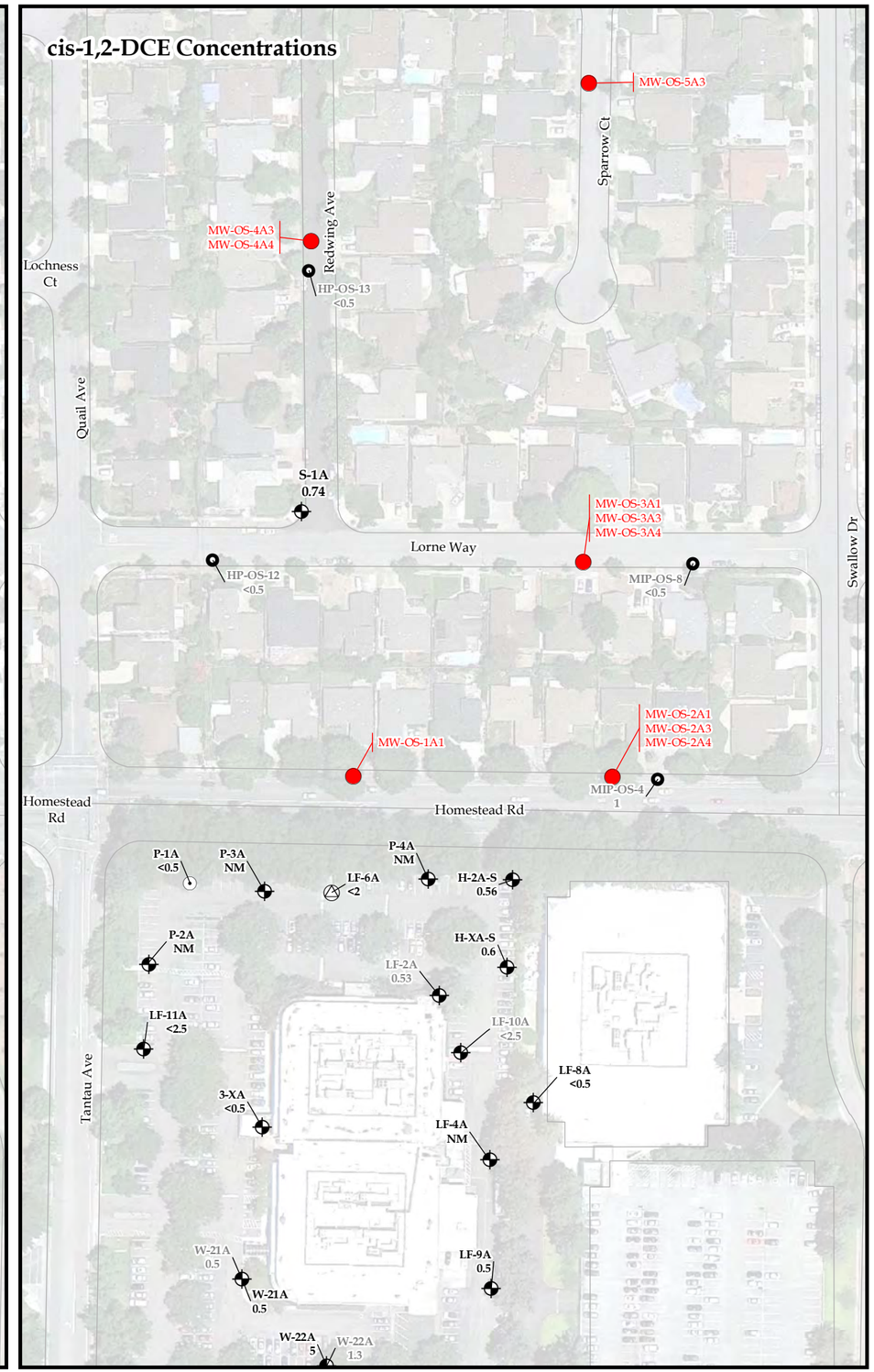

Legend

- Proposed Monitoring Well
- Groundwater Extraction Well
- Injection Point
- MIP and/or Depth Discrete Grab Groundwater Sample
- Monitoring Well
- Piezometer
- Passive Vent Well for the Former SVE System
- Soil Boring
- Soil Vapor Extraction Well

Note:
100 Denotes October 2012 Sample
100 Denotes 2011 Sample
NM Not Measured

N

0 150
Scale in Feet

Off-Site Study Area, Monitoring Well Installation Work Plan
Intersil/Siemens Site
Cupertino, California

FIGURE A-4
2011/2012 TCE AND CIS-1,2-DCE CONCENTRATIONS
A4 DEPTH INTERVAL

ERM

PREPARED BY:
aroe (ERM)

Job No. 01201040
File: FIG_D_SMI_A4_AMEC.mxd

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Appendix B
Standard Operating Procedures

Standard Operating Procedure No. 1
Drilling Methods

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1.0 INTRODUCTION

This standard operating procedure (SOP) has been developed for the former Siemens facility to direct field personnel in the drilling methods for implementing subsurface soil and groundwater investigation activities and groundwater remediation activities at the site.

1.1 OVERVIEW

This SOP will be implemented in accordance with the following documents:

- 15 August 1990, California Regional Water Quality Control Board, San Francisco Bay Region (Water Board) Site Cleanup Requirements (SCR) Order No. 90-119 Order 90-119 as amended by the 9 January 2013 Order R2-2013-002.
- Health and Safety Plan (HASP) which will identify risks to human health and the environment associated with known and potential chemical impacts at the site and the applicable technologies presented herein.

Investigation and remedial design rationale, scope of work, boring, well and/or injection point locations and sampling frequency will be submitted in separate document.

1.2 PURPOSE

The purpose of this SOP is to present the procedures, methods, and considerations for:

- Installation of temporary borings and monitoring wells using drilling methodologies; and
- Collection of soil and grab groundwater sampling using drilling methodologies.

This SOP describes equipment, field procedures, decontamination, documentation, storage, procedures necessary to implement soil borings, collect grab groundwater samples, collect soil samples, and install monitoring wells at the site.

Field activities will be conducted under the supervision of a California Professional Geologist or Professional Engineer to provide direction and oversight of the field activities and to ensure that the field activities follow appropriate quality control and applicable regulatory guidelines.

2.0 *EQUIPMENT*

The following is a typical list of equipment that may be needed to perform drilling activities:

- Work Plan, Sampling and Analysis Plan (SAP) or equivalent;
- Health and Safety Plan (HASP);
- Field forms (e.g., Boring Log Form);
- Drill rig (e.g., direct push rig, sonic rig);
- Photo-ionization detector (PID);
- 100 parts per million isobutylene span gas for PID calibration;
- Stainless steel trowels with handle of non-absorbent material;
- Unified Soil Classification System (USCS) chart;
- Camera;
- Filter Pack material (clean, rounded to well-rounded, hard, insoluble particles of siliceous composition [#2/12 clean silica sand])
- Bentonite pellets (approximately ¼ inch diameter);
- Grout (neat cement/bentonite grout mixed using 6.5 to 7 gallons of water per 94-pound bag of Type 1 Portland cement);
- Drums or bulk containers for storage of soil; and
- Personal protective equipment, including nitrile or powderless surgical gloves, hard hat, steel-toed boots, and in some cases a respirator (specified by the Health and Safety Plan).

The following is a typical list of equipment that may be needed to perform soil and grab groundwater sampling:

- Work Plan, Sampling and Analysis Plan (SAP) or equivalent;
- Health and Safety Plan (HASP);
- Field forms (e.g., Boring Log Form);
- Drill rig (e.g., direct push rig, sonic rig);
- Camera;
- Sample labels;
- Sample containers;

- Chain-of-custody forms;
- Appropriate sample containers (e.g., laboratory-supplied);
- Water quality test kit;
- Ice chests/coolers;
- Ice or frozen ice packs;
- Freezer bags.; and
- Personal protective equipment, including nitrile or powderless surgical gloves, hard hat, steel-toed boots, and in some cases a respirator (specified by the Health and Safety Plan).

The following is a typical list of equipment that may be needed to perform decontamination:

- High-pressure steam cleaner (provided by subcontractor);
- Brushes;
- Wash/rinse tubs;
- Liquinox, Alconox detergent (or equivalent);
- Deionized water; and
- Visqueen plastic; and
- Personal protective equipment, including nitrile or powderless surgical gloves, hard hat, steel-toed boots, and in some cases a respirator (specified by the Health and Safety Plan).

2.1 CALIBRATION OF FIELD EQUIPMENT

For the purpose of this SOP, the only field equipment requiring calibration is a PID. The PID will be used to field screen the VOC concentrations within the soil. The meter will be maintained and calibrated according to manufacturer's specifications. The calibration procedure includes a 2- or 3-point calibration (zero and known).

The meter will be calibrated prior to use in the field. At a minimum, the meter will be calibrated daily in the morning followed with an instrument check at the completion of the day's activities. Calibration procedures and results and any observed "drift" will be recorded in the field log book along with the equipment's serial number.

3.0 DRILLING PROCEDURES

3.1 PRE-DRILLING PROCEDURES

To ensure the health and safety of field personnel during drilling or other intrusive activities, precautions will be taken to avoid contacting underground hazards (e.g., gas lines, high-voltage electrical lines) and overhead hazards (electrical lines), and to prevent damage to other utilities (e.g., water mains, sewer lines, communication lines). All proposed drilling locations will be marked prior to performing any subsurface activities. Underground Service Alert of Northern California (USA), a notification service for marking underground utilities on public rights of way, will be notified at least 48 hours prior to work (phone number: 1-800-227-2600). In addition to notifying USA, a private utilities-locating service will be contracted to locate and mark underground utilities near all proposed drilling locations. All drilling locations will be cleared using a hand-auger or air knife to at least 5 feet bgs to further reduce the potential for encountering underground utilities during investigation activities. If refusal is encountered, boring locations will be relocated and the same procedures outlined above for clearing the locations.

Boring and monitoring wells will be installed within the proposed general area taking into account all applicable restrictions, including overhead obstacles (overhead utilities, power lines, and trees), surface restrictions (transit routes, driveways, traffic control, and areas with restricted access such as loading zones and fire lanes), subsurface utilities, and the discretion of the City for the approval of drilling locations.

3.2 DRILLING METHODOLOGY

The following drilling methods may be used to install environmental monitoring wells or collect soil cores for logging or laboratory analysis under various subsurface conditions. While consideration will need to be given to the depth and nature of materials to be drilled through in order to install the monitoring well, the preferred drilling methods are generally those that case the hole during drilling (e.g., direct push and sonic drilling). However, other methods may be used where specific subsurface or project criteria dictate. The following sections describe common drilling techniques used that may be used at the site.

3.2.1 *Direct Push Drilling*

Direct push technology utilizes a piston to drive, push, or vibrate hollow stem rod into the subsurface. The soil sampling tool or core barrel with a disposable acetate inner-liner is pushed to desired depth. Upon reaching desired depth the drive rod and core barrel is retrieved via hydraulic cylinder or cable winch and the acetate inner-liner is removed for geologic logging and soil sample collection. A new acetate inner-liner is loaded into the core barrel and drive rod and sampler is subsequently pushed into the soil to desired depth. A telescope casing system, which decreases the possibility of cross-contamination by cave-in of up-hole material, the core barrel is extracted, can be used up to a maximum depth of approximately 90 feet bgs using direct push technology.

3.2.2 *Sonic Drilling*

Sonic drilling is a combination of both rotary and percussion of a core barrel, with the added effect of high frequency vibration applied to the rod/barrel assembly. The vibration is in the audible frequency range, hence the term sonic. A telescopic casing system which decreases the possibility of cross-contamination by cave-in of up-hole material, the core barrel is extracted, can be used up to a maximum depth of approximately 200 feet. Sonic borings will be drilled by using a larger outside diameter casing (7 to 14 inches in diameter) and a smaller diameter core barrel ranging from 3.5 to 7 inches in diameter. During sonic drilling the inner core barrel will be advanced with or ahead of the outer core barrel to the total depth of the borehole. The outer drive casing is advanced behind the core barrel, which is used to collect soil samples, to prevent borehole collapse while the inner core barrel is removed. Following retraction of the inner core barrel the soil samples are vibrated out of the core barrel into plastic sleeves for geologic logging.

3.2.3 *Hollow Stem Auger*

Auger drilling methods can be employed without introducing foreign materials into the borehole such as water or drilling fluids, which helps to limit the potential for cross contamination. This type of auger consists of a hollow, steel stem or shaft with a continuous, spiraled steel flight, welded onto the exterior. A hollow auger bit, generally with carbide teeth, disturbs soil material when rotated, whereupon the spiral flights transport the cuttings to the surface.

The hollow auger and bit facilitate collection of soil core using split spoons, or split-barrel samplers that can be driven ahead of the bit. These cores provide lithologic data that allow the geoscientist to assess top and bottom of water-bearing units and interval(s) to set the well screen.

This method is best suited in soils that have a tendency to collapse when disturbed. A monitoring well can be installed inside of hollow-stem augers with little or no concern for the caving potential of the soils. If heaving (flowing) sands are present during monitoring well installations, a drilling rig must be used that has enough power to extract the augers from the borehole without having to rotate them.

If heaving sands are known to be present prior to drilling, a bottom plug, trap door, or pilot bit assembly can be used at the bottom of the augers to keep out most of the soils and/or water that have a tendency to enter the bottom of the augers during drilling. Potable water (analyzed for contaminants of concern) may be poured into the augers during drilling to equalize pressure to limit inflow of formation materials. If continuously collecting soil core while drilling with hollow stem augers, a sampling tool (e.g., split spoon, etc.) is used to collect undisturbed soil cores in advance of the auger. Following sample collection the auger is advanced and the process repeated. Where refusal of the sampling tool (or flowing sand conditions) is encountered, the drilling can continue using an internal (or reverse) auger within the auger stem, or by inserting a bottom plug in the auger string.

Alternatively, when soil sampling or logging is not required during the drilling process, a bottom plug can be used to keep soil from entering the auger string. The bottom plug is wedged into the bottom of the auger bit and is knocked out at depth with drill pipe or the weight of the casing and screen assembly. The plug material should be compatible with the screen and casing materials. The use of chemically-treated wood bottom plugs is not acceptable. The type of bottom plug, trap door, or pilot bit assembly proposed for the drilling activity should be approved by a senior field geologist and project manager prior to drilling operations.

Boreholes can be augered to depths of 150 feet or more (depending on the auger size, lithology and size of the drill rig), but generally boreholes are augered to depths less than 100 feet. Note: for wells deeper than 100 feet, it is important to consider whether the driller's equipment is adequate in the event flowing sands or gravel/cobbles are encountered. Augers may become permanently trapped and the boring may need to be abandoned.

3.3 *SOIL CLASSIFICATION PROCEDURES*

All soil samples should be described in accordance the USCS and the information recorded on field logs completed for each location. The description should include the following pieces of information:

- Sample ID – Location (e.g., boring number) and depth;
- Lithology – e.g., sand, silt, clay, silty clay etc.;
- Color – If a Munsell Color Chart is available use those otherwise use general color descriptions. To the degree practical, describe all colors that are present;
- Moisture Content – use judgment to describe relative amount of moisture in sample (e.g., dry, damp, moist, wet, or water saturated);
- Plasticity – low, medium or high plasticity, crumbly or brittle;
- Uniformity – layering or massive;
- Density; and
- Other characteristics – e.g., rootlets, nodules, concretions, odors (be non-specific use hydrocarbon odor instead of diesel or gasoline odor), and PID headspace readings, etc.

Any visual evidence of impact, unusual color (s) or odor should be noted on the field logs. The sample location and depth should be recorded as accurately as possible, preferably by surveying to a national coordinate system. No soil sample should ever be collected for analysis without an accompanying soil description and sample collection record.

3.4 *SOIL SCREENING*

Select soil samples from each boring will be monitored for organic vapors using a photo-ionization detector (PID). The screening equipment will be calibrated daily against a span gas (e.g., isobutylene) having a concentration of 100 parts per million and recorded on each log. The soil samples will be monitored by placing a sample of soil retrieved from the boring into a plastic bag. The soil sample will be broken up in the sealed bag. The PID probe will then be inserted into the bag to monitor the headspace.

3.5 *BOREHOLE STABILIZATION*

Borehole stabilization techniques are used to provide borehole support (i.e. borehole cave-in issues, etc.) and also for preventing cross-contamination of impacted media between the different groundwater depth intervals and zones. The primary borehole stabilization technique if used at the site will be casing telescoping.

Casing telescope consists of driving a larger outer casing with a smaller an inner sample barrel. Telescope drilling is conducted by advancing an inner casing to a given depth followed by the outer casing, around the inner casing, to that same depth. Once the outer casing is in place, the inner casing and sample barrel can be retracted from the bore hole without concern of bore hole collapse due to the presence of an outer casing which remains in place.

Casing telescoping will also is be used to prevent cross contamination between depth intervals. This will be done by telescoping casings to the aquitard or low permeability zone to seal off the upper water bearing unit from the lower water bearing units. The following steps and methodology will be used at the Former Siemens facility when using casing telescoping techniques:

- Drive a larger outer casing with a smaller an inner sample barrel to the top of the confining layer;
- Verify the presence at this depth by the physical observation of fine grained silts and clays;
- If the fine grained material is not observed in the core barrel sample, advance the outer casing and inner-sample barrel until the presence of the fine grained material is observed;
- Once the top of the confining layer is observed, drive the outer core barrel an additional 2 to 3 feet into the confining layer to create a seal between the layers;
- Retract inner sample barrel and install 2 feet of bentonite chips of pellets in the bottom of the hole;
- Allow approximately 30 minutes for the bentonite chips to hydrate; and
- Telescope larger outer casing and smaller inner sample barrel and complete boring to desired depth.

3.6 *BOREHOLE BACKFILLING TECHNIQUES*

Upon completion of testing and sampling, the open borehole will be backfilled with grout or bentonite chips after the drilling equipment has been removed. The grout mix, if used, will be approximately one sack (94 pounds) cement, and approximately 5.5 gallons water. Grout will be introduced by a tremie into the bottom of the open hole and filled to the surface.

3.7 *WELL INSTALLATION*

The selection of screen intervals will depend on the field data and the intended purpose of the well. Final well depths and screened intervals may be modified based on conditions encountered during drilling. Grout inspection will be performed in accordance with permit requirements.

The monitoring wells will typically be constructed with 10 feet of 2 inch-diameter, machine-slotted, PVC well screen (0.020 inch openings) and 2 inch-diameter, Schedule 40, blank PVC casing set from the top of the screened interval to ground surface. All well casing and screen joints will be flush-threaded, and no glues or solvents will be used.

For single-well installation, the screen and casing will be suspended in the boring and the annular space between the edge of the borehole and the well casing using a tremie pipe. The annular space will consist of the following layers from the bottom to the top:

- Filter Pack – extend from minimum of 1 foot below the screen to 2 feet above the top of the screen;
- Bentonite Seal – extend 3 feet above the filter pack; and
- Cement Bentonite Grout – extend from top of bentonite seal to surface of well.

For dual nested well installations, the screen and casing for each of the wells will be suspended in the boring. Filter pack and grout will be placed in the annular space between the edge of the borehole and the well casing using a tremie pipe. The annular space will consist of the following layers from the bottom to the top:

- Filter Pack – extend from minimum of 1 foot below the screen to 2 feet above the top of the lower well screen;
- Bentonite Seal – extend from filter pack to 2 feet below the bottom of upper well screen;

- Filter Pack – extend from 2 feet below the bottom of upper well screen to 2 feet above the top of the upper well screen;
- Bentonite Seal – extend 2 feet from top of filter pack of upper well screen; and
- Cement Grout – extend from top of bentonite seal to surface of well.

The filter pack materials will consist of clean, rounded to well-rounded, hard, insoluble particles of siliceous composition (#2/12 clean silica sand). Bentonite seal will consist of ground, dried bentonite compacted into pellets approximately ¼-inch diameter. The cement grout will consist of neat cement/bentonite grout mixed using 6.5 to 7 gallons of water per 94-pound bag of Type 1 Portland cement. The addition of bentonite (5 to 10 percent) to the cement grout will be used to delay the setting time, reduce heat of hydration, and prevent shrinking or cracking of the neat cement.

After placement of the filter pack and before placement of a bentonite seal, the well screen interval will be surged for a minimum of 15 minutes to ensure proper settling of the filter pack.

All wells will have a water-tight cap with lock and completed within a sloped traffic-rated well box with metal cover plate at grade.

3.8 INVESTIGATION DERIVED WASTE

Solid IDW (i.e., soil cuttings) will be contained in 55-gallon drums or soil bins. If used, drums will be stored on pallets and transported to a designated IDW holding area. Liquid IDW (e.g., purge water or decontamination water) will be placed in 55-gallon drums or bulk storage tanks located at a designated location. All containers will be clearly labeled with the type of IDW contained, generation date, location, and the appropriate contact information.

Samples will be collected from both solid and liquid IDW storage containers and analyzed for the requirements of the disposal facility. The analytical results will be used to determine the type of disposal necessary for the soil and liquid IDW. Soil, liquid, sludge, purge and/or decontamination water IDW will be collected from designated areas and shipped off-site in a timely manner.

3.9 SURVEYING

To evaluate data geographically, the soil boring locations will be surveyed to a datum consistent with the existing groundwater monitoring network. In addition, to obtain accurate groundwater elevation data and evaluate water quality data geographically, the new groundwater monitoring wells will be surveyed to a datum consistent with the existing groundwater monitoring network. A California-registered surveyor, under the supervision of a responsible field representative, will perform the surveying. The surveyor will use State Plane North American Datum 1983 (NAD 83) California Zone V.

A series of control points or monuments will be established for use in surveying the locations. The majority of control points will consist of permanent features, but installation of monuments may be necessary. To determine accurate groundwater elevations, the necessary precision for vertical survey coordinates of monitoring wells will be 0.01 foot. Horizontal coordinates will be measured to an accuracy of 1.0 foot.

Prior to the wellhead survey, permanent markings will be applied to the well monument and casing/sounding port to provide reference points for the surveyors and to enable consistent future measurements. Groundwater monitoring wells will be surveyed for their horizontal location at the center of the well vault. Vertical elevations will be surveyed at three points: (1) the top of the monitoring well vault; (2) the northern side of the top of the well casing or sounding port; and (3) the ground surface. The ground surface will preferably be surveyed at the northern side of the well, but can be modified if the surface is uneven relative to the well.

4.0 SAMPLING AND DEVELOPMENT PROCEDURES

4.1 CONTAINERS, PRESERVATION AND HOLDING TIME

The method of sample retrieval varies by subcontractor and drilling methodology. The most common form of retrieval is achieved by pulling the drive rods from the sample location and unthreading the sampling tool from the rods.

Following retrieval, the sample will be removed from the sampler device and placed on a clean flat surface for evaluation. The top and bottom of the core and sampled interval will be marked on the liners or plastic sheeting. The ends of each liner containing soil to be submitted for analysis will be covered with Teflon tape prior to installing the plastic end caps.

Each sample tube submitted for analyses will be labeled with the boring number, bottom depth of liner, date and time of sampling, the individual performing the sampling, and job number. If a core barrel is used, the contents of the core barrel will be removed and logged by a qualified geologist or engineer. Analytical samples will be placed in glass jars and labeled. The labeled liners will be placed in self-sealing plastic bags in a cooler with ice or frozen ice packs for storage until they are delivered to the analytical laboratory. Each cooler shall contain a chain-of-custody (COC) record, and each sample placed in a given cooler shall be listed on the COC record for that cooler. The COC protocols are presented in Section 4.3 of this SOP. The remainder of the soil sample will be logged for lithology and soil structure following the Unified Soil Classification System, and other pertinent information.

4.2 GRAB GROUNDWATER SAMPLE COLLECTION

Groundwater samples collected from borings will be collected using Hydropunch™ or similar technology. To collect a sample, the sampler is connected to a drive rod and driven or pushed to the desired sampling depth. As the tool is advanced, it remains in the closed position, which prevents soil or water from entering the sampler. Once the desired sampling depth is obtained, the tool is opened to the aquifer by pulling up the drive rod approximately 5 feet. In the open position, ground water can flow freely into the sample chamber of the tool. When the sample chamber is full, a stainless steel or disposable sampler is pulled to the surface. At the surface the sample is transferred from the bailer to an

appropriate sample container. The tool is a fast, inexpensive alternative for collecting ground water samples from a discrete interval.

4.3 WELL DEVELOPMENT

Monitoring well development will be performed as soon as practical after well installation, but not sooner than 48 hours following placement of the grout seal.

Development of wells will be accomplished with a submersible pump or bailer. A surge block may be used to flush the filter pack of fine sediment in instances where field personnel expect that development may be improved by surging. Surging will be conducted slowly to reduce disruption to the filter pack and screen. Following surging, the well will be pumped or bailed again to remove sediment drawn in by the surging process until suspended sediment is reduced to acceptable levels (see below).

A well is considered fully developed when all the following criteria are met:

- Well water is clear to the unaided eye (based on observations of water clarity through a clear glass jar) and turbidity readings have stabilized to +/- 10 percent over three consecutive readings;
- Sediment thickness remaining in the well is less than one percent of the screen length; and
- Total volume of water removed from the well equals five times the standing water volume in the well plus the volume of drilling fluid lost.

Purge water will be managed as described in Section 3.6. Non-dedicated pumps will be decontaminated prior to reuse.

5.0 SAMPLING INSTRUCTIONS

5.1 CONTAINERS, PRESERVATION AND HOLDING TIMES

Certified clean sample containers and trip blanks will be obtained from the contract analytical laboratory. The bottles, tubes or jars will be labeled to indicate the type of analysis to be performed, and necessary preservatives will be present in the bottles when received from the laboratory.

Table 1 summarizes the sampling containers, preservation, and holding times for the various types of analyses.

5.2 SAMPLE TRACKING

Documents for tracking the samples are generated in the field. This documentation includes field notes, sample labeling, and chain of custody (COC) forms.

5.2.1 Sample Labeling

Each sample will be labeled prior to collection. The sample label will be filled out with waterproof ink. Each sample label contains the following information:

- Project number;
- Company name;
- Site/project name;
- Sample number (well location);
- Parameters for analysis;
- Date and time of collection;
- Preservative; and
- Sampler's signature (or initials).

Information pertinent to field survey measurements (Section 3.2.3) and sampling will be recorded on the field forms and/or in the field notebook.

5.2.2 *Chain-of-Custody Forms*

A COC form will be filled out in the field and will accompany every shipment of samples to the analytical laboratory. The purpose of the COC form is to document possession of a sample from the time of collection in the field to its final disposal by the laboratory.

The laboratory will enter the following information on the form:

- Name of persons receiving the sample;
- Date of sample receipt; and
- Sample condition.

All corrections to the COC record will be initialed and dated by the person making the corrections.

Each COC form will include signatures of the appropriate individuals indicated on the form.

5.3 *SAMPLES FOR ASSESSING QA/QC*

To identify potential errors, four types of QC samples may be included for analysis. All QC samples are labeled and sent to the laboratory along with the actual samples for analysis. QC sample frequencies are summarized below. The three types of QC samples are as follows:

5.3.1 *Trip Blanks*

Trip blanks check for contamination due to handling, transport, contact with other samples during storage, or laboratory error. A VOA bottle set is filled with deionized water by the laboratory. This set is taken to the field, labeled with company name, date, and cooler ID, and stored with the other samples until they are delivered for analysis to the laboratory. Trip blanks are opened by laboratory personnel only. One trip blank set is sent per cooler of samples for volatiles analysis per day.

5.3.2 *Field Duplicates*

Sometimes referred to as a split or replicate, a field duplicate is a check on field and laboratory precision. For groundwater, two samples from a single bailer or consecutive samples collected by means of a bladder pump are filled at the same sampling location.

For soil, two consecutive soil liners are submitted at the sampling location. One is labeled as the actual location and the other is labeled as a duplicate sample. Preservation and shipping of samples and their duplicates is identical. One duplicate will be submitted per 10 samples, or one per sampling event if fewer than 10 samples are collected.

5.3.3 Rinsate Samples

Bailer or sampling equipment rinsate blanks verify that chemicals are not being carried from one sample to the next via the Teflon sampling bailer or other equipment used in the transfer of water samples. Rinsate field blanks will be taken after sampling the wells known to historically contain the highest chemical concentrations for the group of wells sampled. The sampling bailer and/or other equipment are first decontaminated with deionized water. Deionized water is then poured from the bailer (and/or other equipment) into sample bottles labeled with a QC number. One rinsate sample will be submitted per 20 samples collected with a bailer.

Rinsate samples will not be collected for wells to which specific or disposable sampling equipment (bailer or pump) has been dedicated, as no likelihood of transferring chemicals to other samples exists.

6.0 EQUIPMENT DECONTAMINATION PROCEDURES

Decontamination will be performed on all non-dedicated sampling equipment that may contact potentially contaminated water including water level meters and other sampling equipment.. Clean nitrile gloves or powderless surgical gloves are to be worn during decontamination.

An equipment decontamination station will be centrally located on site. Each piece of sampling equipment will be decontaminated before each sampling period and between each well. Plastic sheeting will be laid down around each well during sampling to protect decontaminated equipment from contact with the ground. The decontamination procedure for most equipment will be as follows:

- Wash equipment in an Alconox (or equivalent) and water solution using a brush or clean cloth to ensure removal of all contaminants;
- Rinse equipment in fresh tap water;
- Rinse again with deionized water; and
- Dry equipment with paper towel and place in clean plastic, if appropriate.

The effectiveness of these decontamination procedures will be verified by vigorous QA/QC protocols, including blanks and duplicates.

7.0 DOCUMENTATION

Thorough documentation in the field is required to ensure proper labeling and tracking of samples, identify potential sources of error, and maintain accountability among field personnel.

7.1 FIELD NOTES AND DATA COLLECTION FORMS

Field notes shall be kept in a bound notebook. The following information will be included in the field notes and/or on data collection forms:

General Information:

- Names of personnel;
- Weather;
- Date and time of sampling;
- Location, boring and/or well number;
- Condition of the well or boring;
- Times that procedures and measurements are completed;
- Calibration of meters at start of day;
- Decontamination times; and
- Initial static water level and total well depth, if applicable.

Sampling Information:

- Volume of water evacuated before sampling;
- General description of sample procedures, or reference the SOP;
- Time of sample collection;
- Number of samples collected;
- Sample identification numbers;
- Preservation and storage of samples;
- Record of any QC samples from site;
- Any irregularities or problems that may have a bearing on sampling quality; and
- Type of sampling equipment.

Standard Operating Procedure No. 2
Groundwater Sampling

TABLE OF CONTENTS

FIGURES *ii*

TABLES *iii*

1.0 INTRODUCTION *1*

1.2 OVERVIEW *1*

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1.0 INTRODUCTION

This standard operation procedure (SOP) has been developed for the former Siemens facility to direct field personnel in the sampling of monitoring wells during groundwater investigation activities and groundwater remediation activities at the site.

1.2 OVERVIEW

This SOP will be implemented in accordance with the following documents:

- 15 August 1990, California Regional Water Quality Control Board, San Francisco Bay Region (Water Board) Site Cleanup Requirements (SCR) Order No. 90-119 Order 90-119 as amended by the 9 January 2013 Order R2-2013-002.
- Health and Safety Plan (HASP) which will identify risks to human health and the environment associated with known and potential chemical impacts at the site and the applicable technologies presented herein.

Investigation and remedial design rational, scope of work, boring, well and/or injection point locations and sampling frequency will be submitted to Siemens for approval in a separate document.

1.3 PURPOSE AND OBJECTIVES

The purpose of this SOP is to present the methodologies for sampling and collection of groundwater samples from site monitoring and remediation wells. The objective of the SOP is to provide procedures, methods, and considerations to be used and observed by field personnel to obtain groundwater samples that meet acceptable standards of accuracy, precision, comparability, representativeness, and completeness.

This SOP describes equipment, field procedures, sample containers, decontamination, documentation, storage, holding times, and field quality assurance/quality control (QA/QC) procedures necessary to develop existing ground water monitoring wells and to collect water samples from the site wells.

1.4 *EQUIPMENT LIST*

Sample bottles will be obtained from the analytical laboratory for collecting and testing. Trip blanks for volatile organic compounds will also be obtained from the analytical laboratory.

Typical equipment list for well evacuation and sampling:

- Personal protective equipment, including nitrile or powderless surgical gloves and safety glasses;
- Water level meter;
- pH meter;
- Specific conductivity meter;
- Thermometer;
- Ground Water Sample Collection Data Forms (Figure 1);
- Data recording sheets;
- Field notebook;
- Chain-of-Custody (COC) forms (Figure 2);
- Labels (Figure 3);
- Appropriate sample containers;
- Self-sealing plastic bags;
- Ice chest or cooler;
- Ice or frozen ice packs;
- Spray bottle for deionized water;
- Deionized water; and
- 55-gallon drums or other type of portable storage container.

Equipment used during decontamination:

- Liquinox, Alconox detergent (or equivalent);
- Deionized water; and
- Containers, brushes, paper towels, plastic sheeting.

3.0 GROUNDWATER MONITORING PROCEDURE

3.1 WATER LEVEL MEASUREMENT

Water level measurements will be collected at one time (over the course of a day or two) using a hand-held, electronic water level indicator graduated to 0.01-foot increments and recorded on field data sheets. The depth to water will be measured from the top of the well casing.

3.2 SAMPLE COLLECTION

All wells will be sampled using the HydraSleeve™ sampler. The HydraSleeve™ sampler will be deployed/lowered to the mid-point of the screened interval immediately following water level measurement. The sampler is slim and displaces very little water during deployment; therefore, it does not disturb the water column to the point at which long equilibration times are necessary to ensure recovery of a representative sample. The HydraSleeve™ SOP (GeoInsight Inc., 2010), included in Attachment A, contains diagrams illustrating the steps required for HydraSleeve™ sampler deployment, retrieval, and sample recovery.

3.2.1 Sampler Assembly/Deployment

The following steps will be taken when using the HydraSleeve™ deployment:

1. Remove the sampler from the packaging and crease the reinforced fins outward to open the top of the sampler.
2. Attach a calibrated tether to one of the holes at the top of the sampler.
3. Fold the bottom of the sampler, aligning the two holes, and attach the weight using the stainless steel clip.
4. Lower the weighted sampler to the desired depth of the boring or well screen interval.
5. Secure the sampler at the top of the well by attaching the tether to the well cap. Once the sampler is secure at the surface, the well will be given a minimum of 24 hours to equilibrate before the sample is collected.

3.2.2 *Sampler Retrieval/Sample Collection*

The following steps will be taken when using the HydraSleeve® collection:

1. The sampler will fill as it is pulled upward (out of the well) at a rate of 1 to 2 feet per second.
2. Once the sampler is at the surface, it will be grabbed just below the top to expel water resting on top of the check valve.
3. Using the appropriate tubing, the sampler will be punctured approximately 3 to 4 inches below the white reinforcing strips located at the top of the sampler.
4. Water will be decanted from the sampler through the discharge tube into the appropriate containers for desired laboratory analysis.

3.2.3 *Field Parameter Monitoring*

During purging and collection of groundwater monitoring protocol samples, the following field parameters will be measured and recorded for each well sampled:

- Dissolved oxygen (DO) in milligrams per liter (mg/L);
- Oxidation-reduction potential (ORP) in millivolts (mV);
- pH;
- Temperature in degrees Celsius (°C);
- Specific conductivity in microsiemens per centimeter (µs/cm); and
- Turbidity in naphelometric turbidity units (NTU).

4.0 SAMPLING INSTRUCTIONS

4.1 CONTAINERS, PRESERVATION AND HOLDING TIMES

Certified clean sample containers and trip blanks will be obtained from the contract analytical laboratory. The bottles will be labeled to indicate the type of analysis to be performed, and necessary preservatives will be present in the bottles when received from the laboratory.

Table 1 summarizes the sampling containers, preservation, and holding times for the various types of analyses.

4.2 SAMPLE TRACKING

Documents for tracking the samples are generated in the field. This documentation includes field notes, sample labeling, and chain of custody (COC) forms.

4.2.1 Sample Labeling

Each sample will be labeled prior to collection. The sample label (Figure 3) will be filled out with waterproof ink. Each sample label contains the following information:

- Project number;
- Company name;
- Site/project name;
- Sample number (well location);
- Parameters for analysis;
- Date and time of collection;
- Preservative; and
- Sampler's signature (or initials).

Information pertinent to field survey measurements (Section 3.2.3) and sampling will be recorded on the field forms and/or in the field notebook.

4.2.2 *Chain-of-Custody Forms*

A COC form will be filled out in the field and will accompany every shipment of samples to the analytical laboratory. The purpose of the COC form is to document possession of a sample from the time of collection in the field to its final disposal by the laboratory.

The laboratory will enter the following information on the form:

- Name of persons receiving the sample;
- Date of sample receipt; and
- Sample condition.

All corrections to the COC record will be initialed and dated by the person making the corrections.

Each COC form will include signatures of the appropriate individuals indicated on the form.

4.3 *SAMPLES FOR ASSESSING QA/QC*

To identify potential errors, four types of QC samples may be included for analysis. All QC samples are labeled and sent to the laboratory along with the actual samples for analysis. QC sample frequencies are summarized below. The three types of QC samples are as follows:

4.3.1 *Trip Blanks*

Trip blanks check for contamination due to handling, transport, contact with other samples during storage, or laboratory error. A VOA bottle set is filled with deionized water by the laboratory. This set is taken to the field, labeled with company name, date, and cooler ID, and stored with the other samples until they are delivered for analysis to the laboratory. Trip blanks are opened by laboratory personnel only. One trip blank set is sent per cooler of samples for volatiles analysis per day.

4.3.2 *Field Duplicates*

Sometimes referred to as a split or replicate, a field duplicate is a check on field and laboratory precision. Two samples from a single bailer or consecutive samples collected by means of a bladder pump are filled at the same sampling location. One is labeled as the actual well sample and

the other is labeled as a duplicate sample. Preservation and shipping of samples and their duplicates is identical. One duplicate will be submitted per 10 samples, or one per sampling event if fewer than 10 samples are collected.

4.3.3 Rinsate Samples

Bailer or sampling equipment rinsate blanks verify that chemicals are not being carried from one sample to the next via the Teflon sampling bailer or other equipment used in the transfer of water samples. Rinsate field blanks will be taken after sampling the wells known to historically contain the highest chemical concentrations for the group of wells sampled. The sampling bailer and/or other equipment are first decontaminated with deionized water. Deionized water is then poured from the bailer (and/or other equipment) into sample bottles labeled with a QC number. One rinsate sample will be submitted per 20 samples collected with a bailer.

Rinsate samples will not be collected for wells to which specific or disposable sampling equipment (bailer or pump) has been dedicated, as no likelihood of transferring chemicals to other samples exists.

5.0 EQUIPMENT DECONTAMINATION

Decontamination will be performed on all non-dedicated sampling equipment that may contact potentially contaminated water including water level meters and other sampling equipment. Clean nitrile gloves or powderless surgical gloves are to be worn during decontamination.

An equipment decontamination station will be centrally located on site. Each piece of sampling equipment will be decontaminated before each sampling period and between each well. Plastic sheeting will be laid down around each well during sampling to protect decontaminated equipment from contact with the ground. The decontamination procedure for most equipment will be as follows:

- Wash equipment in an Alconox (or equivalent) and water solution using a brush or clean cloth to ensure removal of all contaminants;
- Rinse equipment in fresh tap water;
- Rinse again with deionized water; and
- Dry equipment with paper towel and place in clean plastic, if appropriate.

The effectiveness of these decontamination procedures will be verified by vigorous QA/QC protocols, including blanks and duplicates.

6.0 DOCUMENTATION

Thorough documentation in the field is required to ensure proper labeling and tracking of samples, identify potential sources of error, and maintain accountability among field personnel.

7.1 FIELD NOTES AND DATA COLLECTION FORMS

Field notes shall be kept in a bound notebook. The following information will be included in the field notes and/or on data collection forms:

General Information:

- Names of personnel;
- Weather;
- Date and time of sampling;
- Location and well number;
- Condition of the well;
- Times that procedures and measurements are completed;
- Calibration of meters at start of day;
- Decontamination times; and
- Initial static water level and total well depth.

Sampling Information:

- Volume of water evacuated before sampling;
- General description of sample procedures, or reference the SOP;
- Time of sample collection;
- Number of samples collected;
- Sample identification numbers;
- Preservation and storage of samples;
- Record of any QC samples from site;
- Any irregularities or problems that may have a bearing on sampling quality; and
- Type of sampling equipment.

Figures

Former SMI Site
10950 North Tantau, Cupertino, CA
QUARTERLY GROUNDWATER SAMPLING
FIELD NOTES / ERM 0201040

Date:
Set up time:
Weather:
Samplers:

WELL #

Location: ERP
Construction:
Groundwater Zone:
Screened Interval:

Construction Depth:
Measured Depth:
Depth to Packer:
Pump Intake:

Purge Setting: Discharge: / Refill:
Sample Setting: Discharge:

Depth to Water:
Height of Water Column:
Volume of one casing:

Packer Pressure:
Purge Start Time:
Discharge Rate:
Purge End Time:

Purge calculations
_____ ft. x gals ___ / ft. x 3 =
_____ gallons

Time	Purge Volume (Gallons)	Temp. (°C)	pH		ORP	DO (mg/L)	Turbidity

ANALYSES REQUIRED	SAMPLE TIME	CONTAINER TYPE	FILTRATION?

FIELD OBSERVATIONS (Well condition, repairs needed)

Disposal method of purge water:

Decontamination procedure:

Other notes:

Sampler Signature(s) :

Figure 1
Groundwater Sampling Form
Standard Operating Procedure No. 2
Groundwater Sampling
Former Siemens Facility
Cupertino, California

Figure
Chain
Stand
Grou
Form
Cupe

Environmental Resources Management

CHAIN OF CUSTODY RECORD

NO: 07889

1277 Treat Boulevard, Suite 500 • Walnut Creek, CA • 94597 • (925) 946-0455 • FAX (925) 946-9968

Page _____ of _____

PROJECT #	PROJECT NAME

SAMPLER: **(PRINT NAME)**	**(SIGNATURE)**

RECEIVING LABORATORY

SAMPLE I.D.	DATE	TIME	COMP	GRAB	SAMPLING METHOD	PRESER-VATIVE	ICE (Y/N)	SAMPLING VOLUME	# OF CONTAINERS	MATRIX: SOIL	MATRIX: WATER	MATRIX: GAS	REQUESTED PARAMETERS											

RELINQUISHED BY *(SIGNATURE)*	DATE	TIME	RECEIVED BY	DATE	TIME	FIELD REMARKS
RELINQUISHED BY *(SIGNATURE)*	DATE	TIME	RECEIVED BY	DATE	TIME	
RELINQUISHED BY *(SIGNATURE)*	DATE	TIME	RECEIVED BY	DATE	TIME	

REMARKS ON SAMPLE RECEIPT	ERM REMARKS	**SEND REPORT TO:**
☐ BOTTLE INTACT ☐ CUSTODY SEALS ☐ CHILLED ☐ PRESERVED ☐ SEALS INTACT ☐ SEE REMARKS		

WHITE – LABORATORY COPY CANARY – FIELD COPY PINK – DATABASE GOLD – PROJECT FILE

Figure 3
Sample Label
Standard Operating Procedure No. 2
Groundwater Sampling
Former Siemens Facility
Cupertino, California

Tables

Table 1 Sample Containers, Preservatives, and Holding Times for Test Parameters

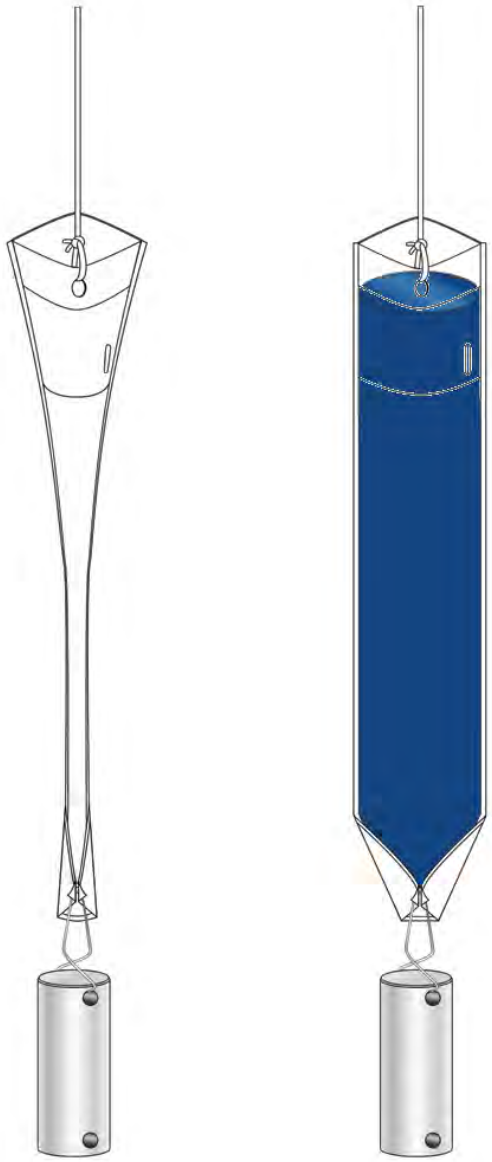
Parameter	Container	Preservative	Lab Holding Times
Volatile organic compounds	3 x 40 mL vial with Teflon faced septa cap	Acidity to pH of <2 with hydrochloric acid. Refrigerate at 4° ±2ºC	Analysis performed within 14 days from sample collection date
Methane, ethane, and ethene	2 x 40 mL vial with Teflon faced septa cap	Acidity to pH of <2 with hydrochloric acid. Refrigerate at 4° ±2ºC	Analysis performed within 14 days from sample collection date
Chloride, nitrate, and sulfate	250 mL polyethylene vial	Refrigerate at 4° ±2ºC	Analysis performed within 28 days from sample collection date
Total organic carbon	50 mL polyethylene vial	Acidity to pH of <2 with hydrochloric acid. Refrigerate at 4° ±2ºC	Analysis performed within 28 days from sample collection date
Dehalobacter and dehalococcoides	1L polyethylene vial	Refrigerate at 4° ±2ºC	Analysis performed within 10 days from sample collection date

Attachment A

HYDRASleeve™

Simple by Design US Patent No. 6,481,300; No. 6,837,120 others pending

Standard Operating Procedure: Sampling Ground Water with a HydraSleeve



This Guide should be used in addition to field manuals appropriate to sampling device (i.e., HydraSleeve or Super Sleeve).

Find the appropriate field manual on the HydraSleeve website at http://www.hydrasleeve.com.

For more information about the HydraSleeve, or if you have questions, contact: GeoInsight, 2007 Glass Road, Las Cruces, NM 88005, 1-800-996-2225, info@hydrasleeve.com.

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Introduction

The HydraSleeve is classified as a no-purge (passive) grab sampling device, meaning that it is used to collect ground-water samples directly from the screened interval of a well without having to purge the well prior to sample collection. When it is used as described in this Standard Operating Procedure (SOP), the HydraSleeve causes no drawdown in the well (until the sample is withdrawn from the water column) and only minimal disturbance of the water column, because it has a very thin cross section and it displaces very little water (<100 ml) during deployment in the well. The HydraSleeve collects a sample from within the screen only, and it excludes water from any other part of the water column in the well through the use of a self-sealing check valve at the top of the sampler. It is a single-use (disposable) sampler that is not intended for reuse, so there are no decontamination requirements for the sampler itself.

The use of no-purge sampling as a means of collecting representative ground-water samples depends on the natural movement of ground water (under ambient hydraulic head) from the formation adjacent to the well screen through the screen. Robin and Gillham (1987) demonstrated the existence of a dynamic equilibrium between the water in a formation and the water in a well screen installed in that formation, which results in formation-quality water being available in the well screen for sampling at all times. No-purge sampling devices like the HydraSleeve collect this formation-quality water as the sample, under undisturbed (non-pumping) natural flow conditions. Samples collected in this manner generally provide more conservative (i.e., higher concentration) values than samples collected using well-volume purging, and values equivalent to samples collected using low-flow purging and sampling (Parsons, 2005).

Applications of the HydraSleeve

The HydraSleeve can be used to collect representative samples of ground water for all analytes (volatile organic compounds [VOCs], semi-volatile organic compounds [SVOCs], common metals, trace metals, major cations and anions, dissolved gases, total dissolved solids, radionuclides, pesticides, PCBs, explosive compounds, and all other analytical parameters). Designs are available to collect samples from wells from 1” inside diameter and larger. The HydraSleeve can collect samples from wells of any yield, but it is especially well-suited to collecting samples from low-yield wells, where other sampling methods can’t be used reliably because their use results in dewatering of the well screen and alteration of sample chemistry (McAlary and Barker, 1987).

The HydraSleeve can collect samples from wells of any depth, and it can be used for single-event sampling or long-term ground-water monitoring programs. Because of its thin cross section and flexible construction, it can be used in narrow, constricted or damaged wells where rigid sampling devices may not fit. Using multiple HydraSleeves deployed in series along a single suspension line or tether, it is also possible to conduct in-well vertical profiling in wells in which contaminant concentrations are thought to be stratified.

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As with all groundwater sampling devices, HydraSleeves should not be used to collect groundwater samples from wells in which separate (non-aqueous) phase hydrocarbons (i.e., gasoline, diesel fuel or jet fuel) are present because of the possibility of incorporating some of the separate-phase hydrocarbon into the sample.

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Description of the HydraSleeve

The HydraSleeve (Figure 1) consists of the following basic components:

- A suspension line or tether (A.), attached to the spring clip or directly to the top of the sleeve to deploy the device into and recover the device from the well. Tethers with depth indicators marked in 1-foot intervals are available from the manufacturer.
- A long, flexible, 4-mil thick lay-flat polyethylene sample sleeve (C.) sealed at the bottom (this is the sample chamber), which comes in different sizes, as discussed below with a self-sealing reed-type flexible polyethylene check valve built into the top of the sleeve (B.) to prevent water from entering or exiting the sampler except during sample acquisition.
- A reusable stainless-steel weight with clip (D.), which is attached to the bottom of the sleeve to carry it down the well to its intended depth in the water column. Bottom weights available from the manufacturer are 0.75” OD and are available in three sizes: 5 oz. (2.5” long); 8 oz. (4” long); and 16 oz. (8” long). In lieu of a bottom weight, an optional top weight may be attached to the top of the HydraSleeve to carry it to depth and to compress it at the bottom of the well (not shown in Figure 1);
- A discharge tube that is used to puncture the HydraSleeve after it is recovered from the well so the sample can be decanted into sample bottles (not shown).
- Just above the self-sealing check valve at the top of the sleeve are two holes which provide attachment points for the spring clip and/or suspension line or tether. At the bottom of the sample sleeve are two holes which provide attachment points for the weight clip and weight.

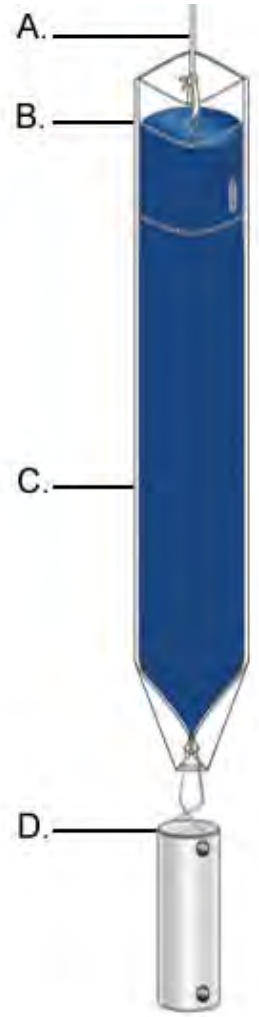

Figure 1. HydraSleeve components.

Note: The sample sleeve and the discharge tube are designed for one-time use and are disposable. The spring clip, weight and weight clip may be reused after thorough cleaning. Suspension cord is generally disposed after one use although, if it is dedicated to the well, it may be reused at the discretion of the sampling personnel.

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Selecting the HydraSleeve Size to Meet Site-Specific Sampling Objectives

It is important to understand that each HydraSleeve is able to collect a finite volume of sample because, after the HydraSleeve is deployed, you only get one chance to collect an undisturbed sample. Thus, the volume of sample required to meet your site-specific sampling and analytical requirements will dictate the size of HydraSleeve you need to meet these requirements.

The volume of sample collected by the HydraSleeve varies with the diameter and length of the HydraSleeve. Dimensions and volumes of available HydraSleeve models are detailed in Table 1.

Table 1. Dimensions and volumes of HydraSleeve models.

Diameter	Volume	Length	Lay-Flat Width	Filled Dia.
2-Inch HydraSleeves				
Standard 625-ml HydraSleeve	625 ml	< 30”	2.5”	1.4”
Standard 1-Liter HydraSleeve	1 Liter	38”	3”	1.9”
1-Liter HydraSleeve SS	1 Liter	36”	3”	1.9”
2-Liter HydraSleeve SS	2 Liters	60”	3”	1.9”
4-Inch HydraSleeves				
Standard 1.6-Liter HydraSleeve	1.6 Liters	30”	3.8”	2.3”
Custom 2-Liter HydraSleeve	2 Liters	36”	4”	2.7”

HydraSleeves can be custom-fabricated by the manufacturer in varying diameters and lengths to meet specific volume requirements. HydraSleeves can also be deployed in series (i.e., multiple HydraSleeves attached to one tether) to collect additional sample to meet specific volume requirements, as described below.

If you have questions regarding the availability of sufficient volume of sample to satisfy laboratory requirements for analysis, it is recommended that you contact the laboratory to discuss the minimum volumes needed for each suite of analytes. Laboratories often require only 10% to 25% of the volume they specify to complete analysis for specific suites of analytes, so they can often work with much smaller sample volumes that can easily be supplied by a HydraSleeve.

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HydraSleeve Deployment

Information Required Before Deploying a HydraSleeve

Before installing a HydraSleeve in any well, you will need to know the following:

- The inside diameter of the well
- The length of the well screen
- The water level in the well
- The position of the well screen in the well
- The total depth of the well

The inside diameter of the well is used to determine the appropriate HydraSleeve diameter for use in the well. The other information is used to determine the proper placement of the HydraSleeve in the well to collect a representative sample from the screen (see HydraSleeve Placement, below), and to determine the appropriate length of tether to attach to the HydraSleeve to deploy it at the appropriate position in the well.

Most of this information (with the exception of the water level) should be available from the well log; if not, it will have to be collected by some other means. The inside diameter of the well can be measured at the top of the well casing, and the total depth of the well can be measured by sounding the bottom of the well with a weighted tape. The position and length of the well screen may have to be determined using a down-hole camera if a well log is not available. The water level in the well can be measured using any commonly available water-level gauge.

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HydraSleeve Placement

The HydraSleeve is designed to collect a sample directly from the well screen, and it fills by pulling it up through the screen a distance equivalent to 1 to 1.5 times its length. This upward motion causes the top check valve to open, which allows the device to fill. To optimize sample recovery, it is recommended that the HydraSleeve be placed in the well so that the bottom weight rests on the bottom of the well and the top of the HydraSleeve is as close to the bottom of the well screen as possible. This should allow the sampler to fill before the top of the device reaches the top of the screen as it is pulled up through the water column, and ensure that only water from the screen is collected as the sample. In short-screen wells, or wells with a short water column, it may be necessary to use a top-weight on the HydraSleeve to compress it in the bottom of the well so that, when it is recovered, it has room to fill before it reaches the top of the screen.

Example

2” ID PVC well, 50’ total depth, 10’ screen at the bottom of the well, with water level above the screen (the entire screen contains water).

Correct Placement (figure 2): Using a standard HydraSleeve for a 2” well (2.6” flat width/1.5” filled OD x 30” long, 650 ml volume), deploy the sampler so the weight (an 8 oz., 4”-long weight with a 2”-long clip) rests at the bottom of the well. The top of the sleeve is thus set at about 36” above the bottom of the well. When the sampler is recovered, it will be pulled upward approximately 30” to 45” before it is filled; therefore, it is full (and the top check valve closes) at approximately 66” (5 ½ feet) to 81” (6 ¾ feet) above the bottom of the well, which is well before the sampler reaches the top of the screen. In this example, only water from the screen is collected as a sample.

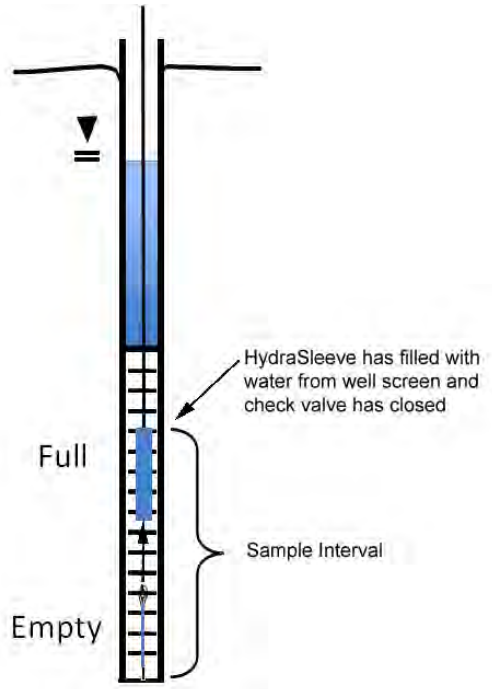

Figure 2. Correct placement of HydraSleeve.

Incorrect Placement (figure 3): If the well screen in this example was only 5' long, and the HydraSleeve was placed as above, it would not fill before the top of the device reached the top of the well screen, so the sample would include water from above the screen, which may not have the same chemistry.

The solution? Deploy the HydraSleeve with a top weight, so that it is collapsed to within 6" to 9" of the bottom of the well. When the HydraSleeve is recovered, it will fill within 39" (3 ¼ feet) to 54" (4 ½ feet) above the bottom of the well, or just before the sampler reaches the top of the screen, so it collects only water from the screen as the sample.

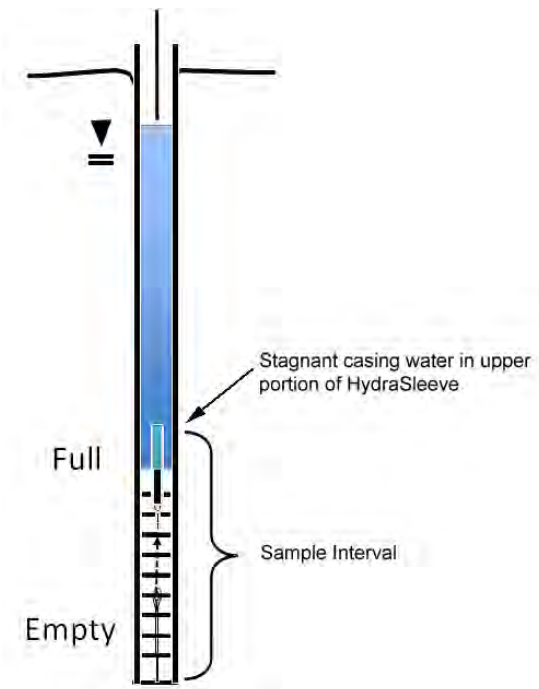

Figure 3. Incorrect placement of HydraSleeve.

This example illustrates one of many types of HydraSleeve placements. More complex placements are discussed in a later section.

Procedures for Sampling with the HydraSleeve

Collecting a ground-water sample with a HydraSleeve is a simple one-person operation.

Note: Before deploying the HydraSleeve in the well, collect the depth-to-water measurement that you will use to determine the preferred position of the HydraSleeve in the well. This measurement may also be used with measurements from other wells to create a ground-water contour map. If necessary, also measure the depth to the bottom of the well to verify actual well depth to confirm your decision on placement of the HydraSleeve in the water column.

Measure the correct amount of tether needed to suspend the HydraSleeve in the well so that the weight will rest on the bottom of the well (or at your preferred position in the well). Make sure to account for the need to leave a few feet of tether at the top of the well to allow recovery of the sleeve

Note: Always wear sterile gloves when handling and discharging the HydraSleeve.

I. Assembling the HydraSleeve

1. Remove the HydraSleeve from its packaging, unfold it, and hold it by its top.
2. Crimp the top of the HydraSleeve by folding the hard polyethylene reinforcing strips at the holes.
3. Attach the spring clip to the holes to ensure that the top will remain open until the sampler is retrieved.
4. Attach the tether to the spring clip by tying a knot in the tether.

Note: Alternatively, attach the tether to one (NOT both) of the holes at the top of the Hydrasleeve by tying a knot in the tether.

5. Fold the flaps with the two holes at the bottom of the HydraSleeve together and slide the weight clip through the holes.
6. Attach a weight to the bottom of the weight clip to ensure that the HydraSleeve will descend to the bottom of the well.

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II. Deploying the HydraSleeve

1. Using the tether, carefully lower the HydraSleeve to the bottom of the well, or to your preferred depth in the water column

   During installation, hydrostatic pressure in the water column will keep the self-sealing check valve at the top of the HydraSleeve closed, and ensure that it retains its flat, empty profile for an indefinite period prior to recovery.

Note: Make sure that it is not pulled upward at any time during its descent. If the HydraSleeve is pulled upward at a rate greater than 0.5'/second at any time prior to recovery, the top check valve will open and water will enter the HydraSleeve prematurely.

2. Secure the tether at the top of the well by placing the well cap on the top of the well casing and over the tether.

Note: Alternatively, you can tie the tether to a hook on the bottom of the well cap (you will need to leave a few inches of slack in the line to avoid pulling the sampler up as the cap is removed at the next sampling event).

III. Equilibrating the Well

The equilibration time is the time it takes for conditions in the water column (primarily flow dynamics and contaminant distribution) to restabilize after vertical mixing occurs (caused by installation of a sampling device in the well).

- Situation: The HydraSleeve is deployed for the first time or for only one time in a well

  The HydraSleeve is very thin in cross section and displaces very little water (<100 ml) during deployment so, unlike most other sampling devices, it does not disturb the water column to the point at which long equilibration times are necessary to ensure recovery of a representative sample.

  In most cases, the HydraSleeve can be recovered immediately (with no equilibration time) or within a few hours. In regulatory jurisdictions that impose specific requirements for equilibration times prior to recovery of no-purge sampling devices, these requirements should be followed.

- Situation: The HydraSleeve is being deployed for recovery during a future sampling event

  In periodic (i.e., quarterly or semi-annual) sampling programs, the sampler for the current sampling event can be recovered and a new sampler (for the next sampling event)

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deployed immediately thereafter, so the new sampler remains in the well until the next sampling event.

Thus, a long equilibration time is ensured and, at the next sampling event, the sampler can be recovered immediately. This means that separate mobilizations, to deploy and then to recover the sampler, are not required. HydraSleeves can be left in a well for an indefinite period of time without concern.

IV. HydraSleeve Recovery and Sample Collection

1. Hold on to the tether while removing the well cap.

2. Secure the tether at the top of the well while maintaining tension on the tether (but without pulling the tether upwards)

3. Measure the water level in the well.

4. In one smooth motion, pull the tether up between 30” to 45” (36” to 54” for the longer HydraSleeve) at a rate of about 1’ per second (or faster).

   The motion will open the top check valve and allow the HydraSleeve to fill (it should fill in about 1 to 1.5 times the length of the HydraSleeve). This is analogous to coring the water column in the well from the bottom up.

   When the HydraSleeve is full, the top check valve will close. You should begin to feel the weight of the HydraSleeve on the tether and it will begin to displace water. The closed check valve prevents loss of sample and entry of water from zones above the well screen as the HydraSleeve is recovered.

5. Continue pulling the tether upward until the HydraSleeve is at the top of the well.

6. Decant and discard the small volume of water trapped in the Hydrasleeve above the check valve by turning the sleeve over.

V. Sample Collection

Note: Sample collection should be done immediately after the HydraSleeve has been brought to the surface to preserve sample integrity.

1. Remove the discharge tube from its sleeve.

2. Hold the HydraSleeve at the check valve.

3. Puncture the HydraSleeve just below the check valve with the pointed end of the discharge tube

4. Discharge water from the HydraSleeve into your sample containers.

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Control the discharge from the HydraSleeve by either raising the bottom of the sleeve, by squeezing it like a tube of toothpaste, or both.

5. Continue filling sample containers until all are full.

Measurement of Field Indicator Parameters

Field indicator parameter measurement is generally done during well purging and sampling to confirm when parameters are stable and sampling can begin. Because no-purge sampling does not require purging, field indicator parameter measurement is not necessary for the purpose of confirming when purging is complete.

If field indicator parameter measurement is required to meet a specific non-purging regulatory requirement, it can be done by taking measurements from water within a HydraSleeve that is not used for collecting a sample to submit for laboratory analysis (i.e., a second HydraSleeve installed in conjunction with the primary sample collection HydraSleeve [see Multiple Sampler Deployment below]).

Alternate Deployment Strategies

Deployment in Wells with Limited Water Columns

For wells in which only a limited water column exists to be sampled, the HydraSleeve can be deployed with an optional top weight instead of a bottom weight, which collapses the HydraSleeve to a very short (approximately 6” to 9”) length, and allows the HydraSleeve to fill in a water column only 36” to 45” in height.

Multiple Sampler Deployment

Multiple sampler deployment in a single well screen can accomplish two purposes:

- It can collect additional sample volume to satisfy site or laboratory-specific sample volume requirements.
- It can accommodate the need for collecting field indicator parameter measurements.
- It can be used to collect samples from multiple intervals in the screen to allow identification of possible contaminant stratification.

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It is possible to use up to 3 standard 30” HydraSleeves deployed in series along a single tether to collect samples from a 10’ long well screen without collecting water from the interval above the screen.

The samplers must be attached to the tether at both the top and bottom of the sleeve. Attach the tether at the top with a stainless-steel clip (available from the manufacturer). Attach the tether at the bottom using a cable tie. The samplers must be attached as follows (figure 4):

- The first (attached to the tether as described above, with the weight at the bottom) at the bottom of the screen
- The second attached immediately above the first
- The third (attached the same as the second) immediately above the second

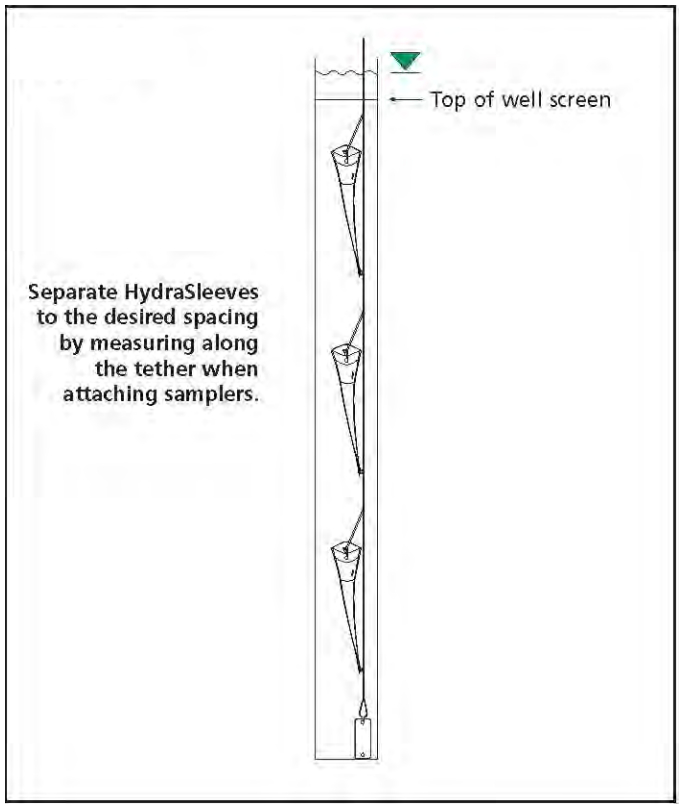

Figure 4. Multiple HydraSleeve deployment.

Alternately, the first sampler can be attached to the tether as described above, a second attached to the bottom of the first using a short length of tether (in place of the weight), and the third attached to the bottom of the second in the same manner, with the weight attached to the bottom of the third sampler (figure 5).

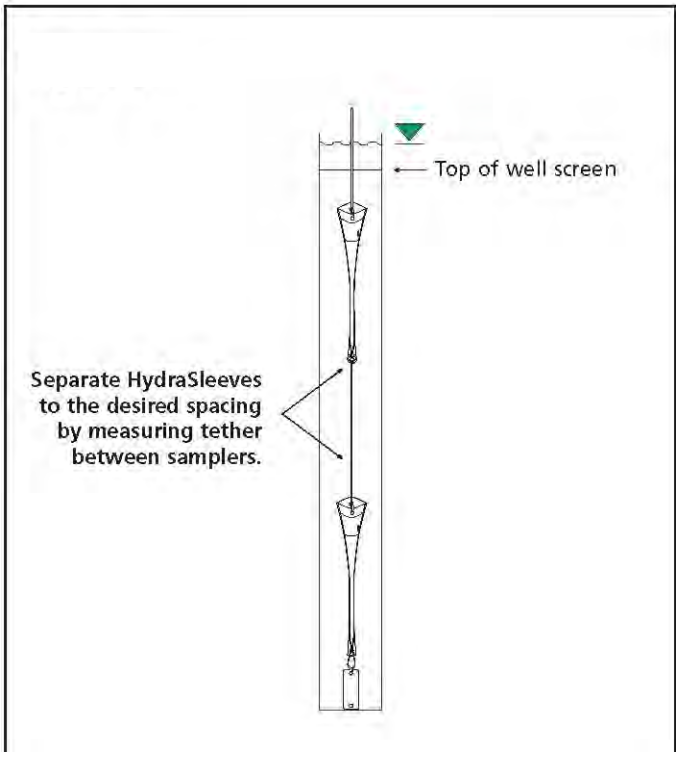

Figure 5. Alternative method for deploying multiple HydraSleeves.

In either case, when attaching multiple HydraSleeves in series, more weight may be required to hold the samplers in place in the well than would be required with a single sampler. Recovery of multiple samplers and collection of samples is done in the same manner as for single sampler deployments.

Post-Sampling Activities

The recovered HydraSleeve and the sample discharge tubing should be disposed as per the solid waste management plan for the site. To prepare for the next sampling event, a new HydraSleeve can be deployed in the well (as described previously) and left in the well until the next sampling event, at which time it can be recovered.

The weight and weight clip can be reused on this sampler after they have been thoroughly cleaned as per the site equipment decontamination plan. The tether may be dedicated to the well and reused or discarded at the discretion of sampling personnel.

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