National Aeronautics and
Space Administration

Ames Research Center
Moffett Field, CA 94035-1000

Reply to Attn of: QE:218-1

JUN 0 7 2011

Ms. Alana Lee
US EPA Region IX
75 Hawthorne Street, SFD-7-3
San Francisco, CA 94105

Dear Ms. Lee:

In accordance with the Environmental Protection Agency's (EPA) recommendation in an e-mail to National Aeronautics and Space Agency (NASA) Ames Research Center (Ames) dated January 10, 2011 as well as the recent EPA comments on the draft Middlefield-Ellis-Whisman (MEW) Air Sampling Work Plan, NASA Ames will adopt the MEW Indoor Air Sampling Work Plan for the upcoming sampling event.

Attachment 1 is a list of buildings that NASA Ames will sample north of the Navy's West-Side Aquifer Treatment System (WATS). Attachment 2 is a map indicating the location of buildings to be sampled. Please note that buildings N211 and N259 will not be sampled as they have been sampled in 2005 with TCE values well below EPA action levels. Buildings N256, T20-C, and T3- B will also not be sampled as these facilities have been demolished since the last building list provided by NASA Ames. Walk-through of each building is tentatively scheduled for the week of June 28th, 2011.

If you have any questions, you may contact me at 650-604-0237, e-mail at Donald.M.Chuck@nasa.gov or Lili Pirbazari at 650-604-1767, e-mail Lili.Pirbazari-1@Nasa.gov.

Cordially,

Donald M. Chuck
Remediation Project Manager
Environmental Management Division

Attachments

cc: (electronically)
Penny Reddy, USEPA
Bethany Dreyfus, USEPA
Jennifer Ledesma, CH2M Hill
Elizabeth Wells, RWQCB
Scott Anderson, US Navy

Valerie Harris, US Navy
Wilson Doctor, US Navy
Marvin Norman, US Navy
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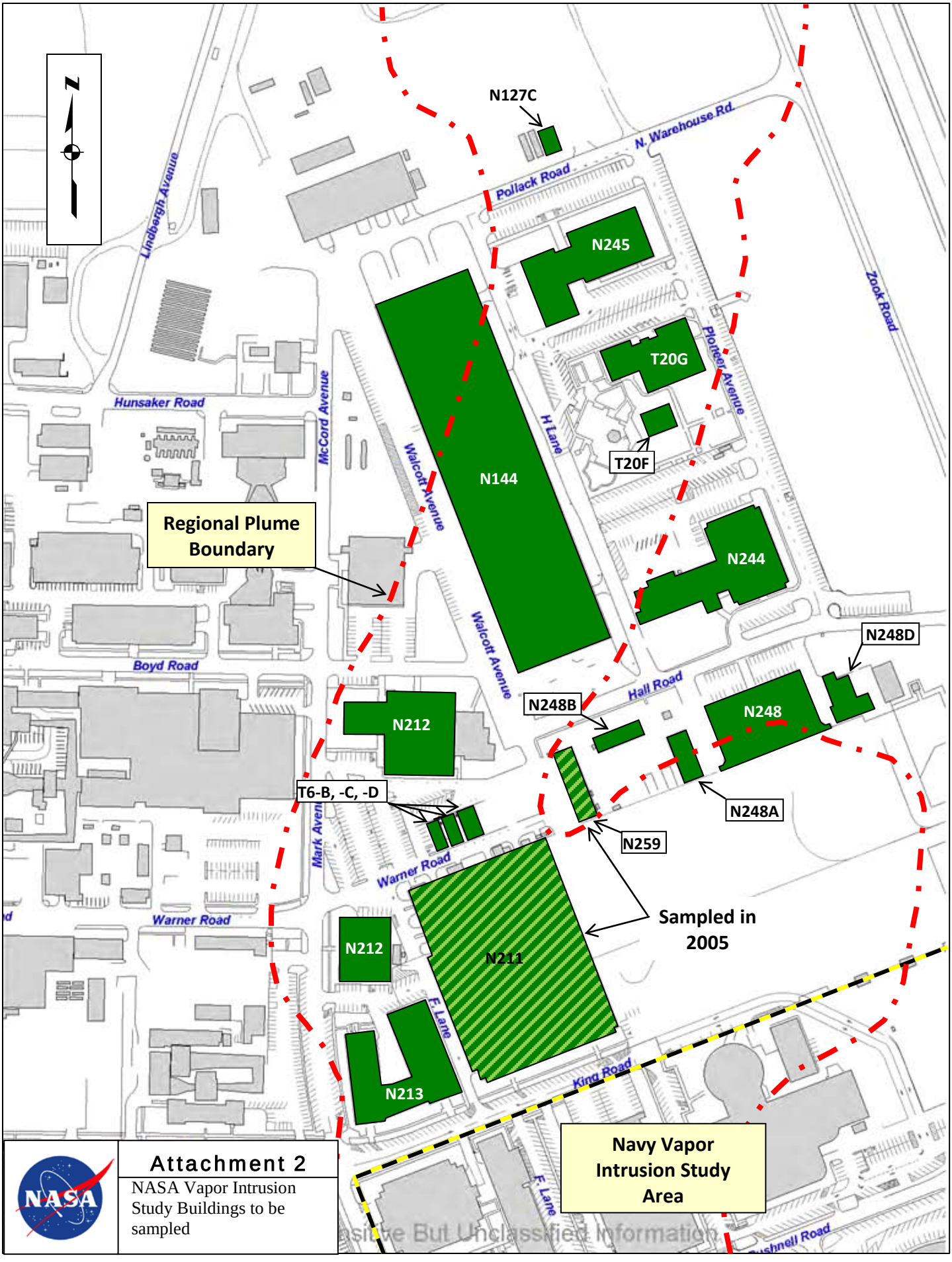
Greg Taylor, Raytheon
John Gallinati, Geosyntec
Nancy Bice, Geosyntec
Susan Gahry, PES
Anja Verce, Weiss
Rick Coffin, BCLT
Gordon Atkinson, Cooley
237-14\A. Clarke
237-14\L. Pirbazari
202A-4\G. Sloup

NASA Vapor Intrusion Study
Building List

Revision 1
6/7/2011

Building Number	Geographical Carveout	Status	Sampled?	Year Sampled	Notes
144	NASA	occupied/ to stay	No		
N127C	NASA	occupied/to be determined	No		FEMA storage shed
N211	NASA	occupied/ to stay	Yes	2005	Sampled after 2003
N212	NASA	occupied/ to stay	No		
N213	NASA	occupied/ to stay	No		
N240	NASA	occupied/ to stay	No		
N244	NASA	occupied/ to stay	No		
N245	NASA	occupied/ to stay	No		
N248	NASA	occupied/ to stay	No		
N248A	NASA	occupied/ to stay	No		
N248B	NASA	occupied/ to stay	No		
N248C	NASA	occupied/ to stay	No		
N256	NASA	**demolished**	No		
N259	NASA	occupied/ to stay	Yes	2005	Sampled after 2003
T20-C	NASA	**demolished**	No		
T20-F	NASA	occupied/ to be demolished	No		
T20-G	NASA	occupied/ to be demolished	No		
T3-B	NASA	**demolished**	No		
T6-B	NASA	occupied/ to be demolished	No		
T6-C	NASA	occupied/ to be demolished	No		
T6-D	NASA	occupied/ to be demolished	No		

Attachment 1


N
N127C
N. Warehouse Rd.
Pollack Road
Lindbergh Avenue
N245
Zook Road
T20G
Plotter Avenue
H Lane
Hunsaker Road
McCord Avenue
Walcott Avenue
N144
T20F
Regional Plume Boundary
N244
Walcott Avenue
N248D
Boyd Road
Hall Road
N248B
N248
N212
T6-B, -C, -D
N248A
Mark Aven
N259
Warner Road
Sampled in 2005
Warner Road
N212
N211
F. Lane
N213
King Road
Navy Vapor Intrusion Study Area
F. Lane
Bushnell Road
Attachment 2
NASA Vapor Intrusion Study Buildings to be sampled
Sensitive But Unclassified Information

SITE-WIDE VAPOR INTRUSION SAMPLING AND ANALYSIS WORK PLAN FOR RESPONSE ACTION TIERING MIDDLEFIELD-ELLIS-WHISMAN SUPERFUND AREA, MOUNTAIN VIEW, CALIFORNIA AND MOFFETT FIELD

by

Haley & Aldrich, Inc.
San Jose, California

for

Fairchild Semiconductor Corporation
Intel Corporation
Raytheon Company
Renesas Electronics America, Inc.
Schlumberger Technology Corporation
SMI Holding LLC
SUMCO USA Corporation
Vishay GSI, Inc.

File No. 36067-009
29 September 2011

HALEY & ALDRICH

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29 September 2011
File No. 36067-009

United States Environmental Protection Agency
Region 9
75 Hawthorne Street
San Francisco, California 94102

Attention: Ms. Alana Lee
Project Manager, Superfund Division

Subject: Site-Wide Vapor Intrusion Sampling and Analysis Work Plan
for Response Action Tiering
Vapor Intrusion Study Area, Middlefield-Ellis-Whisman Superfund Area
Mountain View, California

Dear Ms. Lee:

Please find enclosed the Work Plan referenced above. If you have questions regarding this document, please feel free to call Elie Haddad at (408) 961.4806.

Sincerely yours,
HALEY & ALDRICH, INC.

Mariruth Gruis, PE
Senior Engineer

Elie H. Haddad, PE
Vice President

Enclosures

c: Distribution List (Appendix F)

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SITE-WIDE VAPOR INTRUSION SAMPLING AND ANALYSIS WORK PLAN FOR RESPONSE ACTION TIERING MIDDLEFIELD-ELLIS-WHISMAN SUPERFUND AREA, MOUNTAIN VIEW, CALIFORNIA AND MOFFETT FIELD

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HALEY & ALDRICH

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LIST OF ACRONYMS AND ABBREVIATIONS

Acronym	Description
1,1-DCA	1,1-dichloroethane
1,1-DCE	1,1-dichloroethene
bgs	below ground surface
BSVIER	Building-Specific or Property-Specific Vapor Intrusion Sampling and Evaluation Report
BSVIWP	Building/Property-Specific Vapor Intrusion Sampling and Analysis Work Plan
Cal/EPA	California Environmental Protection Agency
CHHSL	California Human Health Screening Level
cis-1,2,-DCE	cis-1,2-dichloroethene
COC	chemical of concern
CSM	conceptual site model
DQO	data quality objective
DTSC	California Department of Toxic Substances Control
EPA	United States Environmental Protection Agency, Region 9
Fairchild	Fairchild Semiconductor Corporation
GC/MS	gas chromatography/mass spectrometry
Haley & Aldrich	Haley & Aldrich, Inc.
HVAC	heating, ventilating, and air conditioning
IC	institutional control
Intel	Intel Corporation
MEW	Middlefield-Ellis-Whisman
NELAP	National Environmental Laboratory Accreditation Program
μg/L	micrograms per liter
μg/m^3	micrograms per cubic meter
MSDS	material safety data sheet
NASA	National Aeronautics and Space Administration
NASMF	Naval Air Station Moffett Field
PCE	tetrachloroethene (*or* tetrachloroethylene)
ppbv	parts per million by volume
PRP	potentially responsible party
QA/QC	quality assurance/quality control
Raytheon	Raytheon Company
Renesas	Renesas Electronics America, Inc., successor to NEC Electronics America, Inc.
RGRP	Regional Groundwater Remediation Program
RI	remedial investigation
ROD	Record of Decision
RRW	regional recovery well
SCRW	source control recovery well
SIM	selective ion mode

SMI	SMI Holding LLC
SOW	EPA's Vapor Intrusion Statement of Work
STC	Schlumberger Technology Corporation
SUMCO	SUMCO USA Corporation, formerly Siltec Corporation
Tiering Work Plan	Site-Wide Vapor Intrusion Sampling and Analysis Work Plan for Response Action Tiering
trans-1,2-DCE	trans-1,2-dichloroethene
TCE	trichloroethene (*or* trichloroethylene)
VI	vapor intrusion
Vishay	Vishay GSI, Inc., formerly General Instrument Corporation
VOC	volatile organic compound

1. INTRODUCTION

Haley & Aldrich, Inc. (Haley & Aldrich) prepared this Site-Wide Vapor Intrusion Sampling and Analysis Work Plan for Response Action Tiering (Tiering Work Plan) for the Middlefield-Ellis-Whisman (MEW) Superfund Area and parts of Moffett Field in Mountain View, California (Figure 1). The 16 August 2010 Record of Decision (ROD) Amendment defines the Vapor Intrusion (VI) Study Area as "the area where TCE concentrations in shallow groundwater area greater than 5 μg/L" (Figures 2 and 3).

This Tiering Work Plan was prepared pursuant to the U.S. Environmental Protection Agency Statement of Work (SOW) for the vapor intrusion pathway, Section 2.2.2, and on behalf of the following parties, collectively referred to as the MEW Companies:

- Fairchild Semiconductor Corporation (Fairchild); Schlumberger Technology Corporation (STC); Renesas Electronics America, Inc. (Renesas, successor to NEC Electronics America, Inc); SMI Holding LLC (SMI); SUMCO USA Corporation (SUMCO, formerly Siltec Corporation); and Vishay GSI, Inc. (Vishay, formerly General Instrument Corporation) – who were all named Respondents in the Administrative Order for Remedial Design and Remedial Action, United States Environmental Protection Agency (EPA) Docket No. 91-4, issued by EPA (EPA, 1990a); and
- Intel Corporation (Intel) and Raytheon Company (Raytheon), who entered into the MEW Consent Decree with EPA (U.S. District Court Case No. C9120275JW).

This Tiering Work Plan applies to the area designated to be sampled by the MEW Companies as delineated on Figures 2 and 3. In accordance with the SOW for the VI pathway, the MEW Companies are implementing the VI work in the areas of the VI Study Area on Moffett Field designated as the "MEW" area (Figure 3). As indicated on Figure 3, VI work in certain other areas on Moffett Field will be conducted by the Navy and the National Aeronautics Space Administration (NASA).

1.1 Purpose

The purpose for this Tiering Work Plan is to develop the processes for determining the appropriate response action tier for buildings within the VI Study Area per the tiering system defined in the ROD Amendment Tables 6A, 6B, and 7 (EPA, 2010). The tiers defined in the ROD Amendment are summarized in Tables I and II for existing and future buildings, respectively.

1.2 General Scope of Work

The SOW specifies several items to be included in the Tiering Work Plan. These items and where they are addressed in this document are included in the table below:

TASK ITEM	LOCATION IN REPORT
(a) For all existing non-residential buildings, within both the MEW and Moffett Field Areas, indicate the sampling status, and current use and occupancy, where known.	Table VI
(b) For all existing residential buildings within both the MEW and Moffett Field Areas that have been sampled and/or have a vapor intrusion remedy in place, indicate the current Tier and whether any additional sampling is necessary to determine or change response action tier.	See Section 2.4. Tiering of buildings in the VI Study Area will be provided through a process described in Section 3.0 of this Tiering Work Plan.

TASK ITEM	LOCATION IN REPORT
(c) For residential buildings and properties within the MEW and Moffett Field Areas where sampling has not been conducted or where the buildings/properties have not been tiered and where the property owner requests that the building/property be sampled, indicate the process for conducting the sampling, response action tiering, and data reporting for that building/property in the appropriate report(s).	Section 3.1. The Tiering process is described in Section 3.7.
(d) For each non-residential building that has been sampled, indicate the response action tier designation if determined.	Tiering of buildings in the VI Study Area will be provided through a process described in Section 3.0 of this Tiering Work Plan.
(e) Project team organization, roles, responsibilities, and contact information.	Section 3.1
(f) Data quality objectives.	Section 3.0
(g) Sampling design and strategies for sampling different lines of evidence to determine response action tier, and how additional data collection and may result in change of tier designation.	Section 3.7
(h) Methods for evaluating current indoor air ventilation system (e.g., heating, ventilating, and air conditioning) operations, conducting building and property surveys, identifying potential pathways for vapor intrusion and proposed sample locations.	Section 3.7
(i) Laboratory and field methodologies and analytical methods to be utilized.	Section 3.7 and Appendix A
(j) Methodologies proposed to aid in determining whether the indoor air contaminant concentrations are attributable to subsurface Site contamination or other sources, such as consumer products or outdoor background air sources.	Sections 3.3 and 3.7
(k) Description of presumptive interim vapor intrusion mitigation measures that may be taken if sampling or other conditions indicate such measures are necessary and will be consistent with future responses actions to be taken and reporting process after those measures have been taken.	Section 2.6
(l) Description of process to obtain approval of interim vapor intrusion mitigation measures that have not been identified as presumptive interim vapor intrusion mitigation measures.	Section 3.7.3
(m) Description of access requirements for the work to be performed, existing access conditions, and expected additional tasks necessary and scheduled to obtain access.	Section 3.1 and Figure 4
(n) Data Management and Reporting Plan including: (1) discussion of how historical data and future data will be organized, managed, and reported; (2) description of graphical presentation of relevant data by building and property, including analytical sampling data, quality assurance/quality control data, and multiple lines of evidence information; (3) description of reporting format for reports and distribution list of electronic and hardcopy submittals to EPA, the property/building owners, and the public; and (4) description of types of information that will be posted and regularly updated on a publicly available website.	Appendix E
(o) Work schedule, including a staggered schedule for walk-throughs, sampling activities, submittal of the Supplemental Building/Property-Specific Vapor Intrusion Sampling and Analysis Work Plans, and associated tasks.	Section 3.4 and Table VI.

In general, the tasks to determine an appropriate response action tier are as follows:

1. Evaluate existing data for buildings within the VI Study Area.
   - Compare existing indoor air data in each building within the VI Study Area to the cleanup levels presented in the ROD Amendment; also compare existing indoor air data to outdoor air background levels.

- Evaluate other available information for each building, such as building surveys, chemical inventories, walkthroughs, interviews, and inspections for evidence of potential indoor sources or other indicators to suggest additional lines of evidence to determine an appropriate response action tier for the building.
- Identify data needs to adequately determine a response action tier for each building; this list may also include additional lines of evidence.
- Submit a Supplemental Building/Property-Specific Vapor Intrusion Sampling and Analysis Work Plan (BSVIWP) to the property owners/tenants and to EPA for each building/property where additional data are needed.
- Obtain EPA's approval of the BSVIWP.

2. Collect additional data as necessary. Coordinate data collection activities and schedule with the property owners/tenants, as appropriate. EPA will be notified in advance of all field activities and given the opportunity to observe data collection activities if desired.
3. Evaluate all data collected to determine a response action tier for each building in the VI Study Area.
4. Submit a Building-Specific or Property-Specific Vapor Intrusion Sampling and Evaluation Report (BSVIER) to EPA and the property owner/tenant within 60 days of completion of sampling. Reports will identify the tiered classification for each building/property and a plan for moving forward with selected response action, if required.

The details of the process are provided in a Data Quality Objective format in Section 3.0 of this document.

1.3 Work Plan Organization

Section 2 provides a background description of the VI Study Area and previous investigations and implemented remedies for soil, groundwater, and VI. It also summarizes the VI remedies selected in the ROD Amendment. Section 3 describes the seven steps of the data quality objectives (DQO) process.

Typical methodologies, operating procedures, and analyses to be used for collecting data are provided in Appendix A. Quality assurance and quality control (QA/QC) procedures are discussed in Appendix B. Examples of a building survey and a chemical inventory form are included as Appendix C. A typical request for property access letter for building walkthroughs and data collection, to be signed by the building owner and/or tenant, is provided as Appendix D. A data management reporting plan is included in Appendix E; the most recent MEW distribution list, used as a guide for distributing of this document, is provided in Appendix F.

2. SITE DESCRIPTION

The VI Study Area is located in Mountain View and Moffett Field, California, and includes four National Priorities List sites: Fairchild - Mountain View Site (EPA ID: CAD09598778); Intel - Mountain View Site (EPA ID: CAD061620217); Raytheon – Mountain View Site (EPA ID: CAD009205097); and Moffett Field (EPA ID: CA2170090078). EPA is the lead regulatory agency responsible for directing the cleanup process under the Comprehensive Environmental Response, Compensation, and Liability Act for the MEW area and per a Federal Facility Agreement for Moffett Field.

This Tiering Work Plan applies to the area designated to be sampled by the MEW Companies as delineated on Figures 2 and 3.

2.1 Site History and Background

Previous investigations south of U.S. Highway 101 yielded sufficient information to design and implement extensive soil and groundwater remediation activities performed by the MEW Companies, including separate soil and groundwater source control measures and the joint Regional Groundwater Remediation Program (RGRP). These actions were performed consistent with the EPA-issued ROD (EPA, 1989) and subsequent Explanations of Significant Differences (EPA, 1990b, 1996) and EPA-approved design and operation reports.

The area within and adjacent to Middlefield Road, Ellis Street, Whisman Road, and U.S. Highway 101 in Mountain View includes several current and former semiconductor and other manufacturing and industrial facilities. Until 1959, the area south of U.S. Highway 101 was used for agriculture, at which time it was commercially developed with light industrial facilities. Operations in the MEW area have included semiconductor and electronics manufacturing, metal finishing, and other activities. While in operation, these facilities required the storage, handling, and use of a variety of chemicals in the manufacturing process, particularly solvents and other compounds.

Since the 1990s, major redevelopment and reuse has occurred in the VI Study Area. Several structures were demolished and new tenants now occupy new office complexes. During the redevelopment process, some former properties changed mailing addresses. Table III shows the former and current MEW property addresses; Figure 2 shows the location of existing buildings in the VI Study Area south of U.S. Highway 101, currently zoned primarily for commercial and light industrial use and is not located in an environmentally sensitive area (EPA, 2004). The City of Mountain View has also indicated that it has no plan to change the zoning. A small area at the western boundary of the VI Study Area south of U. S. Highway 101 is zoned residential.

Moffett Field consists of the original NASA Ames Campus and the former Naval Air Station Moffett Field ([NASMF]; Figure 3). NASA Ames was established in 1939 as the Ames Aeronautical Laboratory of the National Advisory Committee on Aeronautics adjacent to NASMF. In 1991, the Base Realignment and Closure Commission designated NASMF for decommissioning and transfer to NASA. On 1 July 1994, the NASMF was transferred to NASA Ames with the exception of the military housing. The military housing was assigned first to the U.S. Air Force and then to the U.S. Army. Part of the former air station was designated for the NASA Research Project.

The NASA Research Project is 213 acres planned for redevelopment as a collaborative research and educational campus with associated facilities. The current buildings are located on the original NASA Ames Campus and the NASA Research Project. Several buildings on Moffett Field are unoccupied and designated for demolition. The occupied buildings are used primarily as office, research, or maintenance space.

The MEW Companies, NASA, and the Navy constructed and operate groundwater treatment systems on Moffett Field.

2.2 Hydrogeology

Groundwater aquifers beneath the VI Study Area consist of shallow and deep aquifer systems separated by a laterally extensive aquitard approximately 40 feet thick. The shallow aquifer system is generally less than 160 feet below ground surface (bgs). Subdivisions within the shallow aquifer are designated the "A", "B1", "B2", and "B3" aquifers. The regional aquitard is designated the "B/C" aquitard. The zones below the "B/C" aquitard are termed the "C" aquifer and the Deep aquifers. Groundwater flow in the shallow aquifer zone is generally to the north; groundwater flows in the "C" and Deep aquifers are generally to the northeast. The shallow and deep aquifer systems beneath the VI Study Area are not used for drinking water.

The depth to water in the "A" aquifer, which is the relevant groundwater zone for the VI pathway, varies from approximately 28 feet bgs along East Middlefield Road to the south to less than 5 feet bgs in the northernmost portions of Moffett Field. Regionally, the seasonal variation in water elevations is approximately 0.7 foot, with the higher levels in the spring and lower levels in the autumn. The hydraulic gradient is approximately 0.006 foot per foot to the north. Slurry walls constructed at the VI Study Area divert groundwater flow around the walls.

2.3 Subsurface Remedies Implemented

Starting as early as 1982, soil and groundwater remediation programs implemented by the MEW Companies included soil excavation and treatment, installation of soil-bentonite cutoff walls, in-situ soil vapor extraction, in-situ bioremediation, air sparging, and groundwater extraction and treatment. Remedial actions have reduced vadose zone soil concentrations to below ROD cleanup standards and substantially reduced the groundwater concentrations of trichloroethene (TCE) and other volatile organic compounds (VOCs). For example, average TCE concentrations in groundwater have been reduced by more than 90% since 1992.

Groundwater remediation was implemented from both a source area and regional perspective. Groundwater extraction wells installed and operated by the MEW Company responsible for individual source areas for the purpose of controlling chemical sources are referred to as Source Control Recovery Wells (SCRWs). Groundwater extraction wells that operate as part of the RGRP are labeled Regional Recovery Wells. The treatment system for the RGRP was designed to remove chemicals that had already migrated beyond the SCRWs and where the responsibility for the bulk of the chemicals present cannot be attributed to specific source areas. Thus, the treatment systems are located downgradient of identified source areas and SCRWs.

The Navy operates a groundwater extraction and treatment system located southwest of Hangar 1. The system consists of six extraction wells completed in the “A” aquifer and three extraction wells completed in the “B1” aquifer, as well as sumps that pump groundwater from a tunnel beneath Hangar 1 and an

electrical vault on its east side. The treatment system consists of an advanced oxidation process, followed by four liquid-phase granular activated carbon units in series. After EPA approved the design in June 1997, construction and performance testing took place between July 1997 and November 1998. The system began operating on 26 November 1998. Functional testing was completed in April 1999. Since beginning operation in November 1998, more than 2,500 pounds of VOCs have been removed from the groundwater.

NASA constructed a groundwater extraction and treatment system in 2001 that began operating on 10 September 2001. Groundwater is extracted from four source control extraction wells. NASA's average flow rate is approximately 15 gallons per minute. Extracted groundwater is pre-filtered by two 10-micron bag filters operating in parallel, prior to passing through two 5,000-pound granular activated carbon vessels operating in series. Treated groundwater is then discharged to Stevens Creek in accordance with a National Pollutant Discharge Elimination System permit. Since the start of operations in September 2001, NASA's groundwater extraction and treatment system has removed and treated an estimated 15 pounds of VOCs.

Between 1989 and 1995, NASA performed various subsurface investigation and soil excavation activities to address petroleum-, VOC-, oil and grease-, metal-, and polychlorinated biphenyls-affected soil throughout Moffett Field. The impacted soil was aerated and reused on-site or disposed of off-site.

2.4 Remedial Investigation for Vapor Intrusion and Remedies Implemented

There are 70 commercial buildings in the VI Study Area south of U.S. Highway 101; 40 of them have been sampled to date (Figure 2). Building-specific sampling plans were provided to EPA for the remainder of the 30 buildings, and are awaiting EPA's approval.

In accordance with the SOW for the vapor intrusion pathway, the MEW Companies are implementing the VI work in the areas of the VI Study Area on Moffett Field designated as the "MEW" area on Figure 3. As indicated on Figure 3, VI work in certain other areas on Moffett Field will be conducted by the Navy and NASA. In July 2011, Haley & Aldrich collected indoor air samples in 12 buildings on Moffett Field and the results were submitted to EPA on 13 August 2011 (Haley & Aldrich, 2011b).

In the residential area west of Whisman Road, EPA has sampled 34 residences. The MEW Companies installed a ventilation system in an earthen cellar in one of the homes to reduce its indoor air concentrations. Other than this one home, no mitigation measures were warranted in that area. On Moffett Field, Westcoat Housing was redeveloped in 2000 with a passive ventilation and vapor barrier system installed under the new development. Subsequent sampling in these homes has shown that indoor air concentrations are less than the cleanup levels. Additional information on the results of the residential sampling can be found in the Final Supplemental Remedial Investigation (RI) report (Haley & Aldrich, 2009).

The RI report analyzed site investigation data to identify building similarities, determine data gaps, if any, and provide information to be used in the Supplemental Feasibility Study. While the majority of the buildings did not contain chemicals of concern (COCs) above health-based screening levels, some buildings required the implementation of interim measures to mitigate the VI pathway. Confirmation samples collected after implementing interim mitigation measures showed that the mitigation measures resulting in reduced indoor air concentrations of TCE also resulted in reduced air concentrations for other COCs present in indoor air due to subsurface vapor intrusion. Sampling also revealed that seasonal temperature variations do not appear to have a significant effect on measured indoor TCE air concentrations in the VI Study Area.

2.5 Interim Mitigation Measures for Vapor Intrusion

Interim mitigation measures were implemented during the supplemental RI process in buildings where indoor air concentrations exceeded the TCE interim action level (2.7 micrograms per cubic meter [$\mu g/m^3$] for commercial buildings prior to finalization of the August 2010 ROD Amendment, and 5 $\mu g/m^3$ for commercial buildings and 1 $\mu g/m^3$ for residential buildings afterward). Implemented measures were building-specific and selected based on construction information, heating, ventilation, and air conditioning (HVAC) operation, and/or indoor air sample results. Mitigation measures included: sealing cracks, conduits, and/or elevator shafts that penetrated foundations and floors; refurbishing, retrofitting, and/or installing HVAC systems; plugging drains and sumps; and installing air purification systems. Details for the implemented measures at each location are provided in the RI report (Haley & Aldrich, 2009).

In addition to the interim and precautionary mitigation measures described above, two other mitigation technologies were implemented in the VI Study Area during redevelopment of two properties:

- A sub-slab pressurization system was installed at 425-495 N. Whisman Road; and
- Vapor barriers and a passive ventilation system were installed under 350/370/380 Ellis Street and Wescoat Housing.

2.6 Mitigation Measures Specified in the ROD Amendment

The ROD Amendment specifies the following mitigation measures for the VI pathway (described below and summarized in Table IV):

Existing Non-Residential Buildings: For Tier 1 and Tier 2 non-residential buildings, the VI remedy consists of sealing identified direct and leaking conduits that serve as pathways for subsurface vapors to migrate in the building, installing an active sub-slab/sub-membrane ventilation system, ongoing operations, maintenance, and monitoring, and Institutional Controls (ICs). However, for an existing nonresidential building with an operating indoor air ventilation system, such as a HVAC system, use of that system may be utilized instead of an active sub-slab/sub-membrane ventilation system where the property/building owner agrees in a signed, recorded agreement to use, operate, and allow monitoring of the building's ventilation system in a manner consistent with the operations, maintenance, and monitoring plan developed for that building. A sub-slab pressurization system with vapor barrier may be appropriate for an existing building where (1) such a system has already been installed, and (2) if the system is operated in a manner consistent with the operations, maintenance, and monitoring plan developed for that building.

Existing Residential Buildings: For existing residential buildings where indoor air sampling indicates engineering controls are necessary to reduce COCs in indoor air to below the cleanup levels, the remedy consists of sealing identified direct and leaking conduits that serve as pathways for subsurface vapor migration into the building, installing an active sub-slab/sub-membrane ventilation system, monitoring, and ICs. For residential buildings with a slab-on-grade foundation or basement, the remedy requires depressurization. For residential buildings with a crawlspace, the remedy requires implementation of a sub-membrane depressurization system.

Future (New Construction) Buildings/Properties: The remedy for all future buildings is to install a vapor barrier and passive sub-slab ventilation system with the ability to convert to active, monitoring, and ICs. Areas overlying higher TCE groundwater concentrations are considered to have a greater

potential for VI at levels exceeding indoor air cleanup levels; therefore initial installation of an active sub-slab ventilation system would meet the remedy requirements.

Institutional Controls: The purpose of the ICs for the VI remedy is to: (1) ensure the operation and monitoring of engineering controls used to prevent levels of Site COCs associated with the VI pathway from exceeding indoor air cleanup levels; (2) ensure that the appropriate engineering controls are incorporated, where necessary, into new building development at the site; (3) provide information to building owners and tenants regarding the appropriate VI remedy for each building; and (4) provide information to EPA and the potentially responsible party (PRP) regarding, among other things, new construction and changes of property ownership within the VI Study Area.

The remedy requires utilization of three types of ICs:

1. The remedy's governmental controls include the formalization of planning and permitting requirements in the City of Mountain View to require the appropriate VI control measures in new building construction within the VI Study Area south of U.S. Highway 101 and to require that new construction plans obtain EPA approval to ensure that the appropriate VI control system is part of building construction where necessary. In the Moffett Field Area, the remedy requires incorporation of remedy requirements into the applicable planning and permitting documents. For the NASA-owned portion of the Moffett Field Area, this means compliance with the Environmental Issues Management Plan and incorporation of remedy requirements into the NASA land use master plan, permitting, and other appropriate documents within the Moffett Field Area. For the U.S. Army-owned portion of the Moffett Field Area, the remedy requires that such requirements are incorporated into the appropriate planning, permitting, and other relevant documents for the Wescoat Housing Area. This IC must include a mechanism to ensure that the appropriate requirements are in place and are implemented.
2. For proprietary controls in the VI Study Area south of U.S. Highway 101, the remedy requires the recording of agreements between the PRP and property owners at any property where an engineered VI remedy is in place. These recorded agreements are intended to be enforceable and binding on successors. The recorded agreements should include: (1) notice to future building/property owners of the VI remedy and requirements; (2) access for sampling, remedy operation and maintenance, and monitoring; and (3) notice to EPA and the PRP when changes to the building ownership or operation could impact the VI remedy at that property.

   For future building construction in the MEW Area, the recorded agreements will remain in place and be layered with the governmental ICs implemented through the City of Mountain View's planning and permitting procedures.

   In the Moffett Field Area, ICs will be implemented through the federal land owner's planning documents. For most of the VI Study Area on Moffett Field, the ICs will be implemented through NASA's land use planning documents, including the NASA land use master plan, permitting requirements, the 2005 Environmental Issues Management Plan, and any subsequent EPA-approved revisions thereto. For the Wescoat Housing Area, owned by the U.S. Army, the ICs will be implemented through the applicable planning documents. The land use planning documents will require (1) implementation of the applicable remedy, (2) compliance with building-specific long-term operations, maintenance, and monitoring requirements for VI control measures, (3) access for monitoring of a required remedy, and (4) incorporation of the applicable VI remedy into new building construction.

3. For information mechanisms, the VI remedy requires additional measures, including the creation of a mapping database (e.g., Geographic Information System), to ensure that parties interested in properties within the VI Study Area are informed of the appropriate remedy requirements when making inquiries with the City of Mountain View, property owner, Moffett Field property owner, or EPA. The remedy also requires the use of an informational service to provide information to EPA and the PRPs regarding VI Study Area activities that could impact the VI remedy, including changes to property ownership or occupancy and permitting applications for new construction to ensure that owners and occupants are informed of the remedy and its requirements in a timely manner.

3. DATA QUALITY OBJECTIVES

The DQO process is a seven-step approach used to develop sampling plans to collect the necessary data to make appropriate decisions (EPA, 2000). The DQO process consists of the following seven steps:

1. State the problem;
2. Identify the decision(s);
3. Identify inputs to the decision;
4. Define the boundaries;
5. Develop a decision rule;
6. Specify the limits on the decision error; and
7. Optimize the sampling design/ approach.

The following sections describe the DQO process for data evaluation and collection efforts to be conducted to determine a response action tier for buildings within the VI Study Area. The response action tiers are defined in the ROD Amendment and summarized in Tables I and II.

3.1 Step 1: State the Problem

EPA has requested that the MEW Companies develop a process to assign the appropriate response action tier for each building/property within the VI Study Area. A description of the possible response action tiers for existing and future buildings are summarized in Tables I and II, respectively.

Identify Members of the Planning Team: The planning team for this Tiering Work Plan is Haley & Aldrich, the consultant representing Raytheon and STC (STC is the successor in interest to certain environmental liabilities to Fairchild), and EPA, the lead agency for the VI Study Area. Peer review of this Tiering Work Plan has been provided by the other PRPs in the VI Study Area: Intel; Renesas; SMI; SUMCO; Vishay; and the following consulting companies: Amec/Geomatrix, Geosyntec Consultants, PES Environmental, and Weiss Associates. Air Systems Inc., a HVAC design and installation company, may be retained to evaluate HVAC systems, if system evaluations are necessary. Air samples will be analyzed by a laboratory certified by the National Environmental Laboratory Accreditation Program (NELAP).

Conceptual Site Model:

The Final Supplemental RI report documents the conceptual site model (CSM) for the VI pathway. The following is an update of the CSM, which identifies potential COPC sources in indoor air, COCs, and the potential pathways and receptors. The CSM also incorporates data from the air sampling field investigations.

COC Sources: Potential indoor exposure to COCs could result from one or a combination of the following sources:

- Volatilization from the groundwater into a building structure;

- Occupational, household, or consumer product use in or outside of the workplace or home (background indoor air); and
- Contribution from outdoor air moving into a building through opened doors or windows, or air intakes of HVAC systems. This outdoor air can include contributions from off-site background concentrations and nearby industrial emissions (e.g., dry cleaners).

COCs: The COCs for the VI pathway, as specified in the ROD Amendment, are: TCE; tetrachloroethene (PCE); cis-1,2-dichloroethene (cis-1,2,-DCE) and trans-1,2-dichloroethene (trans-1,2-DCE); vinyl chloride; 1,1-dichloroethane (1,1-DCA); and 1,1-dichloroethene (1,1-DCE). Table V shows the cleanup levels adopted by the ROD Amendment for these COCs in indoor air.

Pathways: Volatile chemicals may volatilize from the groundwater, migrate upward through voids and cracks in the floors, dry conduits, or subsurface structures (e.g., basements and other subsurface structures), and enter buildings where they may impact the indoor air. For buildings with deep enough basements, COCs may volatilize directly from groundwater intrusion directly through the basement floor.

Potential Receptors: Potential receptors are persons in current and future residences and commercial buildings in the VI Study Area.

Available Resources and Constraints: To properly classify each building according to the tiering system, sufficient representative data and use of multiple lines of evidence are necessary. As such, each building must be evaluated individually and additional data may need to be collected if existing data are not sufficient to complete the evaluation. Two constraints to accomplishing this scope are:

1. Implementation of the process defined herein for determining a response action tier for each building is conditioned upon EPA's approval of this Tiering Work Plan, the BSVIWP, and the BSVIER (see Section 3.7).
2. Implementation and the schedule for completing the evaluations and data collection programs are dependent on obtaining access from property owners and their cooperation in attempts to coordinate data collection events according to specific data constraints (e.g., indoor air sampling is to be scheduled when existing active HVAC system can be turned off during sampling[1]). A general process for obtaining access from property owners is provided on Figure 4. In summary, three trials by telephone and two trials in writing will be attempted for each property owner before we request EPA's involvement in securing access to a building to implement the BSVIWP.
3. If sampling requests are received from unsampled residential properties, sampling will be performed by EPA in these residential properties and the response action tiering process will follow the procedures outlined in this Tiering Work Plan.

This sampling program is focused on properties within the VI Study Area south of Highway 101 (Figure 2), and on a designated area on Moffett Field shown on Figure 3. Other buildings on Moffett Field are being addressed by the Navy and NASA.

[1] The "HVAC off" scenario can be achieved by either shutting off the system, or by closing the outside supply air dampers/economizers, if possible.

3.2 Step 2: Identify the Decision

This Tiering Work Plan provides a process by which property- and building-specific data will be used to determine a response action tier for the property per the tiering framework described in the ROD Amendment (Tables I and II). The Tiering Work Plan also includes provisions for additional multiple lines of evidence that may be used to supplement the response action tier decision.

3.3 Step 3: Identify Inputs to the Decision

Information that Will Be Required to Resolve the Decision Statement: Information gathered to resolve the decision statement includes: building surveys (e.g., information from building walkthroughs, chemical use inventory, inspections, HVAC evaluations, and interviews); indoor, and outdoor air sampling; and existing groundwater data. Based on evaluation of this information, additional sampling and data evaluation provisions may be conducted. All building and field sampling information and analytical data will be reported to EPA as discussed in Section 3.7.

Determine the Source of Each Item of Information Identified: Information that will be evaluated or collected as additional lines of evidence are described below. The data collection and tiering process are discussed in Section 3.7. Where applicable, additional details regarding data collection methods, procedures, and analysis are provided in Appendix A.

This work plan provides lines of evidence that are commonly used to evaluate the VI pathway. As new investigative techniques become validated, these techniques would be incorporated into this Tiering Work Plan, if necessary, through addenda.

1. Building Questionnaire: The building questionnaire acts as the basis for an interview and inspection with the tenants/owners. It will be reviewed and completed during the walkthrough after access has been granted. For buildings where this questionnaire has been completed, it may be appropriate to update some responses on recent building and HVAC modifications and chemical use. The need for this update is determined on a building-specific basis and included in the BSVIWP. The questionnaire will provide preliminary information on the building foundation and base slab construction, building use, and HVAC system construction and operation. It also provides information on chemical usage and storage in the building as a preliminary evaluation of other occupational sources.
2. Indoor Air Samples: These samples measure the indoor air concentrations of the COCs in a building. Indoor air samples alone are not necessarily an indication of the VI pathway because other sources may contribute to the indoor air quality such as occupational sources (background indoor air) in the building and outdoor background air. Indoor air samples could be collected with engineering controls operating or turned off. However, to allow for evaluation of the VI pathway without the presence of engineering controls, a minimum of one round of sampling will be conducted at each building with the HVAC system and other engineering controls turned off during sampling.

   Data from previous indoor air sampling events conducted since 2003 are also available. However, some of these samples were collected in buildings during normal occupancy hours (with HVAC system on) to provide representative information on potential health risks during working hours. To determine if engineering controls are necessary, existing data will be evaluated and samples will be collected with the HVAC system off.

3. Background Outdoor Air: TCE and other COCs can also be found in commercial and consumer products that are used in industry or homes. Emissions from these consumer products (e.g., degreasers, adhesives, etc.) or industries (e.g., car service stations, dry cleaners, etc.) contribute COCs to the background outdoor air. Because the air inside a building is mainly outdoor air circulated through open windows and doors, or by an HVAC system, elevated outdoor concentrations may account for elevated indoor air concentrations. Outdoor air samples can therefore be used to provide information regarding outdoor air influences on indoor air quality.

4. Groundwater: Groundwater is periodically monitored by the individual PRPs and updated plume maps are submitted in annual reports to EPA. Groundwater data can be used to compare COCs detected in the indoor air to those detected in the groundwater. The presence of a COC in indoor air and its absence in the underlying groundwater is an indication that the source of this COC is not VI from the groundwater. In addition to this evidence, a site-specific groundwater screening level can potentially be established.

5. Soil Gas: Soil gas data can be used to evaluate the VI pathway. Soil gas can also be used to evaluate if mitigation measures would be necessary in future developments. For example, California Environmental Protection Agency (Cal/EPA) has established conservative screening levels for several chemicals in soil gas, as well as sampling advisories to guide the soil gas sampling and evaluation process. If concentrations in soil gas are below these screening levels, the California Department of Toxic Substances Control (DTSC) considers the VI pathway of no concern on that property.

6. Screening for Indoor Sources: COC concentrations in indoor air could be affected by the use of consumer products and personal habits. For example, COCs in cleaning agents, room deodorizers, dry cleaned clothing, cigarette smoke, petroleum products, and vehicle exhaust can all affect indoor air quality. Certain adhesives, spot removers, paint removers, scented candles, hobby items, and automobile cleaning and degreasing products are potential sources of TCE. TCE is still commercially available and investigations at other sites have revealed that TCE in some buildings was attributed to consumer product sources such as these. As part of the building walkthrough, it is important to identify potential background sources, eliminate them (if possible), and educate the occupants on the activities and consumer products that should be avoided immediately before and during sample collection. Screening for indoor air sources could be accomplished through one or a combination of these methods:

   - *Field Instruments:* Field instruments can help identify whether chemicals in common consumer products are potentially present at concentrations significant enough to influence indoor air sample results. Field measurements may be collected using portable field equipment (ppb RAE, or a field portable gas chromatography/mass spectrometry (GC/MS) instrument).
   - *Sub-Slab Soil Vapor:* Sub-slab soil vapor sampling may be selected as an additional line of evidence to evaluate whether concentrations detected in indoor air are the result of vapor intrusion from the subsurface or whether other sources of COCs are contributing to indoor air concentrations. Sub-slab soil vapor samples would be collected from just beneath the foundation slab and may also be accompanied by concurrent indoor air sampling in the same building. With a sufficient dataset from multiple buildings, the comparison of sub-slab to indoor air samples could provide a site-specific attenuation factor. Collection of sub-slab samples is intrusive and may be access-limited due to security, utilities, quality of floors, and liners.

Identify the Information Needed to Establish the Cleanup Levels: Cleanup levels for indoor air were established in the ROD Amendment and are provided in Table V. No additional information is needed at this time.

Confirm that Appropriate Analytical Methods Exist to Provide the Necessary Data: Previous VI investigations were conducted at the VI Study Area using EPA-approved and available analytical methods. Most air samples were collected using 6-liter passivated canisters and analyzed for the COCs by EPA Method TO-15 in the selective ion mode (SIM) to reach detection limits below the cleanup levels and background outdoor air. Other sampling techniques, such as sub-slab and soil gas sampling are well documented in literature and by the State of California (e.g., DTSC, 2003, CalEPA, 2010).

3.4 Step 4: Define the Boundaries of the Study

Characteristics that Define the Population of Interest: The collection and evaluation of multiple lines of evidence and tiering of buildings described in this Tiering Work Plan will be conducted for buildings in the VI Study Area. Table VI lists all the commercial buildings to be evaluated by the MEW Companies and includes information regarding, occupancy, current sampling status, and ROD implementation responsibility. Figures 2 and 3 show the locations of these buildings. Samples will be analyzed for all or a subset of the following vapor intrusion COCs described in the ROD Amendment: TCE, PCE, cis-1,2,-DCE, trans-1,2-DCE, vinyl chloride, 1,1-DCA, and 1,1-DCE.

Define the Spatial Boundary of the Decision Statement: According to the ROD Amendment, the spatial boundary of the VI Study Area is defined as the area where TCE concentrations in shallow groundwater (generally from 5 to 20 feet bgs) are greater than 5 μg/L. This Tiering Work Plan applies to the portion of the VI Study Area south of U.S. Highway 101 (Figure 2) and a certain area on Moffett Field where the MEW Companies are conducting VI work described in the VI SOW (Figure 3). The Navy and NASA are addressing the VI pathway in other buildings on Moffett Field within the VI Study Area.

Define the Temporal Boundary of the Decision: The temporal boundary of the Decision is a 6-step process:

1. EPA approves this Tiering Work Plan;
2. The SOW requires a BSVIWP or Addenda for additional data collection efforts to determine the response action tier for individual buildings and properties within the VI Study Area. Within 30, 60, and 90 days of EPA approval of this Tiering Work Plan, the MEW Companies will conduct the building walkthroughs, as necessary, and submit a BSVIWP in accordance with the specified phased schedule in Table VI.
3. EPA approves BSVIWP;
4. The SOW further specifies that completion of all sampling and data collection efforts of each building/property must be completed within 60 days of EPA approval of the individual BSVIWP or Addendum;
5. Within 60 days of completion of sampling performed in accordance with the BSVIWP, the PRPs will submit a BSVIER to support the appropriate response action tier for the specific building or property; and
6. EPA approves the BSVIER and a response action tier is determined for the building/property.

If after Step 6 it becomes appropriate to change a response action tier for a building or property, steps 2 through 6 would have to be repeated.

The schedule above is contingent upon the following:

- Access is obtained from building tenants/owners in a timely manner;
- Sampling events can be scheduled with existing active ventilation and/or HVAC systems turned off for a period of time sufficient to allow sampling representative of the HVAC off conditions (typically collected on the weekend); and
- EPA's approvals of the Tiering Work Plan and the several BSVIWPs and BSVIERs are received in a timely manner.

Define any Practical Constraints on Data Collection: As discussed above, data collection is contingent upon obtaining building access from tenants and owners and their cooperation in scheduling sampling during periods where active ventilation systems (i.e., HVAC) can be turned off during sampling and for an agreed upon period of time prior to sampling. Where proposed, building owners and tenants may have additional concerns with penetrations to slabs and flooring necessary to conduct sub-slab vapor sampling. Additionally, due to the nature of business of several companies in the MEW Area and Moffett Field, security access and associated security procedures may also pose constraints on the data collection schedule and location. Information gathered during the building walkthroughs and survey completion may identify additional constraints to data collection, and those will be listed in the BSVIWP.

3.5 Step 5: Develop a Decision Rule

Statistical Parameter that Characterizes the Population of Interest: Data collected will be used to assign a response action tier to buildings in the VI Study Area. Indoor air concentrations will be compared to outdoor background and the cleanup levels established in the ROD Amendment (Table V). Soil gas concentrations would be compared to California Human Health Screening Levels ([CHHSLs]; Table VII), or to a site-specific screening level if one can be established for the VI Study Area in the future (the process for establishing site-specific screening levels is not included in this document and will be provided to EPA in the future, if needed). Therefore, the outdoor background air COC concentrations, the cleanup levels, and CHHSLs are the parameters that characterize the population of interest. However, because indoor air can be affected by many different factors, the evaluation of results from indoor air sampling must also consider factors such as chemical use, indoor activities, and building characteristics in order to identify the potential COC contribution to indoor air from the VI pathway.

Confirm that the Cleanup Levels Exceed Measurement Detection Limits: Section 3.3 discusses available methods and limitations, including their applicability at the VI Study Area. Details are presented in the Indoor Air Sampling and Analysis Work Plan for Existing, Unsampled Commercial Buildings (Haley & Aldrich, 2011a). Several sampling methods, including passivated canisters and Ultra III samplers, provide detection limits below the COC cleanup levels and outdoor background within a reasonable sampling period. Other methods may require an extended sampling time (e.g., 7 days for Radiello and up to 30 days for the Waterloo Membrane Sampler). The sampling method chosen should therefore provide detection limits below indoor air cleanup levels and outdoor background concentrations. The MEW Companies and EPA are in the process of determining alternative sampling methods to passivated canisters; however, for the purpose of this Tiering Work

Plan, it is assumed that passivated canisters will be the sampling method for indoor and outdoor air. For soil gas, the sampling method (e.g., TO-15) provides detection limits at levels below the CHHSLs.

Decision Rule: The decision rules are as follows:

Additional Data Collection:

1. If indoor air samples have not been collected in a building or have otherwise not been collected after shutdown of the HVAC system or other engineering control, additional air sampling may be necessary to determine a response action tier for the building.
2. If through QA/QC procedures samples show false positive results, re-sampling may be warranted.
3. If existing information does not provide sufficient evidence to determine a response action tier, then additional lines of evidence will be collected and the sampling plan will be specified in the BSVIWP for the building.

Response Action Tiers:

1. The ROD Amendment, SOW, and this Tiering Work Plan do not apply to buildings where an indoor source of COCs is found to result in COC concentrations greater than cleanup levels.
2. If soil gas concentrations are lower than screening levels (CHHSLs), indoor air concentrations are lower than cleanup standards established in the ROD Amendment (Table V), and are consistent with background concentrations, then no further action will be needed for the property, and a response action Tier 4 will be assigned to the property.
3. If indoor air concentrations are lower than cleanup standards established in the ROD Amendment, are consistent with background concentrations, and if the indoor air samples were collected without the operation of an engineering control (as pre-approved by EPA in the building-specific plans), a response action Tier 3B will be assigned to the building.
4. If indoor air concentrations are lower than cleanup standards established in the ROD Amendment, but greater than outdoor background concentrations, and if the indoor air samples were collected without the operation of an engineering control (as pre-approved by EPA in the building-specific plans), a response action Tier 3A will be assigned to the building.
5. If samples can be collected only with an engineering control in place, then soil gas or groundwater concentrations can be used to assign a response action tier. If soil gas concentrations are less than CHHSLs or groundwater concentrations are lower than calculated site-specific screening levels (pre-approved by EPA) and indoor air concentrations are lower than cleanup standards established in the ROD Amendment and are consistent with background concentrations, then no further action will be needed for the property and a response action Tier 4 will be assigned to the property. If soil gas concentrations are greater than CHHSLs, the building will be assigned a temporary Tier 2 response action until indoor air samples can be collected without the operation of the engineering control.
6. If indoor air samples concentrations exceed the cleanup levels established in the ROD Amendment, and no indoor or outdoor sources are identified, the building will be assigned a response action Tier 1, and an appropriate mitigation measure will be designed and implemented according to the remedy approved in the ROD Amendment and the process described in the SOW.

7. As the groundwater remediation system removes COCs from the groundwater and reduces TCE concentrations in the groundwater, a building no longer within the VI Study Area defined by the 5 μg/L TCE contour line, or a site-specific groundwater screening level if one is established, will be designated as Tier 4.

8. For future buildings, if existing lines of evidence (including soil gas or groundwater sampling) indicate that VI will not result in concentrations greater than cleanup levels, then the property will be designated Tier B.

9. After the initial determination of the response action tier, if it becomes appropriate to change the tier for a building or property, steps 2 through 6 in Section 3.4 (Define the Temporal Boundary of the Decision) would be followed.

A supplemental decision rule regarding the validity of any additional data that may be collected and the QA/QC procedures are included in Appendix B.

3.6 Step 6: Specify Limits on Decision Errors

The response action tiers are applicable only to the VI pathway. The ROD Amendment, the SOW, and this Tiering Work Plan do not apply to buildings where an indoor source of COCs is found to result in COC concentrations greater than cleanup levels.

Collected data will be evaluated for precision, accuracy, representativeness, completeness, comparability, and sensitivity as defined in the QA/QC procedures provided in Appendix B. If data collected do not meet the QA/QC criteria, it may be necessary to collect additional samples to ensure a complete and valid data set.
Confirmation samples would be collected in some cases where data may not conform to historical trends.

3.7 Step 7: Optimize the Design for Obtaining Data

Data evaluation, data collection, and assigning a response action tier for buildings and properties within the VI Study Area will follow the general process outlined on Figure 5. A data management and reporting plan is included in Appendix E.

This work plan provides lines of evidence that are commonly used to evaluate the VI pathway. As new investigative techniques become validated, these techniques would be incorporated into this Tiering Work Plan, if necessary, through addenda.

3.7.1 Optimize Design for Response Action Tiers 1, 2, 3A, and 3B

Multiple lines of evidence including a combination of the following may be used to assign a response action tier for a building within the VI Study Area: building questionnaire, walkthrough, building chemical inventory, indoor/outdoor air samples, screening for indoor sources, and nearby groundwater well data. The evaluation process may include five components. Where applicable, these components may be reiterated until sufficient data are collected to allow for determination of an appropriate response action tier:

1. Evaluate existing information and data;

2. Prepare a BSVIWP or Addenda;

3. Plan to implement the BSVIWP;

4. Collect additional data; and

5. Prepare a BSVIER.

Evaluate Existing Information and Data: The first step in the process evaluates existing information (e.g., indoor air samples, outdoor background air samples, chemical inventory, building walkthroughs, existing groundwater data, etc.) for the building. The following provides the breakdown of some questions to be answered during the preliminary evaluation:

1. Were indoor air samples collected in the building? If an HVAC system is present and operating, were air samples collected with the HVAC system off (e.g., weekend)?

2. Is the air data set sufficient for this evaluation?

3. Are indoor air concentrations greater than the cleanup levels established in the ROD Amendment (Table V)?

4. Are indoor air concentrations greater than outdoor background concentrations?

5. Were any COCs that exceed either the cleanup level or background found in the underlying groundwater?

6. Does the additional information or data available for the building (building questionnaires, walkthroughs, interviews, inspections, chemical inventories, etc.) suggest a potential for indoor air sources?

7. Are additional lines of evidence necessary to identify indoor sources (e.g., soil gas sampling, field screening instruments, site-specific groundwater water sampling, sub-slab sampling)?

8. Is sufficient information available to classify the building as Tier 1, 2, 3A, or 3B?

9. If sufficient information is not available to classify the building, what additional information should be collected?

Conclusions from the preliminary assessments may include the following:

- For buildings with an operating HVAC system, if indoor air samples were not collected in the HVAC off mode (e.g., weekends), additional air samples may be necessary to determine if engineering controls are necessary;
- If existing information suggest that indoor air sources are present, additional data needs will be determined on a building-by-building basis and included in the BSVIWP; and
- If sufficient information exists to determine the response action tier, the building will be assigned either Tiers 1, 2, 3, or 3B according to the decision rules in Section 3.5.

Prepare a BSVIWP or Addendum: If it is concluded above that additional information is necessary to determine a response action tier, a BSVIWP will be submitted to EPA. The BSVIWP for each building and property to be sampled will include the following:

- Building survey results on chemical use, operations, and current and historical facility and property information;

- Subsurface conditions and features, including potential pathways for subsurface VI;
- Building conditions, occupancy and use conditions; summary of relevant previous data collected at and near the property (e.g., groundwater, soil gas, sub-slab soil gas, crawlspace, pathway samples);
- Lines of evidence and specific data to be collected to determine the response action tier;
- Building/Property layout and proposed sampling locations;
- Sampling method(s) and sampling duration;
- Description of access requirements for the work to be performed, existing access conditions, and expected additional tasks necessary and scheduled to obtain access;
- Description of any interim VI mitigation measures taken at the building to date, and a description of the tasks being performed to monitor the ongoing effectiveness of the measures; and
- Field activity work, sampling, and reporting schedule.

The BSVIWP will be submitted to the property owner and EPA for review. Once the BSVIWP is approved by EPA and access has been obtained, pre-sampling and data collection tasks can proceed as described below.

Plan to Implement the BSVIWP: Several tasks will be performed before collecting additional field data:

- Obtain building access to conduct building/property walkthroughs (if necessary), subsequent sampling, and/or other data collection tasks; the process is described on Figure 4.
- If necessary, information will be obtained from the current property owners and/or tenants on the building questionnaire and during a walkthrough.
- The sampling/data collection schedule will be coordinated with the property owner and tenants, as appropriate.
- Sampling equipment will be ordered after EPA approves the BSVIWP and the owner grants access.
- EPA will be provided with at least 10 days notice of scheduled building walkthroughs and sampling to allow them to participate in the walkthroughs and oversee the sampling.

Collect Additional Data: The BSVIWP will include building-specific provisions to collect additional data as needed to determine a response action tier. Below is a sampling design for each type of data that may be collected; however, not all of these lines of evidence may be necessary to determine a response action tier. The BSVIWP will specify the type of information to be collected for the building/property.

Building Questionnaire: The building questionnaire acts as the basis for an interview and inspection with the tenants/owners. It will be reviewed and completed during the walkthrough after access has been granted. For buildings where this questionnaire has been completed, it may be appropriate to update some responses on recent building and HVAC modifications, and

on chemical use. The need for this update will be determined on a building-specific basis and included in the BSVIWP. An informational building questionnaire (Appendix C) will be submitted to the building owners prior to the initial site visit by the sampling team to give the owners time to prepare and collect information on the building foundation and base slab construction details, building use, and HVAC system construction and operation. Additional information documented on the building survey includes chemical usage and storage in the building as a preliminary evaluation of other occupational sources. A Building Product Inventory Form is also included in Appendix C. The survey is not intended to be a complete industrial hygiene survey but will be used as a tool to:

- Examine appropriate rooms to evaluate if there are areas where COCs were used or are present;
- Obtain information on the foundation and base slab construction, where available;
- Obtain information on basement or crawl space, if they exist.
- Obtain information on HVAC systems and ventilation design and operation; this may include inspection by an HVAC contractor to assess system operations and measure outside air volumetric flow rate;
- Collect information on foundation treatments such as vapor barriers, lime treatment of sub-soils, fiber cement, additional reinforcing bars, or other measures that were incorporated into the base slab design that might act as barriers to vapor migration or to minimize slab cracking;
- Determine whether the base slab is accessible, and, if possible, locate areas where the floor is cracked or seamed;
- Locate plumbing or piping systems, utility conduits, communication conduits, elevator shafts, sumps, or floor drains that penetrate the base slab and may act as preferential pathways for VI; and
- Obtain information to implement presumptive measures such as sealing floor cracks, drains, and/or other preferential pathways prior to collecting additional site data and indoor air samples, if appropriate.

Photographs documenting building conditions, testing and/or sampling locations, chemicals stored on-site, or other features of interest should be taken where possible. Due to the sensitive nature of several companies in the MEW Area, security restrictions may prevent the taking of photographs in and around the buildings. Therefore, the ability to take photographs of site features will be on a building-by-building basis.

Available material safety data sheets (MSDS) will be obtained for the chemicals used in the building. However, the MSDS forms may not be definitive as to the presence or absence of COCs. For example, the MSDS may not necessarily report chemicals that have less than 1% in the solution. Additional screening methods of indoor sources may be implemented and would be specified in the BSVIWP.

EPA will be notified 10 days in advance of the building walkthroughs so that EPA personnel may participate. If available, EPA will be supplied with non-confidential building layout and floor plan maps before the walkthrough and final selection of sampling locations.

Indoor Air Sampling

Several buildings have been sampled in the VI Study Area. For previously unsampled buildings, EPA approved the Indoor Air Sampling and Analysis Work Plan for Existing, Unsampled Commercial Buildings (Haley & Aldrich, 2011a) on 1 July 2011. Available sampling methodologies, their applicability, and limitations were evaluated and presented in the aforementioned work plan. EPA and Haley & Aldrich are revising Table III of that document, which will be updated via an addendum. Previously unsampled buildings will be sampled per that work plan. This section provides similar procedures should the BSVIWP determine that additional indoor air samples are necessary.

Using the results of the building survey, sample locations and total number of samples to be collected will be selected to represent different occupancy use in the building (e.g., office, conference room, warehouse, etc.). Indoor air samples will be obtained from the ground floor of the building, which may include sampling from the basement of the building should one be found during the walkthrough. The indoor air sampling devices will be placed on desks or tables to measure the indoor air concentrations at an approximate breathing zone elevation.

Buildings in the VI Study Area can fall into one of three groups: (1) buildings with an operational HVAC system; (2) buildings without an operational HVAC system; and (3) buildings with an active sub-slab ventilation system.

Group 1 - Buildings with an operational HVAC system: To collect indoor air samples with the HVAC system off, the system would be shut down for a specified period before start of sample collection. In most buildings, the HVAC system typically shuts down on a Friday night and resumes operations Monday morning. Information regarding HVAC operations will be noted during the building walkthroughs to provide a basis for proper shutdown and sample duration criteria. The HVAC system shutdown criteria will be documented in the BSVIWP. Because EPA's 8 October 2010 letter indicated that samples are to be collected after shutdown of the engineering controls (e.g., HVAC system), the available shutdown and sampling period may be mostly limited to weekend hours. For this Tiering Work Plan, 6-liter passivated canisters will be used to collect air samples during this time period. It is anticipated that time-integrated 8-, 10-, or 24-hour samples will be collected; building-specific criteria such as occupancy, ventilation, security, and others will be used to select the sampling duration period.

The BSVIWP may specify air samples to be collected during normal occupancy hours when the HVAC system is operating. In such case, these samples will be collected at the same locations sampled with the HVAC off. Air samples will be collected using 6-liter passivated canisters (i.e., Summas®) to provide consistent data collection methods between this sampling event and the HVAC off sampling event described above. Time-integrated air samples will be collected to coincide with building-specific normal work day occupancy (e.g., if typical occupancy or work shifts are 10-hours, then a 10-hour time-integrated sample will be collected).

Data from previous indoor air sampling events conducted since 2003 are also available. However, some of these samples were collected in buildings during normal occupancy hours (with HVAC system on) to provide representative information on potential health risks during working hours. To determine if engineering controls are necessary, existing data will be evaluated in the BSVIWP and samples will be collected with the HVAC system off, if needed.

If a building in Group 1 is unoccupied, the HVAC system will be operated for three days, using normal occupancy procedures (e.g., from 7:00 AM to 7:00 PM). The HVAC on samples would be collected on the third day of operations when the HVAC system is on; the HVAC off samples would be collected approximately 48 hours after the HVAC system is shut down as described above.

Group 2 - Buildings without an operational HVAC system: Air samples (indoor and outdoor) will be collected during typical occupancy hours using 6-liter passivated canisters. Because an HVAC system is not operating in these buildings, it is assumed that there are no time constraints on the sampling window. If the building is unoccupied, sampling will be postponed until standard occupancy conditions are present.

Group 3 - Buildings with active sub-slab ventilation system: For buildings with an active sub-slab ventilation system, the ventilation system will be shut down for seven days prior to collecting indoor air samples to allow for equilibrium between the building and the subsurface (Massachusetts Department of Environmental Protection, 2010). The plan for collecting indoor air samples at these buildings will then follow the procedures defined above for buildings with or without operating HVAC systems.

Indoor air samples will be collected using 6-liter passivated (i.e. Summa®) canisters equipped with a fixed-rate flow controller and a particulate filter. Prior to use, the analytical laboratory will clean and individually-certify the canisters and flow controllers to be used for indoor air analysis.

Indoor and outdoor air samples will be analyzed by a NELAP-certified analytical laboratory using EPA Method TO-15 SIM for the COCs and results will be reported in parts per billion by volume (ppbv) and $\mu g/m^3$. The samples will be analyzed with a standard turnaround time (10 business days) and the results will be reported electronically. Haley & Aldrich will perform a QA/QC evaluation of the data upon receipt of the analytical results as discussed in Appendix B.

Outdoor Air Sampling

For each round of indoor air samples in a building, a minimum of one outdoor air sample will be collected near an HVAC system air intake, if present. When sampling multiple adjacent buildings on the same day, it may be appropriate to collect one outdoor air sample on that day as a representative outdoor sample for these buildings. The outdoor sample will be collected concurrently with the indoor air samples.

Outdoor air samples should be collected using the same sampling methodology used for the indoor air samples (e.g., 6-liter, individually-certified Summa® canister equipped with individually-certified fixed-rate flow controller and a particulate filter). The outdoor sample will be collected over a period that spans the same time period as when the indoor air samples are being collected. Outdoor air samples will be analyzed and reported in ppbv and $\mu g/m^3$ by a NELAP-certified analytical laboratory using EPA Method TO-15 SIM for the chemicals of concern.

Groundwater

Groundwater concentrations are monitored by the MEW Companies on an annual basis and updated plume maps are submitted to EPA in groundwater status reports. Groundwater sampling in the VI Study Area is performed annually under already established procedures incorporated herein by reference. For areas where nearby monitoring wells cannot be found, grab groundwater samples can be collected from the shallow (first) water and analyzed for COCs.

Groundwater data can be used to compare COCs detected in the indoor air to those detected in the groundwater. The presence of a COC in indoor air and its absence in the underlying groundwater is an indication that the source of this COC is not VI from the subsurface. In addition to this forensic evidence, a site-specific groundwater screening level can be established.

Soil Gas Samples

Soil gas samples could be collected adjacent to the exterior of the building (within 10 feet of the building if accessible). The number and location will be specified in the BSVIWP. Soil gas samples would be collected in accordance with the methodology described in Appendix A. Soil gas samples would be analyzed by a NELAP-certified analytical laboratory using EPA Method TO-15 for the COCs identified in underlying groundwater, and reported in ppbv and $\mu g/m^3$. Samples would be analyzed with a standard turnaround time (10 business days) and the results would be reported electronically. Haley & Aldrich would perform a QA/QC evaluation of the data upon receipt of the analytical results from soil gas sampling as discussed in Appendix B.

Screening for Indoor Air Sources

Screening for indoor air sources could be accomplished through one or a combination of the methods described below:

Field Instruments: Field instrument can help identify whether chemicals in common consumer products are present at significant enough concentrations to influence COC concentrations in the indoor air. Field measurements may be collected using portable field equipment (ppb RAE, or a field portable GC/MS instrument). Additional information regarding methodology for using portable instruments to screen for indoor air sources is provided in Appendix A.

Sub-Slab Soil Vapor Sampling: Sub-slab soil vapor sampling may be selected as an additional line of evidence to evaluate whether concentrations detected in indoor air are the result of vapor intrusion from the subsurface or whether other sources of COCs are contributing to indoor air concentrations. Sub-slab soil vapor samples would be collected from the engineered fill or native soil directly under the foundation slab and may also be accompanied by concurrent indoor air sampling in the same building. With a sufficient dataset from multiple buildings, the comparison of sub-slab to indoor air samples could provide a site-specific attenuation factor. Collection of sub-slab samples is intrusive and may be access limited due to security, utilities, quality of floors, and liners.

Details of the sampling process are provided in Appendix A. Sub-slab vapor samples will be collected in 6-liter passivated canisters equipped with a fixed-rate flow controller and a particulate filter. Prior to use, the analytical laboratory will clean and individually-certify the

canisters and flow controllers. Sub-slab vapor samples will be analyzed and reported in ppbv and $\mu g/m^3$ by a NELAP-certified analytical laboratory. Samples will be analyzed using EPA Method TO-15 SIM for the chemicals of concern with a standard turn-around time (10 business days) and the results will be reported electronically. Haley & Aldrich will perform a QA/QC evaluation of the data upon receipt of the analytical results as further discussed in Appendix B.

Prepare a BSVIER: Within 60 days of completion of sampling performed in accordance with the BSVIWP, the PRPs will submit a BSVIER to support the appropriate response action tier for the specific building or property; the BSVIER will include the following information:

- Building conditions, occupancy and use conditions, summary of all building/property-specific data, including identification of potential pathways for subsurface VI;
- Evaluation of current indoor air ventilation system (e.g., HVAC) operations, building and property surveys;
- Description of any interim VI mitigation measures taken at the building to date, and a description of the tasks being performed to monitor the ongoing effectiveness of the measures;
- Description and summary of all lines of evidence and specific data collected to determine response action tier;
- Map of building/property layout and actual sampling locations;
- Sampling and data collection results and data summary;
- Laboratory analytical data;
- Per Decision Rules in Section 3.5, proposed response action tier designation and, where necessary, indicate what additional information is needed to determine response action tier;
- QA/QC data and activities;
- Description of access requirements for the work to be performed, existing access conditions, and expected additional tasks necessary and scheduled to obtain access;
- Description and schedule if an existing engineered VI control system will be utilized that may not require a Building/Property-Specific Remedial Design under this SOW;
- Recommendations, and follow-up actions, including whether a pilot test for a specific Tier 1 or Tier 2 Building is needed; and
- Schedule.

3.7.2 Optimize Design for Response Action Tier 4

The process design for response action Tier 4 may include the same five components described in Section 3.7.1 above. Where applicable, these components may be reiterated until sufficient data are collected to determine an appropriate response action tier:

1. Evaluate existing information and data;
2. Prepare a BSVIWP;
3. Plan to implementation the BSVIWP;

4. Collect additional data; and

5. Prepare a BSVIER.

The first group of properties to be considered for Tier 4 evaluation includes properties where three lines of evidence converge: (1) indoor air concentrations of COCs from VI pathway are less than cleanup levels; (2) indoor air concentrations from VI pathway are consistent with background outdoor air; and (3) property is located over low groundwater concentration areas based on nearby groundwater well data. For this first group, additional lines of evidence, such as site-specific soil gas samples, will be added. If the results of this first group of properties show that the properties qualify for Tier 4 determination, additional properties over higher groundwater concentrations may also be considered for Tier 4 evaluation.

Evaluate Existing Information and Data: The first step in the process evaluates existing information (e.g., indoor air samples, outdoor background air samples, chemical inventory, building walkthroughs, existing groundwater data, etc.) for the building. The following provides the breakdown of some questions to be answered during the preliminary evaluation:

1. Is the air data set sufficient for this evaluation?

2. Are indoor air concentrations less than the cleanup standard and consistent with outdoor background air?

3. Is sufficient information available to determine a Tier 4 designation?

4. If not, what additional information should be collected?

Prepare a BSVIWP or Addenda: Refer to Section 3.7.1.

Plan to Implement the BSVIWP: Refer to Section 3.7.1 as appropriate.

Collect Additional Data: The BSVIWP includes property-specific provisions to collect additional data as needed to determine if the response action Tier 4 is appropriate for the property. These may include the following lines of evidence, the combination of which should converge to the one conclusion that the VI pathway would not result in concentrations greater than cleanup levels at the property:

1. Building Questionnaire: Details are provided in Section 3.7.1

2. Indoor/Outdoor Air: Details are provided in Section 3.7.1. According to the ROD, concentrations in indoor air should be less than the cleanup levels and consistent with background outdoor air.

3. Soil gas: The sampling details are provided in Section 3.7.1. For Tier 4 designation, soil gas samples collected in accordance with the DTSC advisory should have concentrations less than the applicable CHHSLs. Table VII includes the soil vapor CHHSLs (Cal/EPA, 2005; updates 2009, 2010). The CHHSLs represent conservative (i.e., health protective) concentrations considered to be below levels of concern. As stated by Cal/EPA, the concentration of a chemical in excess of the CHHSL does not indicate that adverse impacts to human health are occurring but suggests that further investigation and/or evaluation may be warranted. Accordingly, the CHHSLs are used as a starting point to assess whether additional actions pertaining to potential vapors

may be warranted, but should not be interpreted as cleanup goals. If concentrations are below CHHSLs, due to the conservatism of the screening levels, no further VI evaluation is needed. The thresholds of concern used to develop the CHHSLs are an excess lifetime cancer risk of one-in-a-million (10^{-6}) and a hazard quotient of 1.0 for non-cancer health effects.

4. Groundwater: Details are provided in Section 3.7.1

Prepare BSVIER: Refer to Section 3.7.1.

3.7.3 Interim Vapor Mitigation Measures

During the response action tiering process, it is possible that interim vapor mitigation measures may be implemented, some of which could be preventative measures. These may include sealing open conduits, refurbishing existing HVAC systems, and/or air purification systems. For these interim measures, the various design reports specified in Section 2.4 of the SOW (Remedial Design of Vapor Intrusion Control Systems) will not be submitted to EPA. Instead, a report of the work, including a description, date of implementation, and results of subsequent confirmation sampling results, will be provided to EPA in subsequent documents as described in Sections 2.2.4, 2.4.1, and 2.6.2 of the SOW. In addition, the MEW Companies will provide EPA with verbal or email notification of the interim work to be performed.

REFERENCES

1 California Department of Toxic Substances Control," Advisory – Active Soil Gas Investigations," January 2003.

2 California Environmental Protection Agency, "Use of California Human Health Screening Levels (CHHSLs) in Evaluation of Contaminated Properties," January 2005, most recent update 2010.

3 California Environmental Protection Agency, "Advisory – Active Soil Gas Investigation", March 2010.

4 Haley & Aldrich, Inc., "Final Supplemental Remedial Investigation for Vapor Intrusion Pathway, Middlefield-Ellis-Whisman Study Area, Mountain View and Moffett Field, California," June 2009.

5 Haley & Aldrich, Inc., 2011a, "Indoor Air Sampling and Analysis Work Plan for Existing, Unsampled Commercial Buildings, Middlefield-Ellis-Whisman Study Area, Mountain View, California" June 2011.

6 Haley & Aldrich, Inc., 2011b, "Building-Specific Air Sampling Report, Moffett Field, California," September 2011.

7 Massachusetts Department of Environmental Protection, "Vapor Intrusion Guidance," December 2010.

8 United States Environmental Protection Agency, "Record of Decision, Fairchild, Intel, Raytheon Sites, Middlefield-Ellis-Whisman Study Area, Mountain View, California," 9 June 1989.

9 United States Environmental Protection Agency, 1990a, "Administrative Order for Remedial Design and Remedial Action, U.S. EPA Docket No 91-4 (106 Order)," 29 November 1990

10 United States Environmental Protection Agency, 1990b, "Explanation of Significant Differences, Fairchild, Intel, Raytheon Sites, Middlefield-Ellis-Whisman Study Area, Mountain View, California," 21 September 1990.

11 United States Environmental Protection Agency, "Explanation of Significant Differences, Fairchild, Intel, Raytheon Sites, Middlefield-Ellis-Whisman Study Area, Mountain View, California," April 1996.

12 United States Environmental Protection Agency, "Data Quality Objectives Process for Hazardous Waste Site Investigations, EPA QA/G-4HW, Final," January 2000.

13 United States Environmental Protection Agency, "Final First Five-Year Review Report for Middlefield-Ellis-Whisman (MEW) Superfund Study Area, Mountain View, California," September 2004.

14 United States Environmental Protection Agency, "Record of Decision Amendment for the Vapor Intrusion Pathway, Middlefield-Ellis-Whisman (MEW) Superfund Study Area, Mountain View and Moffett Field, California," 16 August 2010

TABLES

TABLE I
RESPONSE ACTION TIERING SYSTEM FOR EXISTING COMMERCIAL AND RESIDENTIAL BUILDINGS
SITE-WIDE VAPOR INTRUSION SAMPLING AND ANALYSIS WORK PLAN FOR RESPONSE ACTION TIERING
MEW SUPERFUND AREA AND MOFFETT FIELD, CALIFORNIA

Tier [1]	Description	Response Action
Tiering for Buildings Sampled With Passive or Active Engineering Control in Place or Operating		
Tier 1	Building with indoor air concentrations greater than outdoor (background) [2] air concentrations and indoor air cleanup level.	• Implement selected remedy (appropriate engineering control) to meet indoor air cleanup levels. Once indoor air cleanup level achieved and confirmed, building recategorized as Tier 2. • Implement governmental, proprietary, and informational institutional controls.
Tier 2	• Building with indoor air concentrations below the indoor air cleanup levels. • Former Tier 1 existing building and Tier A future (new) building that confirmed indoor air concentrations are below the indoor air cleanup levels.	• Ensure continued operation and maintenance of active ventilation system or other selected engineered remedy to meet Remedial Action Objectives. • Develop and implement long-term monitoring and institutional controls implementation plan. • Implement governmental, proprietary, and informational institutional controls. • Where remedy is achieved through operation of an active ventilation system, agreement of property owner must be contained in a recorded agreement.
Tiering for Buildings Sampled With No Engineering Control in Place or Operating		
Tier 1	Building with indoor air concentrations greater than outdoor (background) [2] air concentrations and indoor air cleanup level.	• Implement selected remedy (appropriate engineering control) to meet indoor air cleanup levels. Once indoor air cleanup level achieved and confirmed, building recategorized as Tier 2. • Implement governmental, proprietary, and informational institutional controls.
Tier 3A	Building with indoor air concentrations below indoor air cleanup levels, but greater than outdoor (background) [2] concentrations.	• No engineered remedy required. • Develop and implement long-term monitoring plan. • Implement governmental institutional controls.
Tier 3B	Building with indoor air concentrations at or within outdoor air (background) [2] concentrations.	• No engineered remedy nor long-term monitoring required.. • Implement governmental institutional controls.
Tier 4	Buildings where converging lines of evidence demonstrate that there is no longer the potential for vapor intrusion into the building exceeding indoor air cleanup levels.	No action required after performance of all necessary confirmation sampling and documentation approved by EPA that no action is necessary.

[1] Tiering system as presented in the Record of Decision (ROD) Amendment for the Vapor Intrusion Pathway (EPA, 2010)

[2] Outdoor concentrations of trichloroethene (TCE) typically range from below laboratory analytical detection limits to 0.4 µg/m3.

TABLE II
RESPONSE ACTION TIERING SYSTEM FOR FUTURE BUILDINGS
SITE-WIDE VAPOR INTRUSION SAMPLING AND ANALYSIS WORK PLAN FOR RESPONSE ACTION TIERING
MEW SUPERFUND AREA AND MOFFETT FIELD, CALIFORNIA

Tier [1]	**Description**	**Response Action**
Tiering for Future Commercial and Residential Buildings		
Tier A	Future (new) building [2] on property where lines of evidence (soil gas, sub-slab soil gas, crawlspace) indicate that there is the potential for vapor intrusion into the new building above indoor air cleanup levels.	• Implement selected remedy to meet Remedial Action Objectives. Perform indoor air sampling after construction to confirm remedial action is effective. • Implement governmental and proprietary institutional controls. Re-categorize as Tier 2 Existing Building.
Tier B	Future (new) buildings [2] on properties where lines of evidence indicate there is no potential for vapor intrusion into the building exceeding EPA's indoor air cleanup levels.	• Perform indoor air sampling after building is constructed to confirm that there is no potential vapor intrusion risk and indoor air cleanup levels are met. • If confirmed with EPA approval, then no action is required.

[1] Tiering system as presented in the Record of Decision (ROD) Amendment for the Vapor Intrusion Pathway (EPA, 2010)

[2] Commercial or multi-family residential buildings constructed with aboveground raised foundations typically would be separated from the ground by a parking garage, which would allow adequate ventilation to prevent vapor intrusion into the occupied spaces. For this construction, perform targeted confirmation air sampling after building is constructed to verify absence of preferred pathways into building and to confirm indoor air cleanup levels are met.

TABLE III
FORMER AND CURRENT MEW PROPERTY ADDRESSES
SITE-WIDE VAPOR INTRUSION SAMPLING AND ANALYSIS WORK PLAN FOR RESPONSE ACTION TIERING
MEW SUPERFUND AREA AND MOFFETT FIELD, CALIFORNIA

MEW Company	Former Facility Address	Current Address
Fairchild Semiconductor Corp.	369/441 North Whisman Road (Building 19/ Buildings 13 and 23)	369/379/389/399 North Whisman Road
	515/545 North Whisman Road (Buildings 1 and 2)	515/545 North Whisman Road
	313 Fairchild Drive (Buildings 3 and 4)	313/323 Fairchild Drive
	464 Ellis Street (Building 20)	464/466/468 Ellis Street
	401 National Avenue (Building 9)	401 National Avenue
	644 National Avenue (Building 18)	644 National Avenue
Intel Corporation	365 E. Middlefield Road (Lots 3 and 4)	355/365 E. Middlefield Road
		401 E. Middlefield Road
Renesas Electronics Inc (formerly NEC)	501 Ellis Street	501 Ellis Street
Raytheon Company	350 Ellis Street	350/370/380 Ellis Street
	415 E. Middlefield Road (Lots 4 and 5)	401/415 E. Middlefield Road
SMI Holding LLC	455/485 E. Middlefield Road	455/487 E. Middlefield Road
Vishay/SUMCO	405 National Avenue	425 National Avenue

TABLE IV
EPA's SELECTED VAPOR INTRUSION REMEDY FOR EXISITNG AND FUTURE BUILDINGS
SITE-WIDE VAPOR INTRUSION SAMPLING AND ANALYSIS WORK PLAN FOR RESPONSE ACTION TIERING
MEW SUPERFUND AREA AND MOFFETT FIELD, CALIFORNIA

Building Scenario	Vapor Intrusion Remedy
Existing Buildings (Non-Residential and Residential)	
Tier 1 and Tier 2 Buildings	Active Sub-slab/Sub-membrane Ventilation, Monitoring, and ICs (including conduit sealing) [1] ICs consist of: ■ Permitting and building requirements to install appropriate engineering controls in future construction. ■ Recorded Agreements for non-residential buildings in MEW Area to ensure installation and operation of engineering controls; require information be provided to future owners; require information of building changes be provided to EPA and the Implementing Parties. ■ Tracking service to provide information to EPA and the Implementing Parties of occupancy and building changes.
Tier 3A Building	No engineering control. Monitoring and ICs only. ICs consist of: permitting and building requirements to install appropriate engineering controls in future construction.
Tier 3B Building	No engineering control and no routine monitoring. ICs only. ICs consist of: ■ Permitting and building requirements to install appropriate engineering controls in future construction.
Tier 4 Building/Property	No vapor intrusion remedy required for building or future building on property.
Future Buildings (Non-Residential and Residential)	
Tier A Buildings	Passive Sub-slab/Sub-membrane Ventilation with Vapor Barrier (and the Ability to Be Made Active), Monitoring, and ICs[2] ICs consist of: ■ Permitting and building requirements to install appropriate engineering controls. Recorded Agreements remain in place for non-residential buildings.
Tier B Buildings	No vapor intrusion remedy required.

Notes:
[1] Alternatively, Active Indoor Air Ventilation System, Monitoring, and ICs (including conduit sealing) may be selected as the vapor intrusion remedy for Tier 1 and Tier 2 existing non-residential buildings, if the property/ building owner agrees to use, operate, and monitor the indoor air ventilation system (e.g., HVAC), in a manner consistent with the operations, maintenance, and monitoring plan developed for that building, in a signed recorded agreement.

[2] Alternatively, Active Sub-slab/Sub-membrane Ventilation, Monitoring, and ICs (including conduit sealing) may be selected as the vapor intrusion remedy for Tier A future buildings.

Reference: Statement of Work, Table 4

TABLE V
INDOOR AIR CLEANUP LEVELS FOR MEW CHEMICALS OF POTENTIAL CONCERN
SITE-WIDE VAPOR INTRUSION SAMPLING AND ANALYSIS WORK PLAN FOR RESPONSE ACTION TIERING
MEW SUPERFUND AREA AND MOFFETT FIELD, CALIFORNIA

Chemical of Potential Concern	Indoor Air Cleanup Level (µg/m^3) [1]		Comments
	Residential	Commerical	
Trichloroethene	1	5	Representing 1 x 10^{-6} lifetime target cancer risk through application of the Cal/EPA toxicity factor and a 1 x 10^{-4} lifetime target cancer risk through application of draft 2001 EPA toxicity factor.
Tetrachloroethene	0.4	2	Representing 1 x 10^{-6} lifetime target cancer risk.
cis-1,2-Dichloroethene	60	210	Not Available. Based on trans-1,2-Dichloroethene non-cancer Hazard Index of 1.
trans-1,2-Dichloroethene	60	210	Representing non-cancer Hazard Index of 1.
Vinyl Chloride	0.2	2	Representing 1 x 10^{-6} lifetime target cancer risk. EPA uses a larger conversion factor from residential to commercial for vinyl chloride because the residential value takes into account child exposure and higher sensitivity earlier in life.
1,1-Dichloroethane	2	6	Representing 1 x 10^{-6} lifetime target cancer risk.
1,1-Dichloroethene	210	700	Representing non-cancer Hazard Index of 1.

µg/m^3 - micrograms per cubic meter

[1] Cleanup Levels as presented in the Record of Decision (ROD) Amendment for the Vapor Intrusion Pathway (EPA, 2010)

TABLE VI
STAUS OF COMMERCIAL BUILDINGS - VAPOR INTRUSION STUDY AREA
SITE-WIDE VAPOR INTRUSION SAMPLING AND ANALYSIS WORK PLAN FOR RESPONSE ACTION TIERING
MEW SUPERFUND AREA AND MOFFETT FIELD, CALIFORNIA

Building Address	Potentially Reponsible Party	Sampling HVAC On	Sampling HVAC Off	Occupancy	Schedule of BSVIWP (Days after Approval of Tiering Work Plan)	Comments & Notes
North Whisman Road						
265/275 N. Whisman Rd.	Regional Program	No	No	Occupied	90	Building-Specific Sampling Plan submitted to EPA on 7/24/2011
276 N. Whisman Rd.	Regional Program	Not applicable No HVAC system	No	Occupied	90	Building-Specific Sampling Plan submitted to EPA on 7/24/2011
301 N. Whisman Rd.	Regional Program	No	No	Occupied	90	Building-Specific Sampling Plan submitted to EPA on 8/30/2011
310 N. Whisman Rd.	Regional Program	Not applicable No HVAC system	No	Occupied	90	Building-Specific Sampling Plan submitted to EPA on 8/1/2011
369 N. Whisman Rd.	Fairchild Semiconductor Corp.	5/6/2003, 5/13/2003, 10/2/2003, 10/7/2003, 6/30/2010	3/14/2010	Unoccupied	60	
379 N. Whisman Rd.	Fairchild Semiconductor Corp.	5/6/2003, 5/13/2003, 10/2/2003, 10/7/2003, 9/9/2010	7/23/2010, 9/11/2010, 1/29/2011	Unoccupied	60	
389 N. Whisman Rd.	Fairchild Semiconductor Corp.	5/6/2003, 5/13/2003, 10/2/2003, 10/7/2003	7/2/2010	Unoccupied	60	
399 N. Whisman Rd.	Fairchild Semiconductor Corp.	5/6/2003, 5/13/2003, 10/2/2003, 10/7/2003, 6/23/2010	2/21/2010	Unoccupied	60	
425 N. Whisman Rd. #100-800	Regional Program	No	No	Occupied	90	Building-Specific Sampling Plan submitted to EPA on 8/1/2011
435 N. Whisman Rd. #100-400	Regional Program	No	No	Occupied	90	Building-Specific Sampling Plan submitted to EPA on 8/1/2011
445 N. Whisman Rd. #100-400	Regional Program	No	No	Occupied	90	Building-Specific Sampling Plan submitted to EPA on 8/1/2011
455 N. Whisman Rd. #100-400	Regional Program	No	No	Occupied	90	Building-Specific Sampling Plan submitted to EPA on 8/1/2011
465 N. Whisman Rd. #100-600	Regional Program	No	No	Occupied	90	Building-Specific Sampling Plan submitted to EPA on 8/1/2011
475 N. Whisman Rd. #100-400	Regional Program	No	No	Occupied	90	Building-Specific Sampling Plan submitted to EPA on 8/1/2011
485 N. Whisman Rd. #100-400	Regional Program	No	No	Occupied	90	Building-Specific Sampling Plan submitted to EPA on 8/1/2011
495 N. Whisman Rd. #100-500	Regional Program	No	No	Occupied	90	Building-Specific Sampling Plan submitted to EPA on 8/1/2011
515 N. Whisman Rd.	Fairchild Semiconductor Corp.	5/6/2003, 5/13/2003, 10/2/2003, 10/7/2003	9/8/2009	Occupied	60	
545 N. Whisman Rd.	Fairchild Semiconductor Corp.	5/6/2003, 5/13/2003, 10/2/2003, 10/7/2003	9/8/2009	Occupied	60	
East Middlefield Road						
295 E. Middlefield Rd.	Regional Program	Not applicable No HVAC system	No	Occupied	90	Building-Specific Sampling Plan submitted to EPA on 7/24/2011
325 E. Middlefield Rd.	Regional Program	No	Not applicable HVAC operates continuously	Occupied	90	Building-Specific Sampling Plan submitted to EPA on 8/1/2011
335 E. Middlefield Rd.	Regional Program	No	No	Occupied	90	Building-Specific Sampling Plan submitted to EPA on 8/30/2011
340/344/348/350 E. Middlefield Rd.	Regional Program	No	No	Occupied	90	Building-Specific Sampling Plan submitted to EPA on 8/1/2011
345 E. Middlefield Rd.	Regional Program	No	No	Occupied	90	Building-Specific Sampling Plan submitted to EPA on 8/30/2011
355/365 E. Middlefield Rd.	Intel Corporation	5/6/2003, 5/13/2003, 9/4/2003, 9/11/2003, 12/23/2003	No	Occupied	60	
401/415 E. Middlefield Rd.	Raytheon Company	5/6/2003, 5/13/2003, 11/11/2003, 11/14/2003	No	Partially occupied	60	
440 E. Middlefield Rd.	Regional Program	10/7/2009	No	Occupied	30	
448/450 E. Middlefield Rd.	Regional Program	No	No	Occupied	90	Building-Specific Sampling Plan submitted to EPA on 8/1/2011
455 E. Middlefield Rd.	SMI Holding LLC	5/6/2003, 5/13/2003, 9/24/2003, 10/2/2003, 1/5/2004	Not applicable HVAC operates continuously	Occupied	60	
460 E. Middlefield Rd.	Regional Program	7/8/2004, 7/14/2004	No	Occupied	30	
487 E. Middlefield Rd.	SMI Holding LLC	5/6/2003, 5/13/2003, 9/24/2003, 10/2/2003	Not applicable HVAC operates continuously	Occupied	60	

TABLE VI
STAUS OF COMMERCIAL BUILDINGS - VAPOR INTRUSION STUDY AREA
SITE-WIDE VAPOR INTRUSION SAMPLING AND ANALYSIS WORK PLAN FOR RESPONSE ACTION TIERING
MEW SUPERFUND AREA AND MOFFETT FIELD, CALIFORNIA

Building Address	Potentially Reponsible Party	Sampling HVAC On	Sampling HVAC Off	Occupancy	Schedule of BSVIWP (Days after Approval of Tiering Work Plan)	Comments & Notes
490 E. Middlefield Rd.	Regional Program	10/15/2009	No	Occupied	30	
60						
370 Ellis St., Building A	Raytheon Company	11/13/2003, 1/24/2006, 9/26/2006, 2/20/2008	5/10/2003, 5/17/2003, 9/27/2003, 10/4/2003	Occupied	60	
370 Ellis St., Building B	Raytheon Company	11/13/2003, 1/24/2006, 9/26/2006, 2/20/2008	5/10/2003, 5/17/2003, 9/27/2003, 10/4/2003	Occupied	60	
380 Ellis St., Building C	Raytheon Company	11/13/2003, 1/24/2006, 9/26/2006, 2/20/2008	5/10/2003, 5/17/2003, 9/27/2003, 10/4/2003	Occupied	60	
380 Ellis St., Building D	Raytheon Company	5/10/2003, 5/17/2003, 9/27/2003, 10/4/2003, 9/26/2006, 2/20/2008, 7/9/2008		Occupied	60	
350 Ellis St., Building E	Raytheon Company	9/26/2006, 2/20/2008	5/10/2003, 5/17/2003, 7/8/2003, 9/27/2003, 10/4/2003	Occupied	60	
464 Ellis St.	Fairchild Semiconductor Corp.	5/6/2003, 5/13/2003, 10/2/2003, 10/7/2003	2/21/2010	Unoccupied	60	
466 Ellis St.	Fairchild Semiconductor Corp.	5/6/2003, 5/13/2003, 10/2/2003, 10/7/2003	2/21/2010	Unoccupied	60	
468 Ellis St.	Fairchild Semiconductor Corp.	5/6/2003, 5/13/2003, 10/2/2003, 10/7/2003	4/9/2010	Unoccupied	60	
486/488 Ellis St.	Regional Program	10/2/2009	No	Occupied	30	
500 Ellis St.	Regional Program	10/2/2009	No	Occupied	30	
501 Ellis St.	Renesas Electronics Inc. (formerly NEC)	4/30/2003, 5/1/2003, 9/24/2003, 10/2/2003, 1/15/2004, 12/15/2004, 1/26/2005	No	Occupied	60	
515 Ellis St.	Regional Program	2/21/2008	No	Occupied	30	Not known if an HVAC system operated during sampling
550 Ellis St.	Regional Program	10/3/2009	No	Occupied	30	
555 Ellis St.	Regional Program	6/22/2006	No	Occupied	30	
605 Ellis St.	Regional Program	No	No	Occupied	90	Building-Specific Sampling Plan submitted to EPA on 7/24/2011
625 Ellis St.	Regional Program	No	No	Occupied	90	Building-Specific Sampling Plan submitted to EPA on 7/24/2011
636 Ellis St./491 Fairchild Dr.	Regional Program	No	No	Occupied	90	Building-Specific Sampling Plan submitted to EPA on 8/30/2011
645 Ellis St.	Regional Program	No	No	Occupied	90	Building-Specific Sampling Plan submitted to EPA on 7/24/2011
Fairchild Drive						
277 Fairchild Dr.	Regional Program	Not applicable No HVAC system	No	Occupied	90	Building-Specific Sampling Plan submitted to EPA on 8/1/2011
299 Fairchild Dr.	Regional Program	2/21/2008	No	Occupied	30	
313 Fairchild Dr.	Fairchild Semiconductor Corp.	5/6/2003, 5/13/2003, 10/2/2003, 10/7/2003	No	Occupied	60	
323 Fairchild Dr.	Fairchild Semiconductor Corp.	5/6/2003, 5/13/2003, 10/2/2003, 10/7/2003	No	Occupied	60	
331/333 Fairchild Dr.	Regional Program	Not applicable - will be demolished			Not Applicable	Unoccupied to be demolished
411/415 Fairchild Dr.	Regional Program	No	No	Suite 415 is unoccupied	90	Building-Specific Sampling Plan submitted to EPA on 7/24/2011
465A Fairchild Dr. #101-115; #121-135	Regional Program	No	No	Not all suites are occupied	90	Building-Specific Sampling Plan submitted to EPA on 8/1/2011
465B Fairchild Dr. #201-215; #221-234	Regional Program	No	No	Not all suites are occupied	90	Building-Specific Sampling Plan submitted to EPA on 8/1/2011
National Avenue						
401 National Ave.	Fairchild Semiconductor Corp.	Not applicable No HVAC system	5/6/2003, 5/13/2003, 6/9/2003, 9/4/2003, 4/1/2004	Occupied	60	
425 National Ave.	Vishay/SUMCO	9/20/2007, 3/27/2008	No	Occupied	60	

TABLE VI
STAUS OF COMMERCIAL BUILDINGS - VAPOR INTRUSION STUDY AREA
SITE-WIDE VAPOR INTRUSION SAMPLING AND ANALYSIS WORK PLAN FOR RESPONSE ACTION TIERING
MEW SUPERFUND AREA AND MOFFETT FIELD, CALIFORNIA

Building Address	Potentially Reponsible Party	Sampling HVAC On	Sampling HVAC Off	Occupancy	Schedule of BSVIWP (Days after Approval of Tiering Work Plan)	Comments & Notes
450 National Ave.	Regional Program	10/14/2009	10/14/2009, 10/16/2009	Occupied	30	
455/465 National Ave.	Regional Program	No	No	Unoccupied	90	Building-Specific Sampling Plan submitted to EPA on 8/1/2011
612/614/616/618/620 National Ave.	Regional Program	No	No	Occupied	90	Building-Specific Sampling Plan submitted to EPA on 8/1/2011
615 National Ave.	Regional Program	9/29/2009	No	Occupied	30	
625/627 National Ave.	Regional Program	9/17/2009	No	Occupied	30	
630/634 National Ave.	Regional Program	No	No	Occupied	90	Building-Specific Sampling Plan submitted to EPA on 7/24/2011
640 National Ave.	Regional Program	Not applicable No HVAC system	No	Occupied	90	Building-Specific Sampling Plan submitted to EPA on 7/24/2011
644 National Ave.	Fairchild Semiconductor Corp.	Not applicable No HVAC system	5/6/2003, 5/13/2003, 6/9/2003, 11/13/2003, 7/1/2004	Unoccupied to be demolished	Not Applicable	Unoccupied to be demolished
645 National Ave.	Regional Program	7/22/2004	No	Occupied	30	
660 National Ave.	Regional Program	10/2/2003, 10/7/2003, 5/25/2004	No	Unoccupied to be demolished	Not Applicable	Unoccupied to be demolished
670 National Ave.	Regional Program	8/19/2004	No	Unoccupied to be demolished	Not Applicable	Unoccupied to be demolished
Moffett Field						
17	Regional Program	Not applicable No HVAC system	6/30/2003 - 9/26/2003, 12/3/2003 - 5/19/2004	Occupied	60	
18	Regional Program	2/21/2008, 2/27/2008		Occupied	30	Status of HVAC system not known
19	Regional Program	2005-2006, 2/26/2007		Occupied	30	Status of HVAC system not known
20	Regional Program	Not applicable No HVAC system	12/3/2003 - 6/23/2004, 5/28/2008, 5/30/2008, 7/28/2008, 7/30/2008	Occupied	30	
23	Regional Program	7/14/2011	Not applicable HVAC operates continuously	Occupied	30	
25	Regional Program	No	No	Unoccupied	Not Applicable	Additonal work to be performed if occupancy status changes
48	Regional Program	7/13/2011	Not applicable HVAC operates continuously	Occupied	30	
109	Regional Program	No	No	Unoccupied	Not Applicable	Additonal work to be performed if occupancy status changes
146	Regional Program	Not applicable No HVAC system	7/13/2011	Not all areas are occupied	30	
148	Regional Program	No	No	Unoccupied	Not Applicable	Additonal work to be performed if occupancy status changes
149	Regional Program	No	No	Unoccupied	Not Applicable	Additonal work to be performed if occupancy status changes
150	Regional Program	No	No	Unoccupied	Not Applicable	Additonal work to be performed if occupancy status changes
151	Regional Program	No	No	Unoccupied	Not Applicable	Additonal work to be performed if occupancy status changes
152	Regional Program	No	No	Unoccupied	Not Applicable	Additonal work to be performed if occupancy status changes
153	Regional Program	No	No	Unoccupied	Not Applicable	Additonal work to be performed if occupancy status changes
154	Regional Program	Not applicable No HVAC system	2/21/2008, 2/27/2008	Unoccupied	Not Applicable	Additonal work to be performed if occupancy status changes
155	Regional Program	No	No	Unoccupied	Not Applicable	Additonal work to be performed if occupancy status changes
156	Regional Program	No	No	Unoccupied	Not Applicable	Additonal work to be performed if occupancy status changes
476	Regional Program	No	No	Unoccupied	Not Applicable	Additonal work to be performed if occupancy status changes

TABLE VI
STAUS OF COMMERCIAL BUILDINGS - VAPOR INTRUSION STUDY AREA
SITE-WIDE VAPOR INTRUSION SAMPLING AND ANALYSIS WORK PLAN FOR RESPONSE ACTION TIERING
MEW SUPERFUND AREA AND MOFFETT FIELD, CALIFORNIA

Building Address	Potentially Reponsible Party	Sampling HVAC On	Sampling HVAC Off	Occupancy	Schedule of BSVIWP (Days after Approval of Tiering Work Plan)	Comments & Notes
503	Regional Program	Not applicable No HVAC system	7/12/2011	Not all areas are occupied	30	
512 A-C	Regional Program	No	No	Unoccupied	Not Applicable	Additonal work to be performed if occupancy status changes
525	Regional Program	No	No	Unoccupied	Not Applicable	Additonal work to be performed if occupancy status changes
543	Regional Program	7/14/2011	Not applicable HVAC operates continuously	Occupied	60	
547B	Regional Program	No	No	Unoccupied	Not Applicable	Additonal work to be performed if occupancy status changes
547C	Regional Program	No	No	Unoccupied	Not Applicable	Additonal work to be performed if occupancy status changes
547D	Regional Program	No	No	Unoccupied	Not Applicable	Additonal work to be performed if occupancy status changes
547E	Regional Program	No	No	Unoccupied	Not Applicable	Additonal work to be performed if occupancy status changes
554	Regional Program	Not applicable No HVAC system	7/12/2011	Occupied	30	
556	Regional Program	2/25/2008, 2/27/2008	No	Unoccupied	Not Applicable	Additonal work to be performed if occupancy status changes
569	Regional Program	7/14/2011	Not applicable HVAC operates continuously	Occupied	60	
572	Regional Program	No	No	Unoccupied	Not Applicable	Additonal work to be performed if occupancy status changes
583A	Regional Program	Not applicable No HVAC system	7/11/2011	Occupied	30	
583B	Regional Program	Not applicable No HVAC system	7/11/2011	Occupied	60	
583C	Regional Program	7/11/2011	Not applicable HVAC operates continuously	Occupied	30	
596	Regional Program	7/12/2011	Not applicable HVAC operates continuously	Occupied	60	
944	Regional Program	7/13/2011	Not applicable HVAC operates during occupancy	Partially occupied	60	
945	Regional Program	No	No	Unoccupied	Not Applicable	Additonal work to be performed if occupancy status changes
N237	Regional Program	2/21/2008, 2/27/2008, 3/25/2009, 3/27/2009	Not applicable HVAC operates continuously	Occupied	60	

TABLE VII
CALIFORNIA HUMAN HEALTH SCREENING LEVELS FOR MEW CHEMICALS OF POTENTIAL CONCERN
SITE-WIDE VAPOR INTRUSION SAMPLING AND ANALYSIS WORK PLAN FOR RESPONSE ACTION
MEW SUPERFUND AREA AND MOFFETT FIELD, CALIFORNIA

	Soil Gas CHHSLs for Buildings *with* Engineered Fill Below Sub-Slab Gravel [1]				**Soil Gas CHHSLs (µg/L) for Buildings *without* Engineered Fill Below Sub-Slab Gravel [2]**			
	Residential		Commerical/Industrial		Residential		Commerical/Industrial	
Chemical of Potential Concern	(µg/L)	(µg/m^3)	(µg/L)	(µg/m^3)	(µg/L)	(µg/m^3)	(µg/L)	(µg/m^3)
Trichloroethene	1.3	1,300	4.4	4,400	0.53	530	1.8	1,800
Tetrachloroethene	0.47	470	1.6	1,600	0.18	180	0.6	600
cis-1,2-Dichloroethene	41	41,000	120	120,000	16	16,000	44	44,000
trans-1,2-Dichloroethene	84	84,000	240	240,000	32	32,000	89	89,000
Vinyl Chloride	0.028	28	0.095	95	0.013	13	0.045	45
1,1-Dichloroethane [3]	1.5	1,500	5.1	5,100	1.5	1,500	5.1	5,100
1,1-Dichloroethene [3]	42	42,000	120	120,000	42	42,000	120	120,000

CHHSL - California Human Health Screening Level

µg/L - micrograms per liter

µg/m^3 - micrograms per cubic meter

OEHHA - Office of Environmental Health Hazard Assessment

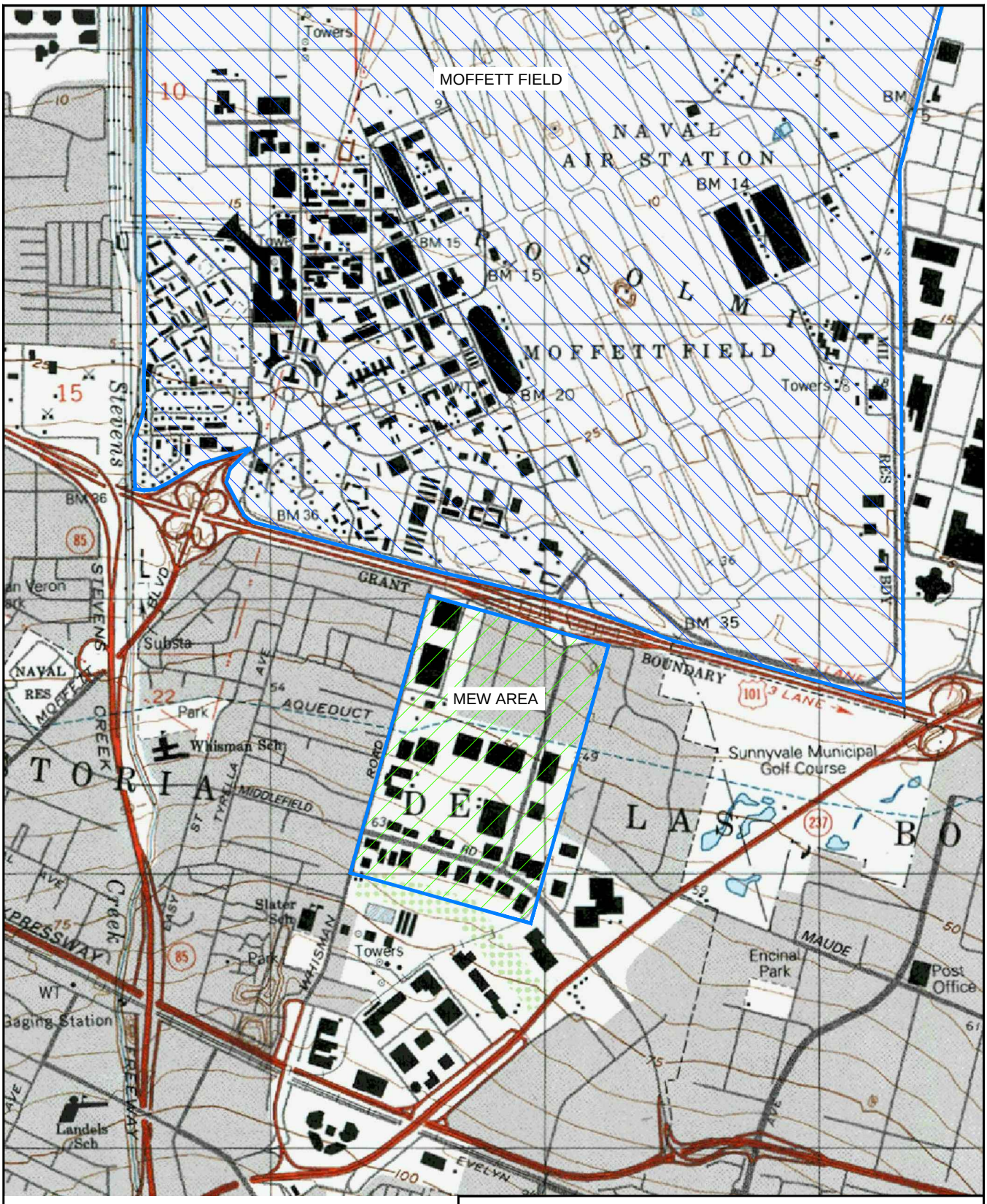
Soil gas CHHSLs are based on soil gas data collected <1.5 meters (five feet) below a building foundation or the ground surface. They are intended for evaluation of potential vapor intrusion into buildings and subsequent impacts to indoor-air. Screening levels also apply to sites that overlie plumes of VOC-impacted groundwater.

[1] CHHSLs updated 9/23/10 as presented on the California OEHHA website (www.oehha.org/risk/chhsltable.html) - Table 2 "Soil-Gas-Screening Numbers for Volatile Chemicals below Buildings Constructed with Engineered Fill below Sub-slab Gravel".

[2] CHHSLs updated 9/23/10 as presented on the California OEHHA website (www.oehha.org/risk/chhsltable.html) - Table 3 "Soil-Gas-Screening Numbers for Volatile Chemicals below Buildings Constructed without Engineered Fill below Sub-slab Gravel".

[3] No CHHSLs are provided for this chemical. Screening levels are obtained from San Francisco Bay Regional Water Quality Control Board Environmental Screening Levels (2007)

FIGURES



SITE COORDINATES:37°24'17"N 122°3'15"W

U.S.G.S. QUADRANGLE: MOUNTAIN VIEW, CA

HALEY & ALDRICH

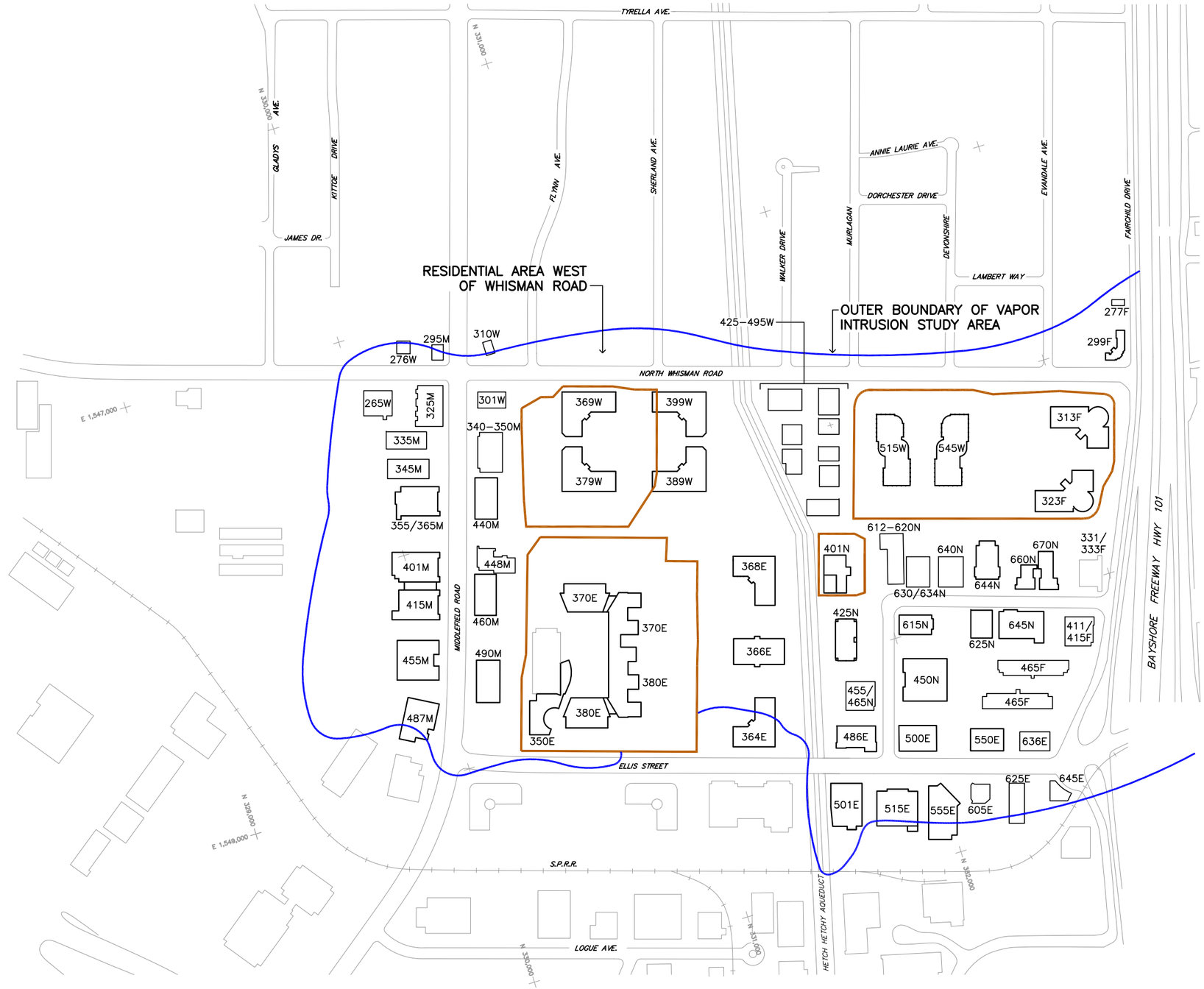
MEW STUDY AREA
MOUNTAIN VIEW, CALIFORNIA

PROJECT LOCUS

SCALE: 1:24,000
JUNE 2011

FIGURE 1

G:\36067\CAD\DRAWINGS\36067-LOCUS.DWG



LEGEND:

SLURRY WALL

E ELLIS STREET

M EAST MIDDLEFIELD ROAD

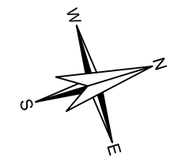
F FAIRCHILD DRIVE

W NORTH WHISMAN ROAD

N NATIONAL AVENUE

NOTES:

1. BOUNDARY OF MEW STUDY AREA IS DEFINED BY THE 5 MICROGRAMS PER LITER (UG/L) TRICHLOROETHENE CONTOUR AS REPORTED IN THE 2010 ANNUAL PROGRESS REPORT (GEOSYNTEC, 2011)
2. BUILDINGS IN RESIDENTIAL AREA WEST OF WHISMAN ROAD ARE NOT SHOWN.



0 500 1,000

SCALE IN FEET

HALEY & ALDRICH

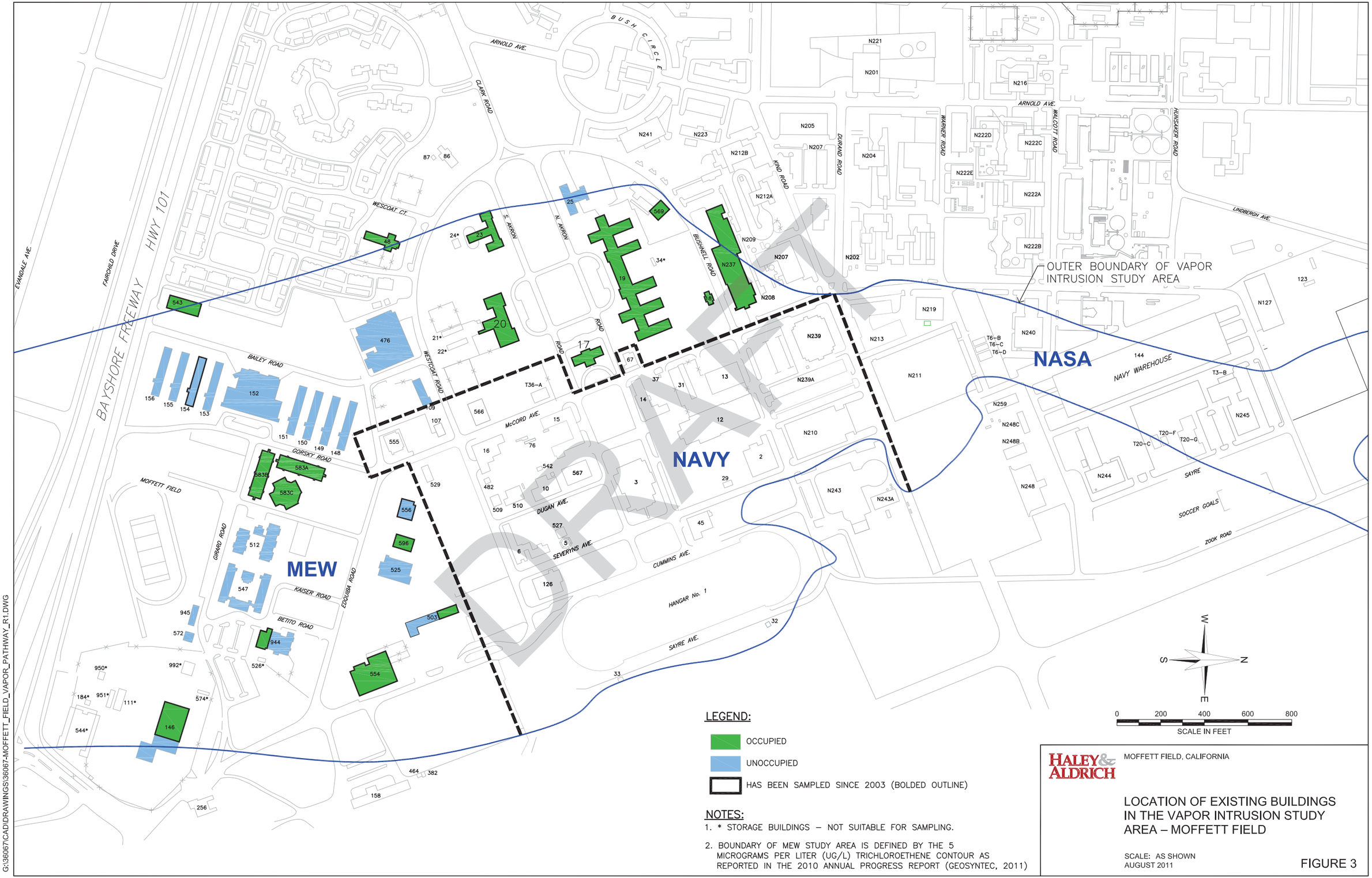
MOUNTAIN VIEW, CALIFORNIA

LOCATION OF EXISTING BUILDINGS VAPOR INTRUSION STUDY AREA SOUTH OF U.S. HIGHWAY 101

SCALE: AS SHOWN
SEPTEMBER 2011

FIGURE 2

G:\36067\CAD\DRAWINGS\36067-EXISTING_BUILDINGS_R1.DWG



LEGEND:

- OCCUPIED
- UNOCCUPIED
- HAS BEEN SAMPLED SINCE 2003 (BOLDED OUTLINE)

NOTES:

1. * STORAGE BUILDINGS – NOT SUITABLE FOR SAMPLING.
2. BOUNDARY OF MEW STUDY AREA IS DEFINED BY THE 5 MICROGRAMS PER LITER (UG/L) TRICHLOROETHENE CONTOUR AS REPORTED IN THE 2010 ANNUAL PROGRESS REPORT (GEOSYNTEC, 2011)

HALEY & ALDRICH

MOFFETT FIELD, CALIFORNIA

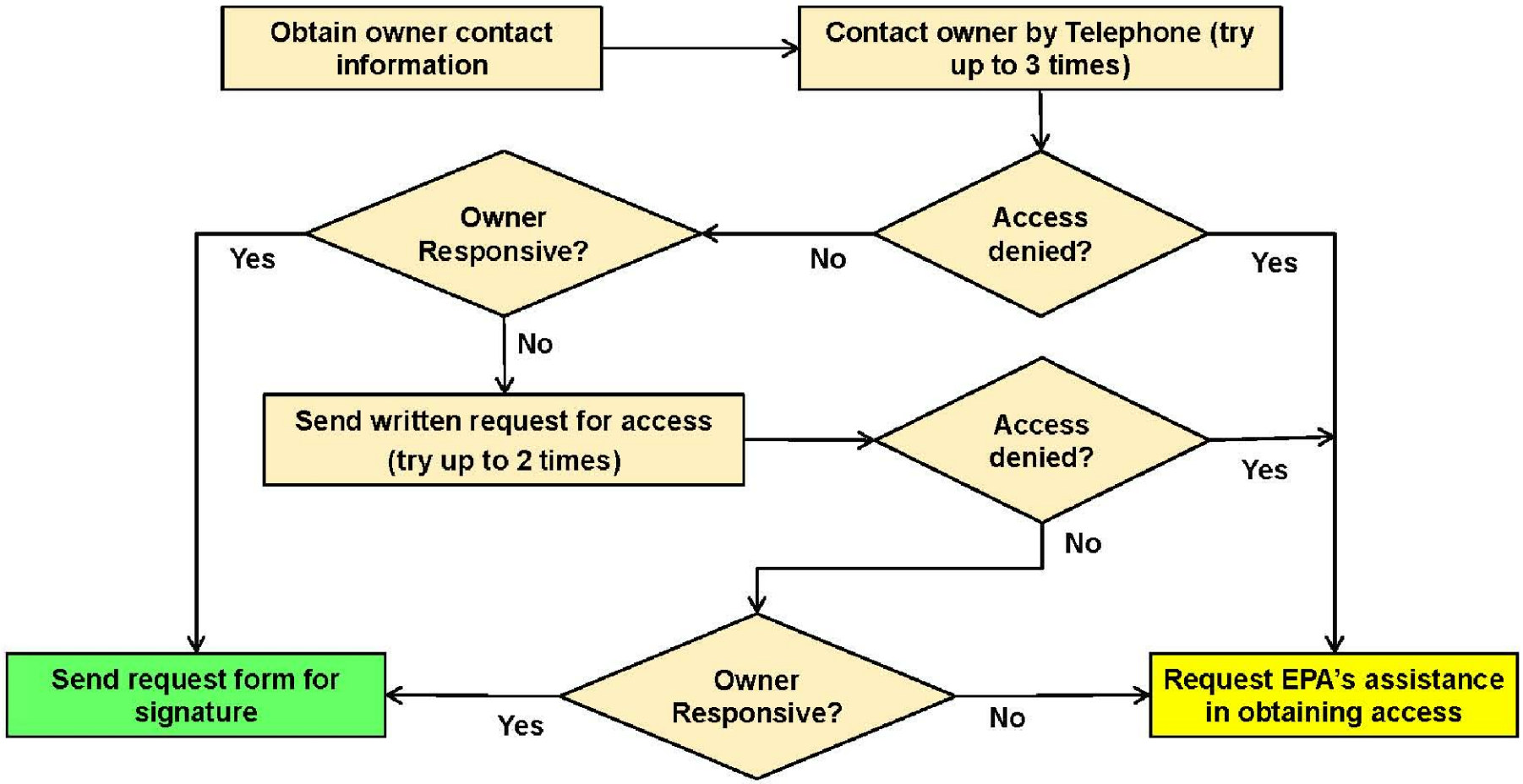
LOCATION OF EXISTING BUILDINGS IN THE VAPOR INTRUSION STUDY AREA – MOFFETT FIELD

SCALE: AS SHOWN
AUGUST 2011

FIGURE 3

G:\36067\CAD\DRAWINGS\36067-MOFFETT_FIELD_VAPOR_PATHWAY_R1.DWG

G:\36067\CAD\DRAWINGS\36067-PROCESS_R1.DWG



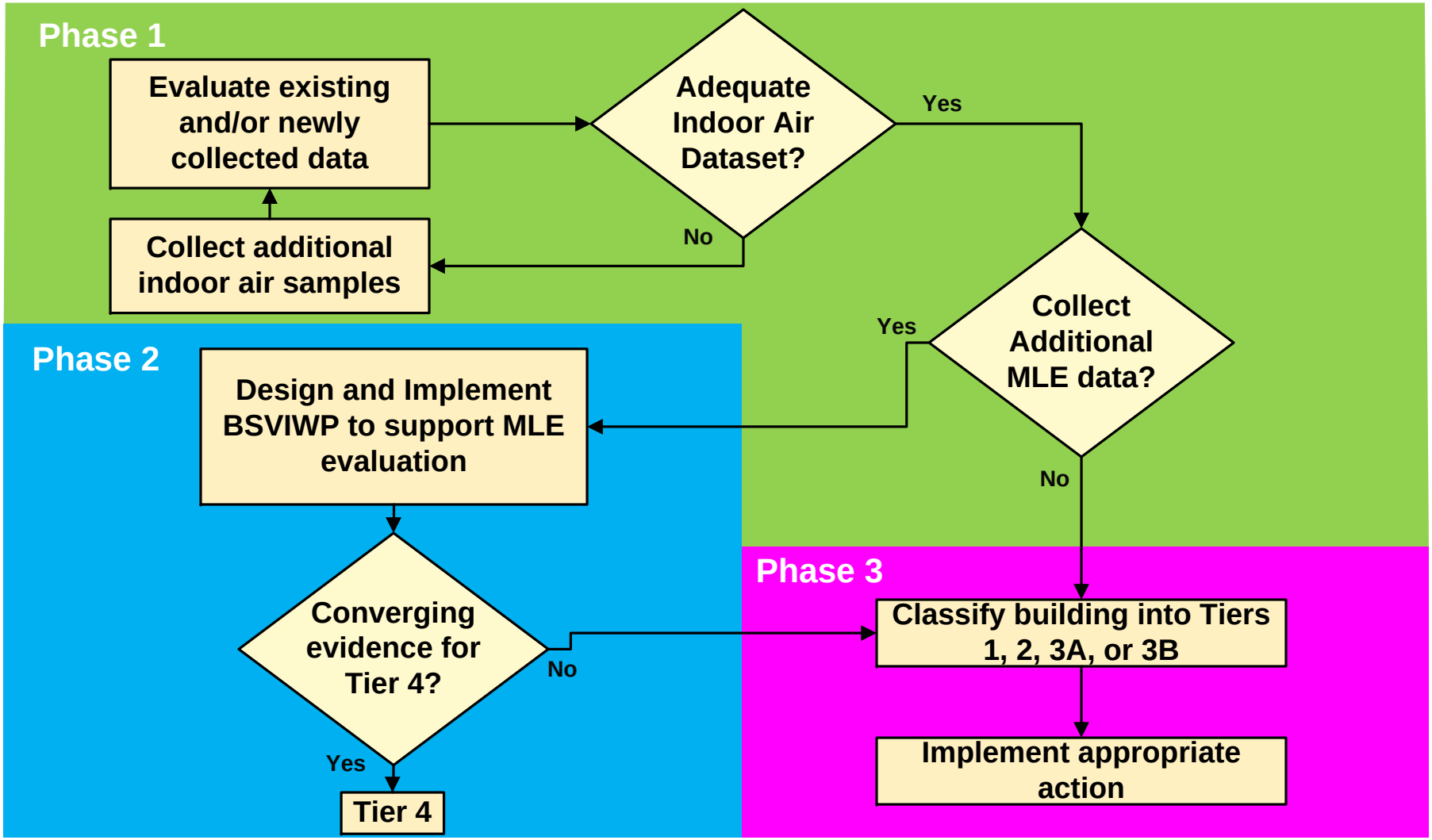
HALEY & ALDRICH

MEW STUDY AREA
MOUNTAIN VIEW, CALIFORNIA

PROCESS FOR REQUESTING ACCESS

SCALE: AS SHOWN
SEPTEMBER 2011

FIGURE 4



BSVIWP – Building Specific Vapor Intrusion Work Plan
MLE – multiple lines of evidence

HALEY & ALDRICH

VAPOR INTRUSION STUDY
MEW AREA AND MOFFETT FIELD AREA

TIERING PROCESS

SEPTEMBER 2011

FIGURE 5

APPENDIX A

Typical Data Collection Methods, Procedures, and Analysis

APPENDIX A

DATA COLLECTION METHODS, PROCEDURES, AND ALALYSIS

Indoor Air Sampling Procedure	PROCEDURE # **36067-009-01**
	EFFECTIVE DATE: 18 May 2011
REVISION #: **1.0**	REVISION DATE: 15 August 2011

INTRODUCTION

This appendix outlines the procedures to prepare for and collect indoor and outdoor air samples from commercial, industrial and/or residential properties for laboratory analysis in accordance with United States Environmental Protection Agency (EPA) Method TO-15.

PLANS REFERENCED/FORMS REQUIRED

- Daily Field Report;
- Indoor Air Sampling Record;
- Project-Specific Health and Safety Plan (HASP); and
- Building-Specific Sampling Plan.

PRESAMPLING ACTIVITIES

1. Obtain access agreement from property owner to sample the building.
2. Contact property owner/tenant to confirm the operating hours of the HVAC system to set the sampling schedule.
3. Set up Sampling Schedule.

   Example Sample Collection Schedule: (assuming that the HVAC system operates on a weekday schedule of 7:00 AM to 7:00 PM).

   - Weekday 7:00 AM: confirm the HVAC system is operating and deploy 10-hour samples at the HVAC intake and indoor sample locations.
   - Weekday 12:00 PM: check status of the passivated canisters And calculate the completion time.
   - Weekday 5:00 PM: pick up the passivated canisters. Passivated canister vacuum should be between 5 and 10 inches of mercury (Hg) vacuum or lower.
   - Saturday 7:00 PM: confirm that the HVAC system is off and deploy 24-hr PASSIVATED canisters.
   - Sunday 7:00 PM: collect passivated canisters.

   Note: Coordinate with the HVAC specialist to be on site before the sampling event.

4. Complete Indoor Air Sampling Field Form.

5. Order Sampling Equipment with Laboratory.

   - Review Building-Specific Sampling Plan for number and duration of indoor air samples;

- Field Duplicate (1 per 10 samples; duplicate samples locations are specified in Building-Specific Sampling Plans);
- Outdoor air sample (at HVAC intake or on the ground outside the building; Note: duration of the background sample should be the same as the indoor air samples); and
- Individually certify passivated canisters with appropriate flow controllers to less than the Reporting Limits for each target compound.

6. Prepare forms and obtain supplies
    - Copy of the Building-Specific Sampling Plan;
    - Indoor Air Sampling Record;
    - Sample "Do Not Disturb" sign;
    - Chain of custody forms (COC);
    - Nitrile gloves;
    - Brass ferrule;
    - 1/4" poly tubing;
    - Sample container and locks for background samples;
    - Galaxy tab portable computer;
    - Digital camera;
    - Tape measure;
    - FedEx shipping labels;
    - Packaging tape;
    - Permanent marker;
    - Chain and padlock;
    - Black ink pens; and
    - Stainless steel wrench (9/16").

SAMPLE ACTIVITIES

Indoor air sampling trains will be setup at locations shown on the site plan. Field documentation, sampling, and COC procedures will be conducted in accordance with the approved Work Plan. Personal protective equipment will be donned in accordance with the requirements of the Project-Specific HASP. Photographs should be collected from each location, but only if pre-approved by building owner/tenant. Sample duration is specified in the Building-Specific Sampling Plan.

APPENDIX A

DATA COLLECTION METHODS, PROCEDURES, AND ALALYSIS

1. Verify that the HVAC system is operating before starting the sampling activities.
2. For the outdoor sampling location collected when the HVAC system is on, place the passivated canister near the HVAC intake or as specified in the Work Plan.
3. The outdoor air samples must be deployed at the same time and for the same sampling duration as the indoor air samples.

Outdoor air sample placed near the building perimeter.

APPENDIX A

DATA COLLECTION METHODS, PROCEDURES, AND ALALYSIS

Outdoor sample placed near the HVAC system intake.

4. For the outdoor sampling location collected when the HVAC system is off, place the passivated canister outside the building in the red box with ¼" poly tubing attached to the flow regulator using a ¼" brass ferrule. The tubing should then be threaded through the top of the box and taped to a stationary object (using packaging tape or nylon stay ties). The red box and passivated canister should be secured to a stationary object using the chain and padlock (not required if the sample is on the roof).

5. For indoor air sampling locations when the HVAC system is either on or off, the passivated canister should be placed 36 to 48 inches above the floor and at locations shown on the Building-Specific Sampling Plan. One field duplicate sample should be collected for every 10 samples. Field duplicate locations are also shown in the Building-Specific Sampling Plan.

6. Leak Test Flow Controller: Attach the flow controller with gauge to the ¼" male fitting on the passivated canister and seal the flow controller with the cap fitting originally provided on the

passivated canister. Open the passivated canister valve approximately ¼ turn. Shut the passivated canister valve and observe the vacuum level on the gauge. If vacuum drops, tighten the cap fitting on the top of the flow controller using a 9/16" wrench. If vacuum continues to drop, tighten the flow controller Swagelock fittings on the passivated canister and within the flow controller.

7. Check passivated Canister Initial Vacuum Reading: After the seal has been confirmed, place passivated canister in the sampling location and remove cap from the flow controller. Place the passivated canister at proper height (See step 5), open the passivated canister valve ¼ turn and record the initial vacuum and start time on the IA Sampling Record. Also fill out the tag on the passivated canister, but leave the end time blank (and end date, if a 24-hour sample).

8. Interim passivated Canister Vacuum Level Check: Schedule a return visit to the sample location with the building owner/tenant for approximately 3 to 4 hours after the start of sampling for each passivated canister. Record the interim sample vacuum level on the IA Sampling Record. If the vacuum reading has not changed or is below 1.0 inch Hg, confirm that the passivated canister valve is opened; if the valve is opened, it is possible that the flow controller has failed. In either case, terminate the sampling event, record the final sample time and vacuum reading on the IA Sampling Record, and contact the Project Manager for corrective action.

9. Final Sample Collection: At the conclusion of sample collection, record the final time on the sampling record and close the valve. Residual passivated canister vacuum should be between 1 and 4 inches of Hg vacuum at the conclusion of sampling. Contact Project Manager if residual vacuum levels are greater than 5 inches Hg for corrective action.

10. Disconnect the passivated canister from the integrated flow controller and attach ¼" ferrule cap on the passivated canister inlet. Label the passivated canister sample tag with the sample identification number, vacuum readings, sampling end time, and end date.

11. Fill out COC form with project name, file number, sample identification, passivated canister and flow controller serial numbers, date and time collected, analysis requirements, and other fields as instructed. Retain copies of the COC form and shipping documents. Place passivated canisters back into their original boxes and ship to the laboratory via standard courier (FedEx) using ground service.

12. Confirm that the passivated canister is labeled with the information described below and recorded on the IA Sampling Record and COC form prior to shipment,. Labels must be secured to the passivated canister and written in indelible ink.

    - Sample number/ID;
    - Passivated canister and flow controller serial numbers;
    - Date and time;
    - Parameters to be analyzed;
    - Project number; and
    - Sampler's initials.

APPENDIX A

DATA COLLECTION METHODS, PROCEDURES, AND ALALYSIS

FIELD NOTES

Field notes must document all events, equipment used, and measurements collected during the sampling activities. The field forms should document the following for each sample location:

- Sampling location;
- Sample identification;
- Parameters requested for analysis;
- Laboratory samples were shipped to;
- COC number for laboratory shipment;
- Field observations on sampling event;
- Name of sample collector(s);
- Climatic conditions, including air temperature;
- Description of the indoor air sampling location;
- Height of the passivated canister intake valve from the floor;
- Problems encountered and any deviations made from the established sampling protocol; and
- IA Sampling Record.

REFERENCES

1. United States Environmental Protection Agency, Soil Gas Sampling SOP# 2042, 1 June 1996, REV. #: 0.0
2. Compendium of Methods for the Determination of Organic Compounds in Ambient Air, EPA/625/R-96/010a, 2nd Edition, June 1999, EPA ORD, Washington DC.

APPENDIX A

DATA COLLECTION METHODS, PROCEDURES, AND ALALYSIS

Soil Gas Sampling Procedure	PROCEDURE # **36067-009-02**
	EFFECTIVE DATE: 29 September 2011
REVISION #: **1.0**	REVISION DATE: 29 September 2011

Soil gas samples will be collected adjacent to the exterior of the buildings (if buildings are present) to minimize disruption to the occupants. The soil gas sampling procedures are based on current best practice techniques and guidance provided in the following documents:

- 7 February 2005 Department of Toxic Substances Control (DTSC) document entitled "Interim Final Guidance for the Evaluation and Mitigation of Subsurface Vapor Intrusion to Indoor Air" (DTSC, 2005) and the associated response to public comments document dated 1 June 2008 (DTSC, 2008);
- 21-22 March 2007 EPA Workshop on Soil Gas Sample Collection and Analysis, San Diego, California; and
- March 2010 California Environmental Protection Agency document entitled "Advisory – Active Soil Gas Investigation" (ASGI 2010).

Sample Location, Density, and Analysis: Soil gas sampling locations will be proposed based on the initial evaluation of building-specific information presented in the Building/Property-Specific Vapor Intrusion Sampling and Analysis Work Plans (BSVIWP).

Soil gas samples adjacent to a small structure may be collected on all four sides of the building, or, at a minimum, on the two sides closest to the source area or higher groundwater concentration area. Sampling points will be located within 5 feet of the structure, if possible, and below hard standing (paved areas) where possible.

For soil gas samples adjacent to a large commercial facility, it may not be necessary or practical to collect samples on all four sides of the facility. As an alternative, sample points may be placed in a line (at least 3 sample points) parallel to the facility on the side closest to the source or higher groundwater concentration area.

At a minimum, collect the greater of one field duplicate sample per day or one field duplicate per 10 samples. Duplicate soil gas samples should be collected and analyzed using the same field collection procedures and analysis as for the primary samples. Most commonly, field duplicates are obtained by collecting two samples sequentially from the same sample point. Alternatively, two samples can be collected simultaneously using a T-connector. Tubing (line) blanks or other equipment blanks may also be useful for evaluating unexpected detections of chemicals of concern.

Trip blanks are samples transported to and from the site without opening the sample vessel. One trip blank per day or per sampling event is appropriate.

Soil gas samples will be collected in 6-liter Summa® canisters and analyzed by a NELAP-certified laboratory using EPA Method TO-15 for, at a minimum, the MEW chemicals of concern present in the property groundwater. Batch certification of passivated canisters is acceptable for soil gas sampling.

APPENDIX A

DATA COLLECTION METHODS, PROCEDURES, AND ALALYSIS

The sampling method should provide detection limits below the California Human Health Risk Screening Levels (CHHSLs) for soil gas. The samples will be analyzed with a standard turnaround time (10 business days) and the results will be reported electronically.

Temporary Soil Gas Probe Installation: Prior to any installation activities, all available sources of information regarding underground utilities should be reviewed and the selected sample locations cleared through the local one-call utility clearance service. The proposed sample locations should be adjusted as necessary to avoid potential subsurface structures and/or utilities and to minimize disturbance to sensitive landscape features. If applicable, sampling locations should be coordinated with any company- or building-specific Health & Safety (H&S) Coordinators.

If the proposed soil gas sampling location is beneath the sidewalk, the concrete will be cored with a 3-inch diameter diamond drill bit. Each boring will be advanced to a total depth of approximately 5.5 feet below ground surface (bgs) to install the soil gas sampling probe at a target depth of 5 feet bgs. Soil gas probes may be installed at a shallower, minimum depth of 3.0 feet bgs if site conditions (i.e., shallow groundwater table) prevent installing probes at the target depth.

Once the total desired depth of approximately 5.5 feet is reached, new, disposable, small-diameter (e.g., 1/8-inch or 1/4-inch outside diameter) Teflon® tubing, fitted with a filter at the bottom to prevent particulate infiltration, will be placed in the boring at approximately 5 feet bgs. Approximately 12 inches of filter pack sand will be placed in the bottom of the boring (from 4.5 to 5.5 feet bgs) and the bottom of the Teflon tubing placed midway through the filter pack sand. Once the sand pack is installed, the borehole will be grouted to the surface in approximately 6-inch lifts with hydrated bentonite; dry granular bentonite will be emplaced between the sand pack and the hydrated bentonite grout to prevent infiltration of the hydrated bentonite into the sand pack. A valve will be fitted to the aboveground end of the tubing and kept closed prior to purging and sampling. Following installation, a temporary cover will be placed over each soil gas probe for probe protection prior to sampling.

Soil gas probes installed by hand augeing will be allowed to equilibrate for a minimum of 48 hours prior to purging and sampling. Soil gas probes installed using a direct-push drill rig will be allowed to equilibrate for a minimum of 30 minutes prior to purging and sampling (ASGI, 2010). If a rain event producing >0.2 inches of rain occurs, sampling will not be conducted for a minimum of five days after the event. Soil gas probes installed near irrigation lines will not be sampled until after the irrigations system has been turned off for a minimum of five days.

Shut-in Test Procedures: The aboveground sampling train will be leak-checked by a shut-in test. The shut-in test steps are listed below; an example setup is shown on Figure 1 below.

1. Valves 1 and 2 are closed; Valve 3 is open to pump.
2. Turn on pump and achieve vacuum of up to 100 inches H2O.
3. Close Valve 3 and monitor vacuum for approximately 60 seconds.
4. The vacuum should not dissipate; if it does, tighten all fittings between Valves 1 and 3 (including passivated canister and flow controller fittings).
5. Repeat steps 2 through 4 until vacuum is stable for approximately 60 seconds.

6. All readings will be recorded.

Once the shut-in test and the purge test are complete, the soil gas samples will be collected into a 6 liter Summa® canister with a flow controller capable of maintaining a flow of approximately 150 to 200 milliliters per minute (mL/minute).

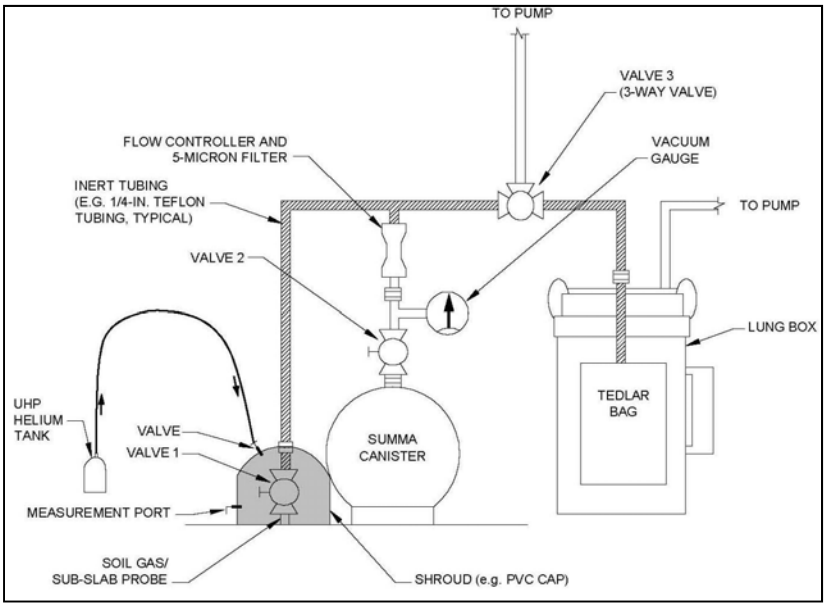


Figure 1: Soil Vapor Sampling Train

Probe Purging, Leak Checking and Sampling Procedures: Each probe will be leak-checked using helium as a tracer compound and purged prior to sample collection. A shroud will be placed to encompass the sampling probe and helium will be introduced into the shroud. The helium concentration will be monitored using a handheld helium detector and the readings will be recorded.

The following procedures will be followed:

- Place a small shroud over the soil gas probe.
- Visually confirm that the shroud is sufficiently sealed to the ground surface.
- Introduce helium around the sample probe by filling the shroud. Helium should be injected into the shroud at a very low pressure; less than 1 pound per square inch. The shroud will have tubing at the top of the chamber to introduce the tracer gas into the shroud and a valve fitting at the bottom to let ambient air out while introducing the tracer gas. The helium concentration within the shroud will be monitored with a handheld field helium detector and maintained at a concentration of 1 percent to 10 percent by volume.
- The shroud will have a gas-tight fitting or sealable penetration to allow soil gas sample probe tubing to pass through and exit the chamber. Attach the sample probe tube exiting the shroud to a pump that will sample soil gas at a vacuum no more than 100 inches of water.
- Purge and leak-check the probe by collecting samples in a 1-liter Tedlar bag prior to collecting the sample in the passivated canister. After one purge volume (internal volume of tubing plus

the annular pore space around probe tip) is collected from the probe, each subsequent purge volume (at least 2) will be collected in a Tedlar bag and screened with the helium detector; all measurements will be recorded. The purge vacuum will not exceed 100 inches of water.

- If the concentration of helium is greater than 10 percent of the concentration measured in the shroud, the probe should be re-sealed. The tracer test will be performed again, and sample collection will proceed when the tracer concentration is less than 10 percent.
- After two consistent readings confirming that the probe is leak-free (less than 10 percent of the helium concentration introduced into the shroud is measured in the Tedlar bag sample), the soil gas probe will be considered properly purged and leak-free.
- Verify start vacuum in the passivated canister to be between -31 and -25 inches Hg; all measurements will be recorded. If the vacuum is low, replace the passivated canister.
- Following sample collection, verify that the passivated canister vacuum is between 10 and 0 inches Hg. An additional soil gas sample will be collected in a Tedlar bag and monitored for helium. If both the pre- and post-sampling Tedlar bag samples contain helium at a concentration less than 10 percent of the shroud concentration, then the sample will have passed the leak test. If not, additional corrective measures will be taken in the field (e.g., re-sealing probe) and the test will be repeated. If the 10 percent criteria cannot be met at a given probe, that location and depth will be eliminated from the sampling program.

All equipment reused during sampling must be properly decontaminated and recalibrated between sampling points, if appropriate. Tubing will not be reused; new tubing will be provided for each sampling point. Tubing and equipment will be stored in sealed bags or containers to avoid contamination prior to use.

Probe Abandonment: Soil gas probes will be abandoned once the data has been validated. Soil gas probes will be abandoned by pulling the probe up through the bentonite seal. Once removed, the bentonite seal will be tamped down to fill any voids in the soil left by the probe. Surface conditions will be restored to original conditions.

APPENDIX A

DATA COLLECTION METHODS, PROCEDURES, AND ALALYSIS

Sub-Slab Soil Vapor Sampling Procedure	PROCEDURE # **36067-009-03**
	EFFECTIVE DATE: 29 September 2011
REVISION #: **1.0**	REVISION DATE: 29 September 2011

Building conditions or access constraints may prevent collection of sub-slab samples. As a first step, explain the procedure to the owner/tenant, including schedule, location, and procedures for drilling and abandoning the sampling location. Avoid collecting sub-slab samples in buildings where vapor barriers or other sub-slab vapor mitigation systems were installed to ensure the integrity of the system.

Sample Location, Density, and Analysis: Within a building, sub-slab soil vapor samples should be collected away from foundation footings. To minimize the disturbance to the building, it is best to locate samples in unfinished portions of basements, within closets, utility corridors, or in other unobtrusive areas. When necessary, sub-slab sampling locations will be proposed based on building-specific information and evaluations presented in the BSVIWP.

It is best to collect sub-slab soil vapor and indoor air samples concurrently to ensure consistent sampling conditions. If high concentrations are expected in a sub-slab sample, installing a sub-slab sample (drilling a hole in the slab) could impact indoor air sampling results. In this case, the sub-slab sampling point should be installed and the area given adequate time to ventilate and return to normal conditions prior to concurrent indoor air and sub-slab sampling.

At a minimum, collect the greater of one field duplicate sample per day or one field duplicate per 10 samples. Duplicate sub-slab samples should be collected and analyzed using the same field collection procedures and analysis as for the primary samples. Field duplicates are most commonly obtained by collecting two samples sequentially from the same sample point though two samples can be collected simultaneously using a T-connector as an alternative. Tubing (line) blanks or other equipment blanks may also be useful for evaluating unexpected detections of chemicals of concern.

Trip blanks are samples transported to and from the site without opening the sample vessel. One trip blank per day or per sampling event is appropriate.

The samples will be analyzed with a standard turnaround time (10 business days) and the results will be reported electronically.

Sub-Slab Sample Collection: Sub-slab vapor samples are collected from the engineered fill or native soil directly under the foundation slab in order to characterize the nature and extent of soil vapor contamination. Sub-slab soil vapor is the gas immediately beneath the floor of the occupied structure, regardless of whether the structure is a slab-on-grade or basement design. Sub-slab soil vapor data may not be relevant for buildings with suspended floors and crawlspaces.

This procedure outlines the general steps to install sub-slab probes and collect sub-slab soil vapor samples. Temporary sub-slab soil vapor probes will be installed using the procedures outlined below. Sub-slab soil vapor probes will be installed using a hand-held rotary drill.

APPENDIX A

DATA COLLECTION METHODS, PROCEDURES, AND ALALYSIS

Field Conditions Documentation:

- Document pertinent field conditions prior to installing any probe locations.
- Record weather information (precipitation, temperature, barometric pressure, relative humidity, wind speed, and wind direction) at the beginning of the sampling event. Record substantial changes to these conditions that occur during the sampling. The information may be measured with on-site equipment or obtained from a reliable source of local measurements (e.g., a local airport). Data should be obtained for the past 24 to 48 hours. Record the indoor conditions as well (temperature, heating/cooling system active, windows open/closed, etc.).
- Conduct a building inventory and survey for possible sources of background contributions.
- Draw indoor floor plan sketches that include the floor layout and sampling locations, chemical storage areas, garages, doorways, stairways, basement sumps or subsurface drains and utility perforation locations through building foundations, HVAC system air supply and return registers, compass orientation (true north), footings that create separate foundation sections, and any other pertinent information . Preferential pathways must be noted.
- Outdoor plot sketches should be drawn that include the building site, area streets, outdoor air sampling locations (if applicable), compass orientation (true north), and paved areas.
- All pertinent observations should be recorded, such as odors and field instrumentation readings.

Sub-Slab Soil Vapor Point Installation Specifications: Temporary sub-slab soil vapor points will be constructed as follows:

- Drill an approximately 3/8-inch hole through the slab; advance the drill bit 2 to 3 inches into the sub-slab material to create an open cavity.
- Using dedicated inert tubing (e.g. Teflon®), insert the inlet of the tubing to the specified depth below the slab.
- Seal the annular space between the hole and the tubing using an inert non-shrinking sealant such as melted 100 percent beeswax, permagum grout, putty, etc. (the sealant must be free of volatile organic compounds (VOCs).
- For permanent points, a protective casing will be set around the top of the point tubing and grouted in place to minimize the infiltration of water or ambient air and to prevent accidental damage to the permanent point.
- The tubing top will be fitted with a valve such as a Swagelok® or equivalent and capped to prevent moisture and foreign material from infiltrating the tubing.

Shut-in Test Procedures: The aboveground sampling train will be leak-checked by a shut-in test. The shut-in test steps are listed below and an example set-up is shown on Figure 1 below.

1. Valves 1 and 2 are closed; Valve 3 is opened to pump;
2. Turn on pump and achieve vacuum of up to 100 inches H2O;
3. Close Valve 3 and monitor vacuum for approximately 60 seconds;

4. The vacuum should not dissipate; if it does, tighten all fittings between Valves 1 and 3 (including passivated canister and flow controller fittings);
5. Repeat steps 2 through 4 until vacuum is stable for approximately 60 seconds; and
6. All readings will be recorded.

Following completion of the shut-in and the purge tests, the soil gas samples will be collected into a 6 liter Summa® canister with a flow controller, capable of maintaining a flow of approximately 150 to 200 mL/minute.

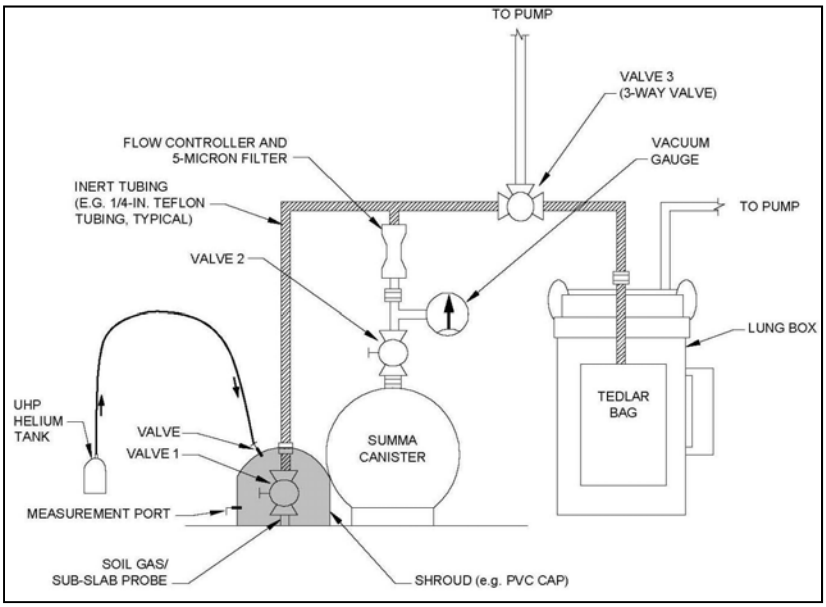


Figure 1: Soil Vapor Sampling Train

Leak Testing/Field Screening: The following tracer gas evaluation procedure uses helium as a tracer gas and will be measured by a handheld detector in the field.

- Introduce the tracer gas around the sample probe and passivated canister by filling an airtight shroud (such as a plastic bucket) positioned over the sample location.
- Make sure the shroud is suitably sealed to the ground surface.
- Introduce the tracer gas into the shroud. The shroud will have tubing at the top of the chamber to introduce the tracer gas and a valve fitting at the bottom to let the ambient air out. Close the valve after the shroud has been enriched with tracer gas. Record the actual concentration of the tracer gas measured with the handheld helium detector.
- The shroud will have a gas-tight fitting or sealable penetration to allow the soil vapor sample probe tubing to pass through and exit the chamber.
- Attach the sample probe tubing exiting the shroud to a pre-calibrated pump to extract soil vapor at a rate of no more than 0.2 liters per minute. Purge three tubing/probe volumes into a Tedlar bag and screen the Tedlar bag with a photoionization detector (PID).

- Prior to collecting the sample in the passivated canister, collect a sample in a 1-liter Tedlar bag. Analyze this Tedlar bag sample with the handheld detector for the tracer gas and with the helium detector and record the detected concentrations. If the concentration of the tracer is >10 percent of the concentration measured from the shroud, the probe should be re-sealed. The tracer test will be performed again, and sample collection will proceed when the tracer concentration is <10 percent.

Sample Collection:

- Samples will be collected in a laboratory-certified clean 1-liter passivated canister (or equivalent) using a certified flow controller calibrated to <200 mL/minute.
- Remove the protective brass plug from the passivated canister. Connect the pre-calibrated flow controller to the passivated canister.
- Record the identification numbers for the passivated canister and flow controller.
- Record the initial passivated canister vacuum from the vacuum gauge. A passivated canister with a significantly different pressure than originally recorded by the testing laboratory should not be used for sampling.
- Connect the tubing from the sub-slab soil vapor probe to the flow controller.
- Open the valve on the passivated canister. Record the time that the valve was opened.
- Stop sample collection when the passivated canister still has a minimum amount of vacuum remaining. Check with the laboratory supplying the passivated canister and flow controller for the ideal final minimum vacuum pressure. The minimum vacuum is typically between 2 and 5 inches of Hg. Record the final vacuum and close the passivated canister valve. Record the date and time the sample collection was stopped.
- Remove the flow controller from the passivated canister and replace the protective brass plug.
- Place the passivated canister and other laboratory-supplied equipment in the packaging provided by the laboratory.
- Enter the information required for each sample on the COC form; make sure to include the identification numbers for the passivated canister and flow controller, and the initial and final passivated canister pressures on the vacuum gauge.
- Samples will be analyzed for VOCs using EPA Method TO-15.
- Include the required copies of the COC form in the shipping packaging, as directed by the laboratory. Maintain a copy of the COC form for the project file.

APPENDIX A

DATA COLLECTION METHODS, PROCEDURES, AND ALALYSIS

Radon Sampling Procedure	PROCEDURE # **36067-009-04**
	EFFECTIVE DATE: 29 September 2011
REVISION #: **1.0**	REVISION DATE: 29 September 2011

Radon occurs naturally in soil and can serve as a tracer of soil gas migration into the building. When recommended, a sample will be collected with a disposable syringe and placed into a 0.5-liter Tedlar bag. Refer to procedures 36067-009-01/02/03 for air, soil gas, and sub-slab sampling methodologies.

Approximately 250 cubic centimeters of sample will be collected at the sampling location by gradually drawing back the plunger on the syringe. The syringe will be connected to the Tedlar bag and the air sample will be inserted. After sample collection, the sampler will squeeze the Tedlar bag slightly to check for leaks.

The samples collected for radon will be analyzed at the University of Southern California under the oversight of Dr. Douglas Hammond. The radon concentration will be analyzed using alpha scintillation in Lucas cells, which has a precision of approximately ± 5 percent at a detection limit of 0.14 pico Curies per liter.

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INDOOR AIR SAMPLING RECORD

Page of

PROJECT _____ H&A FILE NO. _____

LOCATION _____ PROJECT MGR. _____

CLIENT _____ FIELD REP _____

LABORATORY _____ DATE _____

SAMPLING MEDIA _____ FLOW CONTROLLER _____

PROPERTY OWNER AND/OR TENANT CONTACT

Name _____

Phone No. _____

PROPERTY OWNER AND/OR TENANT'S HVAC SPECIALIST CONTACT

Name _____

Phone No. _____

SECURITY CONTACT

Name _____

Phone No.

AFTER-HOURS ACCESS CONTACT

Name _____

Phone No.

HVAC ASSESSMENT DATE

NORMAL OPERATION SAMPLING

24-Hr Sample Deploy Date _____ Date HVAC Operation Confirm _____

24-Hr Sample Location _____ 10-Hr Sample Deploy Date _____

Site Observations During Sampling 10-Hr Sample Location _____

- ☐ Cleaning crews
- ☐ Chemical spills
- ☐ Door locked
- ☐ Door propped open
- ☐ Window propped open

Other: _____

ppbRAE Reading Collected? (If Y, please see attached form.) ☐ Yes ☐ No

AFTER-HOURS SAMPLING

Date HVAC Operation Confirmed _____ Time HVAC Operation Confirmed _____

Date HVAC Operation Confirmed _____ Time HVAC Operation Confirmed _____

24-Hr Sample Deploy Date _____ 10-Hr Sample Deploy Date _____

24-Hr Sample Location _____ 10-Hr Sample Location _____

Site Observations During Sampling

- ☐ Cleaning crews
- ☐ Chemical spills
- ☐ Door locked
- ☐ Exterior door propped open
- ☐ Window propped open
- ☐ HVAC unit operating

Other: _____

ppbRAE Reading Collected? (If Y, please see attached form.) Yes No

Weather _____ Temperature Max: Min: Mean:

Link to NOAA website

Sample ID	Sample Location	Intake Height	Canister ID	Flow Controller ID	Start Time	Check Time	End Time	Initial Pressure	Check Pressure	Final Pressure

Comments

SOIL VAPOR PROBE MEASUREMENTS

HALEY & ALDRICH

Project:_____ Project Number:_____ Probe No._____ Sub-slab probe Soil vapor probe

Site Location:_____ PID Model and S/N: _____ Lamp: 10.6 11.7 eV

Date:_____ Weather: _____ Landfill Gas Meter Model and S/N: _____

Site Personnel:_____ Helium Detector Model and S/N: _____

Surface Type: __ Concrete __ Grass __ Other (specify) _____

Surface Thickness (in inches): _____ (or) ___ Unknown
(if asphalt or concrete)

Calculated Casing Volume (one volume):

_____ Subslab <0.1 L Soil Vapor Probe_____ (L)

Purge Measurements

Pre- or Post-Sample?	Vac. Pressure (in. Hg)	Purge Volume (L)	Cumulative Volume (L)	Landfill Gas Meter (%)			PID
				CH_4	CO_2	O_2	VOCs

Tracer Gas Measurements (Helium)

Shroud (%)		Purge Sample Concentration
Min	Max	

Helium concentration in field-screened samples is less than 10% of minimum concentration in the shroud? Yes No

Shut-in test completed prior to purging and sampling? Yes No

Sample Collection

Start Time	End Time	Canister ID	Flow Controller #	Initial Vacuum (in. Hg)	Final Vacuum (in. Hg)	Sample ID

Comments:

TestAmerica Los Angeles
3585 Cadillac Ave., Suite A
Costa Mesa, CA 92626
Phone 714-258-8610 Fax 714-258-0921

Canister Samples Chain of Custody Record

TestAmerica Laboratories, Inc. assumes no liability with respect to the collection and shipment of these samples.

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Client Contact Information	Project Manager:		____ of ____ COCs
Company:	Phone:	Samples Collected By:	
Address:	Email:		
City/State/Zip			
Phone:	Site Contact:		
FAX:	LAB Contact:		
Project Name:	Analysis Turnaround Time		
Site:	Standard (Specify)_____		
PO #	Rush (Specify)_____		

Sample Identification	Sample Date(s)	Time Start	Time Stop	Canister Vacuum in Field, "Hg (Start)	Canister Vacuum in Field, "Hg (Stop)	Flow Controller ID	Canister ID	TO-15	TO-14A	TO-3	EPA 3C	EPA 25C	ASTM D-1946	Other (Please specify in notes section)	*Sample Type*	Indoor Air	Ambient Air	Soil Gas	Landfill Gas	Other (Please specify in notes section)

Temperature (Fahrenheit)			
	Interior	Ambient	
Start			
Stop			

Pressure (inches of Hg)			
	Interior	Ambient	
Start			
Stop			

Special Instructions/QC Requirements & Comments:

Samples Shipped by:	Date/Time:	Samples Received by:
Samples Relinquished by:	Date/Time:	Received by:
Relinquished by:	Date/Time:	Received by:

Lab Use Only **Shipper Name:** **Opened by:** **Condition:**

APPENDIX B

Quality Assurance/Quality Control

APPENDIX B

QUALITY ASSURANCE/QUALITY CONTROL

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QUALITY ASSURANCE/QUALITY CONTROL

LIST OF ACRONYMS AND ABBREVIATIONS

%D	percent difference
%R	percent recovery
CCV	continuing calibration verification
COC	chain of custody
DQO	data quality objective
EPA	United States Environmental Protection Agency
LCS	laboratory control sample
MEW	Middlefield-Ellis-Whisman
NELAP	National Environmental Laboratory Accreditation Program
PARCCS	precision, accuracy, representativeness, completeness, comparability, and sensitivity
QA	quality assurance
QC	quality control
RF	response factor
RPD	relative percent difference
SDG	Sample Delivery Group
SIM	selective ion mode

APPENDIX B

QUALITY ASSURANCE/QUALITY CONTROL

1. INTRODUCTION AND PURPOSE

This appendix describes project quality assurance and quality control (QA/QC) objectives as well as data management, verification, and validation procedures. These QA/QC procedures provide standardized requirements for environmental laboratory data verification and validation of indoor air, outdoor air, sub-slab vapor, and soil gas samples to be collected within the Vapor Intrusion Study Area of the Middlefield-Ellis-Whisman (MEW) and Moffett Field Superfund Study Area (VI Study Area). These QA/QC procedures are also intended to ensure that all analytical data meet suitable measurement performance criteria identified as precision, accuracy, representativeness, completeness, comparability, and sensitivity (PARCCS). Evaluation of the PARCCS criteria will be used for decision making and reporting purposes.

APPENDIX B

QUALITY ASSURANCE/QUALITY CONTROL

2. DATA QUALITY

The quality of data is dependent on the sampling rationale and procedures used to collect the samples, as well as the methods used to analyze the samples. Additional information regarding sampling and analytical methods is provided in Appendix A of the Work Plan. This section describes the procedures and methods to be used to determine the quality and usability of the data collected during indoor air, outdoor air, sub-slab vapor, and soil gas sampling at the VI Study Area.

Data assessment is typically discussed in two primary categories: data verification and data validation. Data verification evaluates the completeness, correctness, and conformance/compliance of a specific data set against the method, procedural, or contractual requirements. Data validation is an analyte- and sample-specific process that extends the data evaluation beyond method, procedural, or contractual compliance (i.e., data verification) to determine the analytical quality of a specific data set.

The tiers of validation that will be used for data collected from the VI Study Area are modeled on the United States Environmental Protection Agency (EPA) Region 9 Draft Superfund Data Evaluation/Validation Guidance R9QA/006.1 as presented in Table B-I and discussed in Section 2.3. The person conducting the validation will also perform the tiered data evaluation in accordance with the requirements outlined in the EPA Contract Laboratory Program National Functional Guidelines for Organic and Inorganic Data Review, EPA 540/R-99/008 and EPA 540/R-01/008.

2.1. Methodology

Air samples shall be analyzed for the chemicals of interest by a laboratory certified under the National Environmental Laboratory Accreditation Program (NELAP) using the laboratory reporting limits provided in Table B-II. Available methods and limitations for indoor air sampling, including their applicability at the VI Study Area, were evaluated and presented in the Indoor Air Sampling and Analysis Work Plan for Existing, Unsampled Commercial Buildings at the MEW Study Area approved by EPA in July 2011. Refer to the aforementioned work plan for methods, procedures, and analysis to be used for additional indoor air data collection efforts.

Appendix A provides sampling procedures for indoor air, outdoor air, sub-slab vapor, and soil gas sampling and includes method-specific information regarding sampling technique, handling, and quality control (QC).

2.2. Quality Control Criteria

The PARCCS criteria assess whether the quality of data collected satisfy the data quality objectives (DQOs). Acceptable criteria limits are established based on data characteristics such as sample matrix or analyte and the generated data are then evaluated against these limits to determine data usability. Analytical QC is assessed by verifying the PARCC parameters defined below.

2.2.1 Precision

Precision measures the agreement between repeat measurements or observations made under

the same conditions, such as the reproducibility of a set of duplicate results.

Field Precision: Field precision will be assessed by collecting and analyzing one field duplicate per ten field samples. Using field duplicate results, the precision measurement is determined using the relative percent difference (RPD) between results. RPD is calculated as follows:

$$RPD\ (\%) = \frac{|D_1 - D_2|}{\frac{1}{2} * (D_1 + D_2)} * 100$$

Where: D_1 is the analyte concentration in the primary sample
D_2 is the analyte concentration in the duplicate sample

For field duplicates, both sample and duplicate results will be considered "estimated" for any analyte which exceeds a 30% RPD.

Laboratory Precision: Laboratory precision will be assessed through the analysis of:

- Field duplicate sample pairs;
- Mass spectral tuning;
- Initial calibration verification standards;
- Continuing calibration verification standards (CCVs); and
- Laboratory control samples (LCS).

Precision acceptance criteria for each chemical of interest are specified in Table B-III.

2.2.2 Accuracy

Accuracy measures the overall agreement of a result or the mean of a set of results to the true or accepted value. The accuracy of a measurement system is affected by factors such as the sampling process, field contamination, preservation, handling, sample matrix, sample preparation, and analytical techniques.

Accuracy will be evaluated from the analysis of spiked samples, reference standards by calculating percent recovery (%R), and the analysis of calibration verification standards by calculating percent difference (%D) with the following equations:

$$\%R = \frac{|X_s - X_u|}{K} * 100$$

Where: X_s is the measured value of the spiked sample
X_u measured value of the unspiked sample
K is the known amount of the spike in the sample

$$\%D = \frac{|RF_1 - RF_c|}{RF_1} * 100$$

Where: RF_1 is the average response factor (RF) from the initial calibration
RF_c is the average RF from the calibration verification standard.

There are acceptable accuracy limits for each different analyte and method as provided in Table B-III.

Field Accuracy: A qualitative bias assessment of field data will be conducted by reviewing instrument calibration, sample collection, preservation, handling, and shipping procedures for compliance with the specifications presented herein.

2.2.3 Representativeness

Representativeness reflects the extent to which data accurately and precisely represents a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Representativeness is qualitative and predominantly concerned with proper sampling program design.

Field Data: Representativeness of field data depends on the proper design of the data collection procedures. Representativeness of the field data will be evaluated by assessing whether the sampling procedures defined herein were followed during sample collection. In addition, the RPD of analytical results from field duplicate sample pairs will be used to evaluate the representativeness of the field sampling procedures.

Laboratory Data: Representativeness of laboratory data will be evaluated for by assessing the following:

- Compliance with specified analytical criteria herein and the respective laboratory standard operating procedures;
- Compliance with sample preservation and holding time criteria;
- Field duplicate sample results; and
- Method reporting limits.

2.2.4 Completeness

Completeness measures the amount of valid data collected during a project phase and is usually expressed as a percentage. The completeness goal is to generate enough valid data to meet project needs. The completeness of a data set is calculated by dividing the number of valid results by the number of possible individual analyte results. The completeness requirement for this project is 85% and is calculated as follows:

$$\% \text{ Completeness} = \frac{\text{number of valid results}}{\text{total number of possible results}} * 100$$

Where: The number of valid results is the total number of samples collected or analytical measurements considered usable (not rejected ["R" flagged])

The number of possible results is the total number of samples scheduled for collection or the total number of analytical measurements generated.

2.2.5 Comparability

Comparability is a qualitative term that expresses the measure of confidence that one data set can be compared to and potentially combined with another data set for decision-making purposes. Comparability is achieved by using standard sampling and analysis methods (including sample collection, transport, and analytical procedures; see Appendix A) and reporting data in appropriate units.

Field Data: Field data comparability depends on the use of similar sampling and analytical methodology and standard units of measure for similar tasks at a site. Field data will be collected using standard sampling and measurement procedures and recorded in the field logbook and on applicable field forms (i.e., sample collection records and chain of custody forms). Field data comparability will be evaluated by reviewing the field documentation to determine whether the field data collection procedures and sample collection, handling, and shipping protocols were followed.

Laboratory Data: Laboratory data comparability depends on the use of similar sampling and analytical methodology and standard units of measure for similar tasks at a specific site. Laboratory data will be collected using EPA-approved standard sampling and analysis procedures at laboratories certified by a NELAP or equally accredited organizations. Laboratory data comparability will also be assessed by comparing investigative sample data to QA or QC sample data.

2.2.6 Sensitivity

Sensitivity is the ability of the method to detect the chemical of concern at the action level of interest. A review of LCS data, method blanks, calibration data, low level standard level, and other information may be used to evaluate sensitivity.

2.3. Tiered Approach for Data Verification and Validation

The key elements of the tiered data validation and verification approach include:

- Each tier requires more stringent review of the data;
- The percentages of the analytical data and methods/analytes subject to verification and validation vary based on the type of work being performed; and
- The tier of validation performed varies based upon the nature and sensitivity of the work being performed.

2.3.1. Tier I Evaluation

The goal of a Tier I evaluation is to quickly provide a brief summary of key analytical issues/deficiencies that might affect data quality and user decisions based on the data. Tier I data review that includes verification of the PARCCS parameters, including an evaluation of accuracy and precision indicators such as holding times, reporting limits, LCS recoveries, matrix spike/matrix spike duplicate and lab duplicate results, surrogate recoveries, and method and field QC blank contamination. Possible applications include recurrent monitoring activities, emergency or time-critical situations, and “non-critical” assessment activities.

2.3.2. Tier II Evaluation

Tier II evaluation is an intermediate level of data evaluation that includes the elements of Tier I plus a more detailed review of summarized calibration and instrument performance criteria, as well as the option to focus validation review on specific analytes of interest or task-specific DQOs. Tier II evaluation can be performed by the same methods as Tier I plus the associated calibration summaries, lab bench sequence logs, and instrument performance summaries such as gas chromatography-mass spectroscopy tuning, interference checks, and internal standards.

2.3.3. Tier III Evaluation

Tier III is the most stringent level of data evaluation and includes all the elements of Tier II plus a review of the laboratory instrument raw data used to calculate and report the analysis results. Tier III evaluation can be performed by the same methods as Tier II plus the laboratory raw instrument data for each sample delivery group (SDG).

2.3.4. Proposed Validation Tiers

For the work performed under this Tiering Work Plan, it is anticipated that validation will be conducted as shown in the following table and that Tier III validation will not be required for this project. However, if necessary, Tier III validation will be performed on a subset of the data. The laboratory will be notified that Tier III level data packages must be available, if needed, to resolve discrepancies in the data set.

	% of All Laboratory Data to be Validated [(1)]	% of Selected Data to be Validated Subject to Tier I Evaluation [(2)]	% of Selected Data to be Validated Subject to Tier II Evaluation [(2)]	% of Selected Data to be Validated Subject to Tier III Evaluation [(2)]
Air Sampling at MEW Study Site	25%	80%	20%	0%

(1) This % represents the portion of laboratory data collected in a task that will be subject to validation; data to be selected at random from the laboratory data set for validation.

(2) These are the percentages of the subset of data selected for validation (i.e., if 100 samples are collected in a sampling event, 25 samples will be collected for overall validation. Of those 25 samples, 20 will be subject to Tier 1 evaluation and 5 will be subject to Tier 2 evaluation. The subset of data will be randomly divided into the 80/20 split for Tier I and Tier II evaluation.

APPENDIX B

QUALITY ASSURANCE/QUALITY CONTROL

3. FIELD QC PROCEDURES

Field QC procedures will be used to assure that sampling results achieve the DQOs presented in the Tiering Work Plan.

3.1. Sample Methodology Field QC

As discussed in Section 2.2.1, field duplicates will be collected at a rate of one per ten field samples. The field duplicates will be 'blind' to the laboratory, meaning they will be numbered similar to the other samples so the laboratory cannot differentiate between the field samples and the duplicate samples. The sampling schedule will be reviewed by the project manager to determine when field duplicates are to be collected to achieve the rate of one per ten field samples.

3.2. Sample Custody and Documentation

This section discusses QC that can be maintained in the collection and transport of samples to the laboratory. The ability to trace samples from the time they are collected to receipt of final data is essential to the sampling program.

Field Sample Custody and Documentation: Samples will be labeled in the field to ensure proper location identification and all information relevant to field sampling will be documented on field logs and on COC forms. Samples will be stored and shipped at ambient temperature to the laboratory via common courier with accompanied COC forms. Precautions will be taken to avoid sample interference, such as fueling vehicles prior to sampling or using of pens or markers that may contain solvents to label the samples.

Laboratory Sample Custody and Documentation: All samples will be shipped to the laboratory via UPS, Federal Express, or by courier for next day arrival. Samples will be delivered to the laboratory person authorized to receive samples who will inspect and note the condition of the canisters and enter the samples into laboratory record for analysis. If there are any discrepancies between the received samples and the COC forms, the sender will be immediately notified.

Custody Documentation Corrections: As with corrections made in the field, any changes made to the COC form will be made by striking the item and initialing and dating the correction in ink.

APPENDIX B

QUALITY ASSURANCE/QUALITY CONTROL

4. ANALYTICAL QC PROCEDURES

This section describes analytical QC procedures, including laboratory qualification, QC procedures and samples and calibration.

4.1. Laboratory Qualification and QC Procedures

The analytical laboratory selected to analyze samples will be NELAP-certified and able to provide necessary turnaround times and data deliverables. The laboratory will have written operating procedures defining the instrumentation, maintenance, calibration, method detection limits, QC analysis, acceptance criteria, etc., for the analytical methods used. The procedures must be available to the laboratory chemists performing the work and meet or exceed the requirements of the method to be used for analysis (e.g., TO-15). The laboratory must maintain records of all activities that have an impact on the quality of the results.

The laboratory must maintain instrumentation required for analysis; any method substitution due to instrument failure will not be permitted without prior approval.

4.2. Laboratory Calibration and QC Samples

The laboratory will calibrate all instruments and equipment in accordance with the method specifications. Calibrations are conducted when the method is initially set up and whenever the calibrations fail to meet the acceptance criteria. If instrumentation undergoes significant repairs or maintenance, a valid initial calibration will be conducted.

As noted in Section 2, any QC samples collected or prepared will include field duplicates, method blanks, and LCSs.

4.3. Field Calibration

All field instruments must be calibrated daily according to manufacturer instructions. Calibrated equipment will be identified and dated; calibration and maintenance information will be documented on field logs.

If equipment malfunction is suspected, the instrument will be removed from the field and tagged for recalibration, and a substitute instrument will be used in its place. Equipment that fails calibration will also be removed from the field and recalibrated.

APPENDIX B

QUALITY ASSURANCE/QUALITY CONTROL

5. DATA QUALITY MANAGEMENT

5.1. Data Review and Validation

The laboratory will conduct the initial review and data validation. As part of the review process, if necessary, data are flagged with qualifiers, which may include the following:

- J = Estimated result;
- U = Compound analyzed for, but not detected at or above the reporting limit;
- UJ = Non-detected compound associated with low bias in the CCV;
- Q = Exceeds QC limits;
- E = Exceeds instrument calibration range;
- B = Compound present in laboratory blank greater than reporting limit (background subtraction not performed); and
- R = Data not usable because the presence or absence of the analyte could not be determined.

Data validation will be performed according to Section 2.3. The data validation process involves the evaluation and calculation of the PARCCS parameters as described in Section 2. Criteria used to verify data integrity include ensuring that:

- The correct sampling procedures (Appendix A) were followed;
- The COC form was properly completed;
- Samples are analyzed before the holding time limit expired;
- Calculations and units are performed and reported correctly;
- Results obtained are within the working calibration range of instrument used; and
- QC results meet the acceptance criteria.

If outlying data are found, the differences will be investigated. For the initial phase of sampling, outlying data are defined as any results falling out of the acceptance criteria (Table B-III). If a credible rationale for the differences cannot be found, it may be beneficial to collect a second sample at the location to confirm or deny the anomalous data.

5.2. Data Deliverables and Management

The laboratory will provide the appropriate deliverables as identified in Table B-I for reporting, verification, and validation. Laboratory data deliverables will include a non-conformance narrative. The narrative will include a description of any and all sample handling and analytical anomalies and method performance issues. The laboratory must maintain all relevant raw data and documentation for at least two years. The laboratory will provide notification prior to the disposal of any relevant records. Copies of all COC forms and laboratory reports will be maintained, in accordance with applicable Consent Decree and 106 Order requirements.

APPENDIX B

QUALITY ASSURANCE/QUALITY CONTROL

6. QA OVERSIGHT

QA oversight will include system audits of field activities and laboratory procedures.

6.1. System and Performance Audits

System audits involve the inspection of equipment for sampling and data gathering, and are usually conducted early in the initial stages of a field activity. Performance audits include an inspection of field and laboratory activities to verify that standard procedures were followed and conform to the necessary specifications to provide accurate data generation. Performance audits are typically completed at the onset of the sampling program and at the same time as field audits to verify procedures are understood and implemented over the course of the program as intended by the Work Plan. It is anticipated that a minimum of one system and performance audit would be conducted.

The EPA may perform field or laboratory audits, submit performance evaluations or split samples for analysis, perform data validation, and/or perform other QA oversight activities.

6.1.1. Field and Performance Audits

Field audits may include an evaluation of sample collection and identification, observations of COC procedures, field documentation and measurements, and instrument calibrations. Field documents and COC forms will be reviewed to ensure that they are signed and dated, and that all entries are legible and in ink. Samples may be randomly checked for proper labeling.

Performance audits may be completed to ensure that work is completed in a controlled manner and that data quality requirements are met.

6.1.2. Laboratory Audits

The laboratories selected for analysis will have their own system of routine performance and system audits. As such, laboratory audits are not planned unless deemed necessary as a result of data quality concerns.

6.2. Corrective Actions

During field and performance audits, deviations or discrepancies identified for field techniques or sampling protocol should be discussed, corrected, and/or adjusted at the time of the audit. The contractor performing the audit will document the deviations or discrepancies, the related discussions with field team members, and what corrections or adjustments were made to rectify the problem. If corrections could not be made, documentation will include an explanation of why this was so and whether the issued identified has any potential to qualitatively or quantitatively affect the data being collected.

Each laboratory will have a corrective action program to address any unacceptable data or conditions. After completing analyses, the laboratory will verify compliance with the laboratory QA/QC plan. If

any parameters are outside of the control limits, corrective actions will be implemented. An initial corrective action is to verify that calculation errors have not occurred. If appropriate and holding time permits, reanalysis will be performed. If it is confirmed that the parameters are outside of the control limits, the corrective action process will be initiated. Corrective actions may include:

- Verification of dilution factors;
- Verification of sample preparation and instrument performance;
- Verification of procedure by monitoring method performance; if necessary, amending sampling and analytical procedures; and
- Re-sampling and analysis.

The laboratory will maintain records of corrective action reports and submit them with the hard copies of the laboratory reports.

7. REPORTING

Upon completion of data verification and validation, the data validator will prepare a brief Data Validation Report. The report will include, at a minimum, the following: project information; laboratory data validated (SDG number and/or lab batch number); evaluation tier utilized; description of qualifiers assigned to any data set; discrepancies or deviations from acceptable QC criteria; and a narrative assessment of the data usability.

Brief memorandums will also be prepared to document deviations or issues identified during data and/or field verification checks, results of system and performance audits, and corrective actions planned/implemented.

TABLE B-I
LABORATORY DATA VERIFICATION AND VALIDATION REQUIREMENTS
WORK PLAN FOR TIERING OF BUILDINGS WITHIN THE VAPOR INTRUSION STUDY AREA
MEW AREA, MOUNTAIN VIEW, CALIFORNIA

	Tier I Evaluation	**Tier II Evaluation**	**Tier III Evaluation**
Required Laboratory Deliverable	Standard Laboratory Report with QC Results and Chain of Custody +/- EDD (if automated verification software is to be used)	All Items in Tier 1 Plus Initial and Continuing Calibration Data	All Items in Tier 2 Plus Raw Data (spectrum and chromatographs etc.)
Laboratory Deliverable Details	- Sample Collection, Preparation and Analysis Chronologies - Method Blank Sample Results-All - Matrix Spike and MSD Results - Laboratory Control Sample Results - All - Field QA Samples (Trip/Field Blanks) - Case Narrative Discussing All Non-compliance Issues and Flags - +/- EDD File Containing Sample Results and QC Data in California "GeoTracker" EDF format	Same as Tier 1 Plus Bench Summary Reports and Initial and Continuing Calibration Results	Same as Tier 2 Plus all Raw Data Which Includes: - Spectrum and Chromatograms - Preparation Logs - Analysis Run Logs - LCS - Dilution Factors
Data Verification/ Validation Procedures	Completeness, Accuracy, and Transcription Check Between COC and Laboratory Report	Same as Tier 1 Plus Items Below	Same as Tier 2 Plus Items Below
	Hold Time Violation Check	Bench Summary Report Transcription Error Check vs. Laboratory Report	Bench Summary Report and Raw Data Transcription Error Check versus Laboratory Report
	Contact Required Detection Limits versus Reporting Limit Check	Instrument Initial and Continuing Calibration Check versus Method Requirements	Perform Random Check on Raw Data to Verify and Recalculate Concentrations of Standards
	Contact Required Analyte List Check versus Reported Analytes	Perform Compliance Review of Method QA/QC Criteria Including:	Verify Field & QC Sample Results Were Calculated and Reported Correctly
	Batch QA/QC Review Check (Method Blank, Surrogates, MS/MAD, LACES) Against QC Limits	-Instrument Tuning - Internal Standards - ICY Interference Checks	Review Mass Ion Spectra Matches
	Sample QA/QC Review Check versus. QC Limits Field QA/QC Review, Trip Blanks, Field Blanks, Field Duplicates.		Assess Interference Problems or System Control Issues Such as Drift or Baseline Anomalies
	Case Narrative Review Check		

TABLE B-II
LABORATORY REPORTING LIMITS
WORK PLAN FOR TIERING OF BUILDINGS WITHIN THE VAPOR INTRUSION STUDY AREA
MEW AREA, MOUNTAIN VIEW, CALIFORNIA

Analyte	Reporting Limit	
	EPA Method TO-15 (ppbv)	**EPA Method TO-15 SIM (ppbv)**
Trichloroethene	0.5	0.005
Tetrachloroethene	0.5	0.005
cis-1,2-Dichloroethene	0.5	0.005
trans-1,2-Dichloroethene	0.5	0.005
Vinyl Chloride	0.5	0.005
1,1-Dichloroethane	0.5	0.005
1,1-Dichloroethene	0.5	0.005

ppbv - parts per billion by volume
SIM - selective ion mode

TABLE B-III
PRECISION AND ACCURACY ACCEPTABLE CRITERIA FOR CHEMICALS OF POTENTIAL CONCERN
WORK PLAN FOR TIERING OF BUILDINGS WITHIN THE VAPOR INTRUSION STUDY AREA
MEW AREA, MOUNTAIN VIEW, CALIFORNIA

Parameter	Method	Acceptable Criteria	
		Accuracy (%R)	Precision [c] (RPD)
VOCs [a]	EPA Method TO-15	70-130 (LCS)	25
VOCs [a]	EPA Method TO-15 SIM	70-130 (LCS) [b]	30

a - Analyte list includes: trichloroethene, tetrachloroethene, cis-1,2-dichloroethene, trans-1,2-dichloroethene, vinyl chloride, 1,1-dichloroethane, and 1,1-dichloroethene.

b - Accuracy range for all analytes listed except for trans-1,2-dichloroethene which has a %R range of 60-140.

c - Precision criteria for field duplicates.

LCS - laboratory control sample

RPD - relative percent difference

SIM - selective ion mode

TestAmerica Los Angeles
3585 Cadillac Ave., Suite A
Costa Mesa, CA 92626
Phone 714-258-8610 Fax 714-258-0921

Canister Samples Chain of Custody Record

TestAmerica Laboratories, Inc. assumes no liability with respect to the collection and shipment of these samples.

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Client Contact Information	Project Manager:		____ of ____ COCs
Company:	Phone:	Samples Collected By:	
Address:	Email:		
City/State/Zip			
Phone:	Site Contact:		
FAX:	LAB Contact:		
Project Name:	Analysis Turnaround Time		
Site:	Standard (Specify)_____		
PO #	Rush (Specify)_____		

Sample Identification	Sample Date(s)	Time Start	Time Stop	Canister Vacuum in Field, "Hg (Start)	Canister Vacuum in Field, "Hg (Stop)	Flow Controller ID	Canister ID	TO-15	TO-14A	TO-3	EPA 3C	EPA 25C	ASTM D-1946	Other (Please specify in notes section)	*Sample Type*	Indoor Air	Ambient Air	Soil Gas	Landfill Gas	Other (Please specify in notes section)

Temperature (Fahrenheit)			
	Interior	Ambient	
Start			
Stop			

Pressure (inches of Hg)			
	Interior	Ambient	
Start			
Stop			

Special Instructions/QC Requirements & Comments:

Samples Shipped by:	Date/Time:	Samples Received by:
Samples Relinquished by:	Date/Time:	Received by:
Relinquished by:	Date/Time:	Received by:

Lab Use Only **Shipper Name:** **Opened by:** **Condition:**

APPENDIX C

Indoor Air Quality Building Survey and Building Product Inventory Form

INDOOR AIR QUALITY BUILDING SURVEY

DATE:

BUILDING:

Owner/Developer/Property Manager

Contact Name:

Address:

Phone:

Email:

Tenant

Contact Name:

Address:

Phone:

Email:

Building Construction Characteristics:

General description of building construction materials:_____

_____

How many occupied stories does the building have?_____

What year was the building constructed?_____

What type of basement does the building have? (Circle all that apply)

None Full basement Other (specify): _____

How is the basement used? (Circle all that apply)

Not used Office space Storage Utilities Other (specify): _____

What are the characteristics of the basement? (Circle all that apply)

Basement floor: Concrete Other (specify): _____

Foundation walls: Poured concrete Other (specify): _____

Moisture: Dry Wet Damp Other (specify): _____

What are the characteristics of the floor slab? (Circle all that apply)

Concrete Carpeted Tiled Stone

Cracks Seams Other (specify): _____

Are drains or sumps present? (Y/N) ____ Describe each, including information on contents :

_____

_____

Are elevator shafts present? (Y/N) ____ Describe each:_____

_____

Are there locations where chemicals were or are used or stored? (Y/N) ____ Describe each:_____

_____

Are plumbing pipes or utility conduits present that penetrate the floor slab? (Y/N) ____ Describe each:

_____

_____

Were foundation design specifications and as-built drawings for the facility obtained? (Y/N) _____

Was soil beneath the floor slab treated with lime or cement prior to placing the slab? (Y/N) _____

Describe:_____

Was a vapor barrier installed under the floor slab? (Y/N) _____

Describe:_____

Were any other liners installed under the floor slab? (Y/N) _____

Describe:_____

Were fibers or additional rebar added to the concrete floor slab to minimize cracking? (Y/N) _____

Describe:_____

Were other techniques used to restrict vapor migration through the floor slab? (Y/N) _____

Describe:_____

Heating, Ventilation and Air Conditioning Systems (HVAC):

Were HVAC as-built drawings for the facility obtained? (Y/N) _____

Is the HVAC system a zone cooling/heating system? (Y/N) _____

If not, what type of HVAC system is used in this building? _____

How Many?_____

Describe, and delineate HVAC zones in the facility and corresponding rooftop HVAC air inlets:

Other (specify and describe):

Does the HVAC system have an exhaust capability? (Y/N)

What other type of mechanical ventilation systems are present and/or currently operating in the building?

Mechanical fans Open windows Restroom vent fans

Other (specify):

Who maintains and manages the HVAC system operation?

Describe the control sequencing and operation of the HVAC system with respect to hours of operation, the intake of outside air, minimums, maximums, relative percentage outside air, differences between day and evening operation on weekdays and weekends:

What type(s) of fuel(s) for space heating and water heating are used in this building? (Circle all that apply)

Natural gas Electric Solar Other (specify):

Are any other fuels or chemicals used in this building? (Y/N)

Describe:

Sources of Chemical Contaminants:

Which of these items are present in the building? (Check all that apply)

Potential chemical source	Location of Source	MSDS obtained?
Lacquers, paints or paint thinners		
Gas-powered equipment		
Gasoline storage cans		
Cleaning solvents		
Lubricants		
Air fresheners		
Oven cleaners		
Carpet/upholstery cleaners		
Hairspray		
Nail polish/polish remover		
Bathroom cleaner		
Appliance cleaner		
Furniture/floor polish		
Moth balls		
Fuel tank		
Wood stove		
Fireplace		
Perfume/colognes		
Photographic darkroom chemicals		
Glues		
Scented trees, wreaths, potpourri, etc.		
Other (specify): _____		
Other (specify): _____		

What are the hours during which a majority of the workers are in the building during a work day?

_____

Do the occupants of the building frequently have their clothes dry-cleaned? (Y/N) _____

Was there any recent remodeling or painting done in the building? (Y/N) _____

When and where was the most recent carpeting applied in the building? _____

Were glues used to attach the carpeting to the floor slab? (Y/N) _____

Are there any pressed wood products in the building (e.g. hardwood plywood wall paneling, particleboard,

fiberboard)? (Y/N) _____

Are there any new upholstery, drapes, or other textiles in the building? (Y/N) _____

Has the building been treated with any insecticides/pesticides? If so, what chemicals were used and how often were they applied? _____

Outdoor sources of contamination:

Is there any stationary emission source in the vicinity of the building? _____

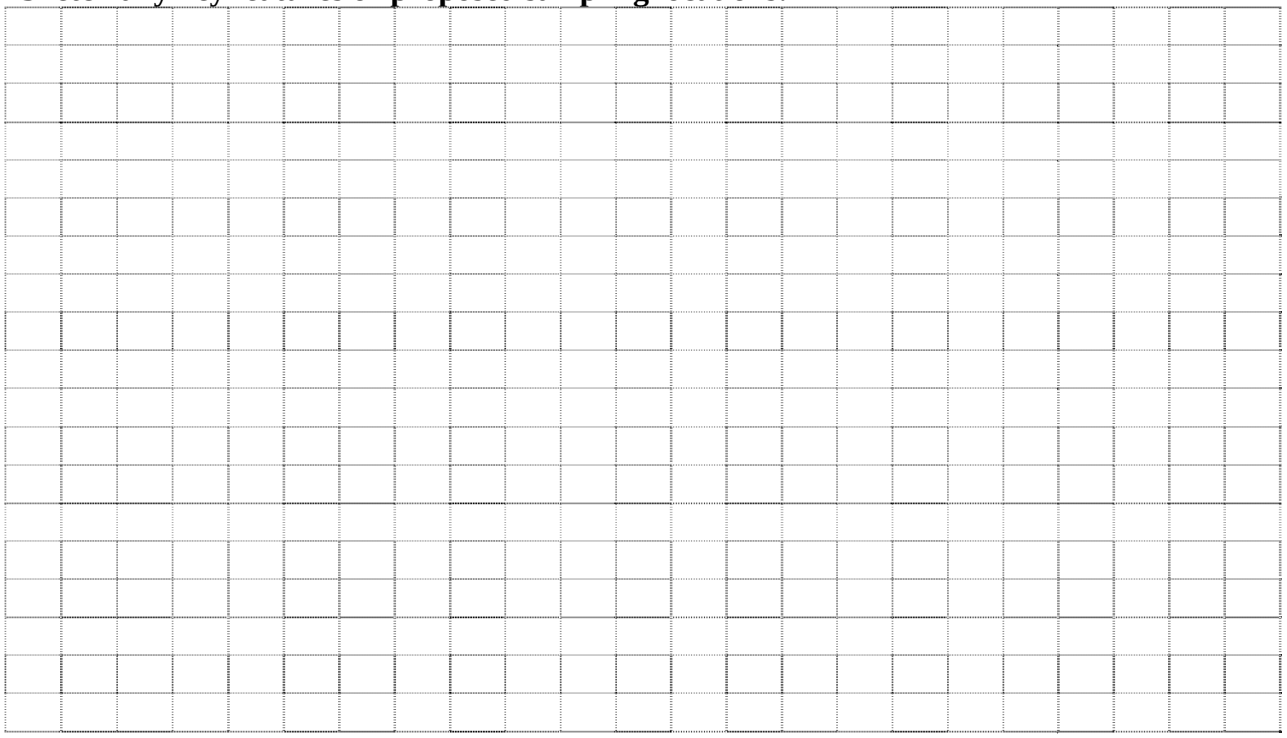
Are there any mobile emission sources (e.g. highway, bus stop, high-traffic area) in the vicinity of the building? _____

Is there any other information about the structural features of this building, the habits of its occupants or potential sources of chemical contaminants to the indoor air that may be of importance in facilitating the evaluation of the indoor air quality of the building? _____

_____

_____

Sketch any key features or proposed sampling locations:



Building Product Inventory Form

Make & Model of field instrument used: _____

List specific products found in the residence that have the potential to affect indoor air quality.

Location	Product Description	Size (units)	Condition*	Chemical Ingredients	Field Instrument Reading (units)	Removed Before Sampling ? Y/N	Photo Y / N **

Describe the condition of the product containers as **Unopened (UO), Used (U),** or **Deteriorated (D)** ** Photographs of the **front and back** of product containers can replace the handwritten list of chemical ingredients. However, the photographs must be of good quality and ingredient labels must be legible.

List specific other items or conditions found in the residence that have the potential to affect indoor air quality (e.g., furnishings or building materials, maintenance or cleaning activities, etc.).

Location	Description of Item or Activity	Field Instrument Reading (units)	Photo ** Y / N

APPENDIX D

Typical Request for Property Access

Haley & Aldrich, Inc.
2107 N. 1st Street, Suite 420
San Jose, CA 95131-2028
Tel: 408.961.4805
Fax: 408.453.8708
HaleyAldrich.com

HALEY&
ALDRICH

Date
File No. 36067-004

Address of Property Owner

Attention: (Owner)

Subject: Request for Property Access
Per requirement from U.S. Environmental Protection Agency
(Street Address), Mountain View, CA

Dear (name of Owner):

Per requirement from the U.S. Environmental Protection Agency (EPA), we are requesting access to your property at the address above to evaluate the potential for soil vapor to enter your building in accordance with EPA's Record of Decision (ROD) Amendment attached to this letter. Responsible parties (RPs)[1], with EPA's oversight, have been conducting vapor intrusion investigations in the Middlefield Road-Ellis Street-Whisman Road area of Mountain View, California (known as the "MEW Area") since 2003. Based on results from these investigations, EPA issued the attached ROD Amendment in 2010, which defines the vapor intrusion work to be conducted in the MEW Area.

EPA is requiring that data be collected from nearly all commercial buildings in the MEW Area. Specifically, EPA has requested that RPs investigate whether volatile organic compounds (VOCs) in the groundwater under buildings in the MEW Area have the potential to migrate in vapor form into the buildings overlying the groundwater, resulting in indoor air concentrations above cleanup levels established in the ROD.

Available property records indicate that you are the current owner of the property at (Street Address), Mountain View, California. Your building is in the MEW Area as shown on Figure 1.

Our company, Haley & Aldrich, is a licensed and insured environmental consulting firm that has been retained by certain of the RPs to conduct the work under direction from the EPA. Accordingly, we request access to your building to perform the activities shown on the attached Building/Property Specific Vapor Intrusion Work Plan (BSVIWP). The work will help in determining a response action tier for the building/property, in accordance with Tables 6A and 6B of the attached ROD Amendment (page 35).

With your permission, we would schedule an appointment to conduct a walkthrough and collect pertinent information about the building. The walkthrough would be conducted by two Haley & Aldrich employees, accompanied by one EPA employee, and would last from one to two hours. We would send you in advance a questionnaire to update, so that we could better understand building construction and use information that is specific to your building.

---

[1] The parties implementing the ROD Amendment in the MEW Area include Fairchild Semiconductor Corporation, Raytheon Company and Intel Corporation, who are taking the lead with respect to this investigation.

Subsequent to the walkthrough, we would schedule dates with you to implement the BSVIWP.

It should be emphasized that you will not incur cost for this work. The work will be performed by Haley & Aldrich, with direction from EPA, in accordance with applicable regulations, and in a manner that does not disrupt or interfere with the use or occupancy of the building.

To indicate your access permission, please complete and sign the attached form. If you have any questions, please feel free to call me at (408) 961-4806. Thank you for your assistance with this project.

Sincerely yours,
HALEY & ALDRICH, INC.

Elie H. Haddad, P.E.
Vice President

Attachments

Figure 1 – Locations of Building in MEW Area
EPA's Record of Decision Amendment

ACCESS PERMISSION FOR BUILDING WALKTHROUGH AND SAMPLING

Property Address: (Street Address), Mountain View California

U.S. Environmental Protection Agency representatives, and contractors for Fairchild Semiconductor Corporation, Raytheon Company, and Intel Corporation, may enter my property to conduct a building walkthrough and collect samples as described in the BSVIWP to evaluate the vapor intrusion pathway in accordance with EPA's Record of Decision Amendment. I understand that sampling will be coordinated with me or my designated representative to minimize disruption to the normal ongoing activities at the property.

Any damage to property or persons caused by the work will be the responsibility of Fairchild Semiconductor Corporation, Raytheon Company, and Intel Corporation and will be promptly repaired. This permission is not to be deemed a grant of interest in my property.

Property Owner's Signature: _____

Print or Type Name: _____

Title: _____

Date: _____

APPENDIX E
Data Management and Reporting Plan

APPENDIX E

DATA MANAGEMENT AND REPORTING PLAN

This appendix provides a description of the project database system and summarizes the general procedures for handling media-specific sampling and analytical results obtained during implementation of the Tiering Work Plan.

DATA MANAGEMENT PROCEDURES

The majority of the data will be generated by the chemical analysis of field samples at off-Site laboratories. The laboratory data report will typically include the following:

General Information:

- Title Page;
- Project name and number;
- Laboratory project or lot number;
- Signature of the Laboratory Quality Assurance Officer or his/her designee; and
- Date issued.

Laboratory Case Narrative:

- Number of samples and respective matrices;
- Laboratory analyses performed;
- Deviations from intended analytical strategy;
- Definition of data qualifiers used;
- Quality Control (QC) procedures utilized and references to the acceptance criteria;
- Condition of samples “as received”;
- Discussion of whether or not sample holding times were met;
- Discussion of technical problems or other observations that may have created analytical difficulties; and
- Discussion of laboratory QC checks that failed to meet project criteria.

Shipping and Receiving Documents:

- Sample container documentation; and
- Sample reception information and original chain of custody (COC) form.

Data Package by Analytical Method (e.g.., TO15) including:

- Sample reporting limits (RL);
- Estimated (J) values for parameters detected between the RL and method detection limit;
- Dilution factors (where applicable); and
- Raw data for sample results, when required (dated chromatograms, parameter-specific quantitation reports, mass spectra and instrument printouts).

APPENDIX E

DATA MANAGEMENT AND REPORTING PLAN

QC Summary Data:

- Matrix spike and matrix spike duplicate recoveries;
- Laboratory control samples;
- Method blank results;
- Surrogate compound recoveries;
- Gas chromatography/mass spectrometry tuning results;
- Internal standard recoveries;
- Serial dilutions;
- Reagent blank results; and
- Interference check standards.

Calibration Data:

- Initial calibration data;
- Initial calibration checks;
- Continuing calibration verification/check standards;
- Initial and continuing calibration blanks;
- Instrument performance checks; and
- Resolution checks and specific compound degradation checks.

Raw data:

- Dated chromatograms;
- Parameter specific;
- quantitation reports; and
- Mass spectra and instrument print outs).

Off-Site laboratory chemical data will be sent to the data manager as an Electronic Data Deliverable (EDD) via email. The EDD will be in a format compatible with the in-house database to expedite the process of uploading data. For example, Haley & Aldrich uses EQuIS[1] as the platform for its database management. The lab EDD is uploaded when it is received from the lab. After validation is complete[2], a validated EDD will be uploaded to the project database. Any changes that occur during validation will be incorporated into the upload of the EDD, and the record of the original laboratory qualifiers will be preserved. Once the data are uploaded into the project database, a report is printed and compared to the validated hard copy of the lab report to ensure all data were correctly uploaded to the project database. The validated hard copy lab report will be retained in the project files. The EDDs typically include the following:

[1] From EarthSoft, Inc.

[2] See Appendix B of this Tiering Work Plan

APPENDIX E

DATA MANAGEMENT AND REPORTING PLAN

Sample Fields:

- Sample code (unique to each record);
- Sample date;
- Sample time;
- Sample matrix;
- Sample delivery group;
- Sample type; and
- Sample field preparation (e.g., field filtered), if applicable.

Laboratory Testing Fields:

- Analysis method;
- Analysis date;
- Analysis time; and
- Lab name code.

Result Fields:

- Chemical abstract service registry number;
- Chemical name;
- Result type;
- Result value;
- Result error (if applicable);
- Laboratory qualifier;
- Result unit; and
- Reporting limit.

Batch Fields:

- Laboratory test batch type; and
- Laboratory test batch ID.

Data Storage and Retrieval:

Data collected in the field during sample collection activities will be recorded electronically or on field sample keys (FSKs). Upon completion of field activities, the electronic data and/or the FSKs will be provided to the project data manager for data entry into the project database. Data entry may be limited to those parameters that need to be compiled for later evaluation.

SAMPLE INITIATION AND TRACKING

This process will track the sample from the time it is collected to the time the data associated with the

sample have been uploaded into the project database. Sample locations/buildings will be identified prior to the start of a day's field sampling. Upon completion of sampling, an FSK and a COC will be filled out to initiate the sample tracking procedure.
The following steps are taken in this process:

- The field staff will give copies of the FSKs and COCs to the data manager prior to receipt of the lab analytical results.
- The data manager will enter the following into the project database: sample identification, date sampled, time sampled, sample type, matrix, laboratory shipped to, date shipped to lab and analyses requested.
- The data manager will upload the EDD after it is received from the lab. The EDD is automatically checked against the field sample information that was previously entered by the data manager. Any discrepancies between the field information and the lab information will be resolved prior to uploading the EDD.
- The data manager will upload the data from the validator after it is received.

Data Control, Accuracy and Security

The project database is controlled and secure and only specifically-trained and approved database managers are given access. Database entries are checked to confirm accuracy with the results reported by the laboratory.

MEW PROJECT DATABASE

This section provides a general description of the project database used by Haley & Aldrich for maintaining project data.

Historical air sampling results presented in the Remedial Investigation (RI) Report[3] and those subsequently collected by Haley & Aldrich since the submittal of the RI Report are housed in an EQuIS database from Earthsoft, Inc. The database is located on a dedicated Microsoft SQL Server in Boston, Massachusetts. All data records in the project database are preserved in EQuIS, and backed up nightly.

The database is organized into key related tables (e.g., dt_location, dt_sample, dt_test, dt_result) along with a number of supporting reference tables used to standardize data input. The dt_location table contains sample location information. The dt_sample table contains information for samples collected for the project. The dt_test table contains information on the lab method, preparation and sample characteristics. The dt_result table contains the analytical data associated with the field samples and QC samples. The supporting tables consist of valid values for sample types, matrix types, and parameter names.

The EQuIS database receives input directly from laboratory EDDs in the EQuIS format for ease of data

[3] Haley & Aldrich, Inc., *Final Supplemental Remedial Investigation for Vapor Intrusion Pathway, Middlefield-Ellis-Whisman Study Area, Mountain View, California, and Moffett Field, California*, June 2009.

transfer and to avoid mistakes in data transcription. The EDD output format is provided by analytical laboratories from their Laboratory Information Management Software systems, thereby eliminating the need for manual transcription and/or reformatting.
Data validation procedures and quality measures taken during the database population process are discussed in Appendix B of this Tiering Work Plan. Upon completion of data validation, the data are corrected for valid values and validation update. These updates are reviewed and the validated data are uploaded to the project database when the data has been finalized.

DATA ORGANIZATION, ANALYSIS, AND PRESENTATION

The database contains the following, when applicable:

- Sample ID;
- Sample date;
- Field parameters (e.g., temperature);
- Sampling conditions (HVAC on or HVAC off);
- Matrix type (e.g., outdoor air, indoor air, soil gas, etc.);
- Effluent filtering system air flow data;
- Sample location (e.g., canister location by building/floor);
- Laboratory EDD containing analytical data; and
- Data qualifiers.

For reports using site-specific chemical data, the database queries are generated directly from the project database by the database manager or his/her designee. The project database data would have already undergone data validation, and the accuracy of those data would have been checked and verified as it is entered and accepted as final data. Data analysis for interpretation is conducted by qualified individuals. All tables and figures for reports are reviewed by the preparer and the professional assigned to check the figure or table for accuracy against original source data.

Commonly used software applications for data presentation include Microsoft® Word, Microsoft® PowerPoint®, Microsoft® Excel®, Autocad® and other products in graphics design and computer aided design.

Field data are typically reported in a tabular format, including Quality Assurance/Quality Control (QA/QC) results. A typical report is provided in Table E-I. The report would include the following:

- Sample ID;
- Sampling date;
- Sampling media (air, soil gas, groundwater, etc.);
- Sampling conditions (HVAC on, HVAC off);
- Concentrations of analytes (in microgram per cubic meter [$\mu g/m^{3l}$);
- QA/QC sample concentrations (in $\mu g/m^3$);
- Laboratory identifiers and explanations;

- Short- and long-term cleanup levels (or screening levels); and
- Miscellaneous notes as needed.

This information is provided graphically on a map (e.g., Figure E-1) and shows the following information:

- Building and/or property layout;
- Sample names and locations (different symbols for different media – indoor air, soil gas, groundwater, etc);
- Posted concentrations (in $\mu g/m^3$); and
- Miscellaneous notes as needed.

DOCUMENTATION

The database will be provided to the United States Environmental Protection Agency (EPA) on an annual basis concurrent with the annual status report (April 15), or upon request from EPA.

Building-Specific or Property-Specific Vapor Intrusion Sampling and Evaluation Reports will be submitted to EPA within 60 days of completion of sampling performed in accordance with the "Supplemental Building/Property-Specific Vapor Intrusion sampling and Analysis Work Plan." The content of the reports are described in the Statement of Work[4]. The reports will also be submitted to the property owner.

Deliverables to EPA will be provided electronically. EPA may choose to post reports on a publically available website. Private residential or confidential business information will be redacted prior to making information publically available.

[4]U.S. EPA, Statement of Work, Remedial Design and Remedial Action to Address the Vapor Intrusion Pathway, Middlefield-Ellis-Whisman (MEW) Superfund Study Area, Mountain View and Moffett Field, CA, 2011

TABLE E-I
AIR SAMPLING RESULTS - BUILDING ADDRESS

Sample ID	Date	Vinyl chloride	TCE	PCE	trans-1,2-DCE	cis-1,2-DCE	1,1-DCE	1,1-DCA
After-Hour Indoor Air Sampling Results (HVAC Off)								
AMB1	7/23/2010	<0.0051	0.6	0.36	<0.020	0.038J	0.054	0.045
	9/11/2010	<0.0051	0.5	0.16	<0.020	0.056	0.011 J	0.018 J
	1/29/2011	<0.0051	0.5	0.26	<0.020	0.029 J	0.020	0.019 J
AMB1-DUP	7/23/2010	<0.0051	0.5	0.32	<0.020	0.032J	0.057	0.041
	9/11/2010	<0.0051	0.5	0.18	<0.020	0.059	0.010 J	0.019 J
AMB2	7/23/2010	<0.0051	0.3	0.33	<0.020	0.032 J	0.045	0.039
	9/11/2010	<0.0051	0.4	0.19	<0.020	0.053 J	0.017 J	0.021
	1/29/2011	<0.0051	0.6	0.25	<0.020	<0.0099	<0.0079	<0.0081
OUT1	7/22/2010	<0.0051	0.046	0.054 J	<0.020	0.011 J	<0.0079	<0.0081
	9/11/2010	<0.0051	0.29	0.071 J	<0.020	0.019 J	<0.0079	<0.0081
	1/29/2011	<0.0051	0.028	0.12 J	<0.020	<0.0099	<0.0079	<0.0081
Normal Occupancy Indoor Air Sampling Results (HVAC On)								
Sample ID	**Date**	**Vinyl chloride**	**TCE**	**PCE**	**trans-1,2-DCE**	**cis-1,2-DCE**	**1,1-DCE**	**1,1-DCA**
AMB1	9/9/2010	< 0.0051	0.59	0.15	<0.020	0.027 J	<0.0079	<0.0081
AMB2	9/9/2010	<0.0051	0.48	0.11 J	<0.020	0.026 J	<0.0079	<0.0081
OUT1	9/9/2010	<0.0051	0.077	0.062 J	<0.020	0.015 J	<0.0079	<0.0081
Short-Term Action Levels								
Acute(14 days)		1,300	11,000	1,400	800	NA	NA	NA
Intermediate (15 - 365 days)		80	540	NA	800	NA	80	NA
Long-Term Cleanup Level								
Commercial		2	5	2	210	120	700	6

Notes:
All units are micrograms per cubic meter (ug/m^3)

<0.0081 - denotes result was below respective method detection limit

J: Estimated value. Analyte detected at a level less than the Reporting Limit (RL) and greater than or equal to the Method Detection Limit (MDL).

AMB-1	07/14/2011 ug/m3
1,1-Dichloroethane	ND (0.02)
1,1-Dichloroethene	ND (0.04)
cis-1,2-Dichloroethene	ND (0.056)
Tetrachloroethene	ND (0.14)
trans-1,2-Dichloroethene	ND (0.056)
Trichloroethene	0.12
Vinyl chloride	ND (0.013)

DUP-1	07/14/2011 ug/m3
1,1-Dichloroethane	ND (0.02)
1,1-Dichloroethene	ND (0.04)
cis-1,2-Dichloroethene	ND (0.055)
Tetrachloroethene	ND (0.14)
trans-1,2-Dichloroethene	ND (0.055)
Trichloroethene	0.12
Vinyl chloride	ND (0.013)

DUP-2	07/14/2011 ug/m3
1,1-Dichloroethane	ND (0.02)
1,1-Dichloroethene	ND (0.04)
cis-1,2-Dichloroethene	0.11
Tetrachloroethene	ND (0.14)
trans-1,2-Dichloroethene	ND (0.056)
Trichloroethene	0.27
Vinyl chloride	ND (0.013)

AMB-3	07/14/2011 ug/m3
1,1-Dichloroethane	ND (0.02)
1,1-Dichloroethene	ND (0.04)
cis-1,2-Dichloroethene	0.12
Tetrachloroethene	ND (0.14)
trans-1,2-Dichloroethene	ND (0.056)
Trichloroethene	0.27
Vinyl chloride	ND (0.013)

AMB-1
DUP-1
DUP-2
AMB-3
OFFICE
CLASSROOM
STORAGE ROOM
CLOSET
OUT-1
BREEZEWAY
AMB-2
LAB ROOM

OUT-1	07/14/2011 ug/m3
1,1-Dichloroethane	ND (0.02)
1,1-Dichloroethene	ND (0.04)
cis-1,2-Dichloroethene	ND (0.055)
Tetrachloroethene	ND (0.14)
trans-1,2-Dichloroethene	ND (0.055)
Trichloroethene	ND (0.027)
Vinyl chloride	ND (0.013)

AMB-2	07/14/2011 ug/m3
1,1-Dichloroethane	ND (0.02)
1,1-Dichloroethene	ND (0.04)
cis-1,2-Dichloroethene	ND (0.055)
Tetrachloroethene	ND (0.14)
trans-1,2-Dichloroethene	ND (0.055)
Trichloroethene	0.12
Vinyl chloride	ND (0.013)

LEGEND:

◆ INDOOR AIR SAMPLING LOCATION

○ OUTDOOR AIR SAMPLING LOCATION

NOTES:

1. BUILDINGS AND INTERIOR FEATURES WERE DIGITIZED FROM A DRAWING PROVIDED BY OTHERS, AND FROM BUILDING WALKTHROUGH.
2. ALL LOCATIONS APPROXIMATE.
3. CHEMICAL CONCENTRATIONS IN MICROGRAMS PER CUBIC METER (ug/m³).
4. ND DENOTES CHEMICAL WAS NOT DETECTED AT THE LEVEL SHOWN.
5. SAMPLE DURATION IS 24 HOURS.

N W E S

0 20 40

APPROXIMATE SCALE IN FEET

HALEY & ALDRICH

LOCATION OF AIR SAMPLES AND RESULTS - (BUILDING ADDRESS)

SCALE: AS SHOWN
SEPTEMBER 2011

FIGURE E-1

G:\360671009\CAD\DRAWINGS\360671-23 S_AKRON_RD-CHEM_DATA(WORKPLAN).DWG

APPENDIX F

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APPENDIX F
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