DEPARTMENT OF THE AIR FORCE
60TH CIVIL ENGINEER SQUADRON (AMC)

March 24, 2010

MEMORANDUM FOR DISTRIBUTION

FROM: 60 CES/CEANR
411 Airmen Dr.
Travis AFB, CA 94535-2001

SUBJECT: Final Vapor Intrusion (VI) Assessment Report

1. The attached final VI Assessment Report summarizes the results of two phases of VI data collection, presents the data from a third phase, and provides an evaluation of the potential VI risk on a site-by-site basis. This report will support remedy selection in the upcoming Basewide Groundwater Record of Decision.

2. If you have any questions concerning this report, please contact Mr. Glenn Anderson at (707) 424-4359.

MARK H. SMITH
Chief, Environmental Restoration

Attachment:
Final VI Assessment Report

Distribution: (see attached)

Distribution List
Final VI Assessment Report
Travis Air Force Base California

HQ AFCEE/EXEW Building 171 — CD-ROM
ATTN: Howard Mathews, WP: 395- Howard Mathews
485 Quentin Roosevelt Road
San Antonio, TX 78226-1845

California Regional Water Quality Control Board, — CD-ROM
San Francisco Region
ATTN: Alan Friedman
1515 Clay Street, Suite 1400
Oakland, CA 94612

U.S. Environmental Protection Agency — Two hard copies and CD-ROM
ATTN: James Chang
75 Hawthorne Street, SFD-8-1
San Francisco CA 94105-3901

DTSC Region 1 — CD-ROM
ATTN: Jose Salcedo
8800 Cal Center Drive
Sacramento, CA 95826

60 CES/CEANR — Three hard copies and CD-ROM
ATTN: Glenn Anderson
411 Airmen Drive, Building 570
Travis AFB, CA 94535-2001

CH2M HILL — CD-ROM
ATTN: Mike Wray
2485 Natomas Park Drive, Suite 600
Sacramento, CA 95833

TRAVIS AIR FORCE BASE
ENVIRONMENTAL RESTORATION PROGRAM

Final

Vapor Intrusion Assessment Report

CDRL Nos. A001b, A001c, A001d, B005, B011, and B012
SOW Paragraph Nos. 4.4, 6.3, 9.7.2.1, 9.7.4.1, and 9.11.1

AFCEE Contract Nos. F41624-03-D-8595

Task Order 0507

Submitted by:

60 CES/CEAO
Travis Air Force Base, California

Prepared by:

2485 Natomas Park Drive, Suite 600
Sacramento, California 95833

March 2010

Final

Vapor Intrusion Assessment Report

Prepared for

Air Force Center for Engineering and the Environment

and

Travis Air Force Base, California

March 2010

CH2MHILL
2485 Natomas Park Drive
Suite 600
Sacramento, California 95833

Final

Vapor Intrusion Assessment Report

Submitted to

Air Force Center for Engineering and the Environment

and

Travis Air Force Base, California

March 2010

CH2MHILL

Contents

Appendixes

Tables

Figures

Acronyms and Abbreviations

µg/L	microgram(s) per liter
µg/m^3	microgram(s) per cubic meter
AFB	Air Force Base
AFCEE	Air Force Center for Engineering and the Environment
AFIOH	Air Force Institute of Occupational Health
ASL	Applied Sciences Laboratory
ATSDR	Agency for Toxic Substances and Disease Registry (Atlanta)
BCE	base civil engineer
bgs	below ground surface
Cal/EPA	California Environmental Protection Agency
CAMU	Corrective Action Management Unit
CAS	Chemical Abstracts Service
COC	chemical of concern
CSM	conceptual site model
DCA	dichloroethane
DCB	dichlorobenzene
DCE	dichloroethene
DNAPL	dense non-aqueous phase liquid
DTSC	Department of Toxic Substances Control
EDB	dibromoethane
EIOU	East Industrial Operable Unit
EPA	U.S. Environmental Protection Agency
ERP	Environmental Restoration Program
ESL	environmental screening level
FD	field duplicate
FSP	field sampling plan
FTA	fire training area

GSAP	Groundwater Sampling and Analysis Program
HEAST	Health Effects Assessment Summary Table (EPA)
HVAC	heating, ventilation, and air conditioning
IRA	interim remedial action
IRIS	Integrated Risk Information System
ITRC	Interstate Technology & Regulatory Council
J&E	Johnson and Ettinger
L	liter
LNAPL	light non-aqueous phase liquid
MCL	maximum contaminant level
MEK	2-butanone
MIBK	methyl isobutyl ketone
mL/min	milliliter(s) per minute
MTBE	methyl tert-butyl ether
NA	not applicable
NAPL	non-aqueous phase liquid
ND	not detected
NEWIOU	North, East, and West Industrial Operable Unit
NFA	No Further Action
NOU	North Operable Unit
OSA	Oil Spill Area
OWS	oil/water separator
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCE	tetrachloroethene
POCO	petroleum only contaminated
POL	petroleum, oil, and lubricants
ppbv	part(s) per billion by volume
PPRTV	EPA Provisional Peer-reviewed Toxicity Value
PRT	post-run tubing

QA/QC	quality assurance/quality control
RBC	risk-based concentration
RI	remedial investigation
ROD	record of decision
RSL	regional screening level
RWQCB	Regional Water Quality Control Board
SIM	selective ion monitoring
SOP	standard operating procedure
SSA	Solvent Spill Area
SSG RBC	shallow soil gas risk-based concentration
SSRW	storm sewer right of way
SVOC	semivolatile organic compound
TCA	trichloroethane
TCE	trichloroethene
TPH-D	total petroleum hydrocarbon as diesel
TPH-G	total petroleum hydrocarbon as gasoline
USA	Underground Services Alert
VI	vapor intrusion
VOC	volatile organic compound
WABOU	West/Annexes/Basewide Operable Unit
WIOU	West Industrial Operable Unit

SECTION 1

Introduction

The Air Force Center for Engineering and the Environment (AFCEE) has requested an evaluation of the vapor intrusion (VI) pathway at the Environmental Restoration Program (ERP) groundwater sites at Travis Air Force Base (AFB) to support the Travis AFB Basewide Groundwater Record of Decision (ROD). The ERP groundwater sites included in this VI assessment are: Sites FT004, FT005, LF006, LF007, LF008, SS015, SS016, SS029, SS030, SD031, ST032, SD033, SD034, SS035, SD036, SD037, DP039, and SD043. These sites are shown on Figure 1-1 (all figures and tables are provided at the end of each section). This work is being performed under AFCEE Contract No. 41624-03-D-8595, Task Order 0507.

This project used a phased approach, and field work was conducted in three phases. Soil gas sampling (Phase 1) was performed at Sites FT004, SS029, DP039, and the West Industrial Operable Unit (WIOU). Subslab soil vapor, indoor air, and outdoor air sampling were also performed during Phase 1 at three buildings to support the development of a site-specific attenuation factor for industrial buildings. Phase 2 of the investigation consisted of performing building surveys in areas where shallow soil gas or groundwater data indicated a potential for VI pathways to be a concern.

Phase 3 of the investigation was performed at ERP Site SS016 and the WIOU, which includes Sites SD033, SD034, SS035, SD036, and SD037. The purpose of the Phase 3 investigation was to close remaining data gaps at these sites that were identified upon completion of Phases 1 and 2. Phase 3 consisted of collecting subslab soil gas samples, indoor air samples, and outdoor air samples. The samples were collected in July 2009. Phase 3 samples were collected both by the U.S. Environmental Protection Agency (EPA) and CH2M HILL.

This report presents the data collected during Phase 3 of the field investigation, summarizes the results of Phases 1 and 2 of the field investigation, and provides an evaluation of potential VI risk on a site-by-site basis. The data collected for this assessment during all three phases were used to assess the potential for VI within buildings located in close proximity (within approximately 100 feet) to known groundwater volatile organic compound (VOC) contamination plumes and to evaluate potential risk associated with exposure to VOCs in buildings under future land use conditions. The results of this assessment will support the upcoming Basewide Groundwater ROD. The VI assessment and associated sample collection were performed in accordance with the *Vapor Intrusion Assessment Work Plan* (CH2M HILL, 2008).

1.1 Purpose

The purpose of this phased field investigation is to assess the potential for VI at the ERP groundwater sites identified in the Work Plan (CH2M HILL, 2008). As documented in the Work Plan, groundwater VOC concentrations at all of the ERP sites were compared with VI screening levels developed using the Department of Toxic Substances Control's (DTSC's)

version of EPA's Screening-level Johnson and Ettinger (J&E) Model for groundwater (DTSC, 2005a; EPA, 2004). The data collected during Phases 1 and 2 were used to evaluate the assumptions when developing the groundwater screening levels and determine if those screening levels were adequately protective or if sites initially screened out in the Work Plan should be re-evaluated using more conservative screening levels. Phases 1 and 2 results indicated that the groundwater screening levels developed in the Work Plan were appropriate for Travis AFB.

The purpose of this report is to present the data collected during Phase 3 of the investigation, summarize the results of Phases 1 and 2 of the VI assessment, and provide an evaluation of potential VI risk on a site-by-site basis.

1.2 Phased Investigation Approach

This project used a phased approach with the initial emphasis on addressing buildings and/or locations with the highest potential for vapor intrusion and focusing sampling in areas to reduce uncertainties at each phase of the assessment.

This VI assessment process included the following steps:

Documentation provided in the *Vapor Intrusion Assessment Work Plan* (CH2M HILL, 2008):

1. Reviewed the conceptual site model (CSM).
2. Developed groundwater VOC screening levels using site-specific data and the DTSC's (2005a) version of EPA's (2004) Screening-level J&E (1991) Model for groundwater.
3. Compared the most recent groundwater VOC analytical data (2004–2007) against screening levels.

Documentation provided in the *Vapor Intrusion Assessment Report* (this document)*:*

4. Conducted shallow soil gas sampling (between 6 and 10 feet below ground surface [bgs]) at sites with groundwater VOC concentrations exceeding screening levels (Phase 1).
5. Collected subslab soil vapor and indoor air samples concurrently at three buildings to support development of a site-specific soil gas attenuation factor for industrial buildings (Phase 1) and site-specific shallow soil gas risk-based concentrations (SSG RBCs).
6. Compiled indoor air RBCs using the industrial and residential air screening levels from *EPA's Regional Screening Levels for Chemical Contaminants at Superfund Sites* (EPA, 2008). Multiplied the indoor air RBCs by a site-specific soil gas attenuation factor to obtain site-specific SSG RBCs.
7. Compared shallow soil gas sample concentrations to site-specific SSG RBCs.
8. Conducted a building survey in areas where shallow soil gas concentrations exceed industrial site-specific SSG RBCs (Phase 2).
9. Based on the results of the shallow soil gas screening and building surveys, conducted subslab soil vapor and/or indoor air sampling at existing buildings with potential for

chemical exposure through VI (Phase 3). Potentially occupiable, enclosed buildings that were not scheduled for demolition and had shallow soil gas concentrations exceeding the site-specific industrial SSG RBCs and buildings with remaining data gaps were included in Phase 3.

10. Compared indoor air concentrations with indoor air RBCs and subslab concentrations with subslab RBCs.

11. Identified sites for no further action (i.e., the VI exposure pathway is considered insignificant because VOC concentrations are below site-specific RBCs, cumulative risks for VOCs are within the EPA's risk management range of 10^{-6} to 10^{-4} and hazard indices are less than 1, or the pathway is incomplete).

12. Identified sites for further investigation or mitigation measures (i.e., VI exposure pathway is considered potentially significant because VOC concentrations exceed RBCs, cumulative risks are greater than EPA's risk management range of 10^{-6} to 10^{-4} or hazard indices exceed the threshold of 1, and the pathway is potentially complete).

The decision criteria for entering each phase of this investigation are illustrated on Figure 1-2.

This project has followed the steps outlined above, and a combination of factors was used to determine if subslab and/or indoor air sampling was warranted in Phase 3, including the concentrations of VOCs in groundwater, concentrations of VOCs in soil gas, and current/future use of the buildings. The uncertainties related to these factors have been considered in determining whether subslab and/or indoor air sampling would be performed in Phase 3. The data collected during Phases 1 and 2 were reviewed, along with the initial screening assumptions (e.g., input parameters into the J&E model and number and locations of samples). The data were used to determine areas of greatest uncertainty, areas where the results did not match the initial assumptions made during the screening process, and areas or media where additional investigation was warranted in Phase 3. A site-specific soil gas attenuation factor for industrial buildings, based on site-specific data, was developed to reduce the amount of uncertainty associated with using soil gas screening levels.

1.3 Document Organization

This report is organized into the following sections:

- **Section 1: Introduction.** Provides an introduction for this report.
- **Section 2: Site-specific Groundwater, Indoor Air, Subslab, and Shallow Soil Gas RBCs.** Presents the site-specific RBCs developed for Travis AFB.
- **Section 3: Summary of Phases 1 and 2 Results.** Provides a summary of the data collected during Phases 1 and 2
- **Section 4: Phase 3 Field Investigation Activities.** Summarizes the field activities performed during Phase 3 of this investigation.
- **Section 5: Phase 3 Results.** Provides the analytical results of Phase 3 sampling.

- **Section 6: Vapor Intrusion Evaluation.** Presents an evaluation of potential risk associated with exposure via the VI pathway at each ERP site, based on available groundwater, shallow soil gas, subslab, indoor air, and outdoor air data.
- **Section 7: Conclusions.** Summarizes the main conclusions of the VI assessment.
- **Section 8: Works Cited.** Provides references cited in this document.
- **Appendix A: Analytical Data** (on CD).
- **Appendix B: Data Quality Summary Report** (on CD).
- **Appendix C: Building Surveys** (on CD).
- **Appendix D: Differential Pressure Measurement Evaluation** (on CD).
- **Appendix E: Field Documentation** (on CD).
- **Appendix F: EPA Split Samples** (on CD).
- **Appendix G: Development of Site-specific Screening Criteria** (on CD).
- **Appendix H: Standard Operating Procedure for the Installation of Shallow Soil Gas Sampling Probes** (on CD).
- **Appendix I: Response to Comments** (on CD).

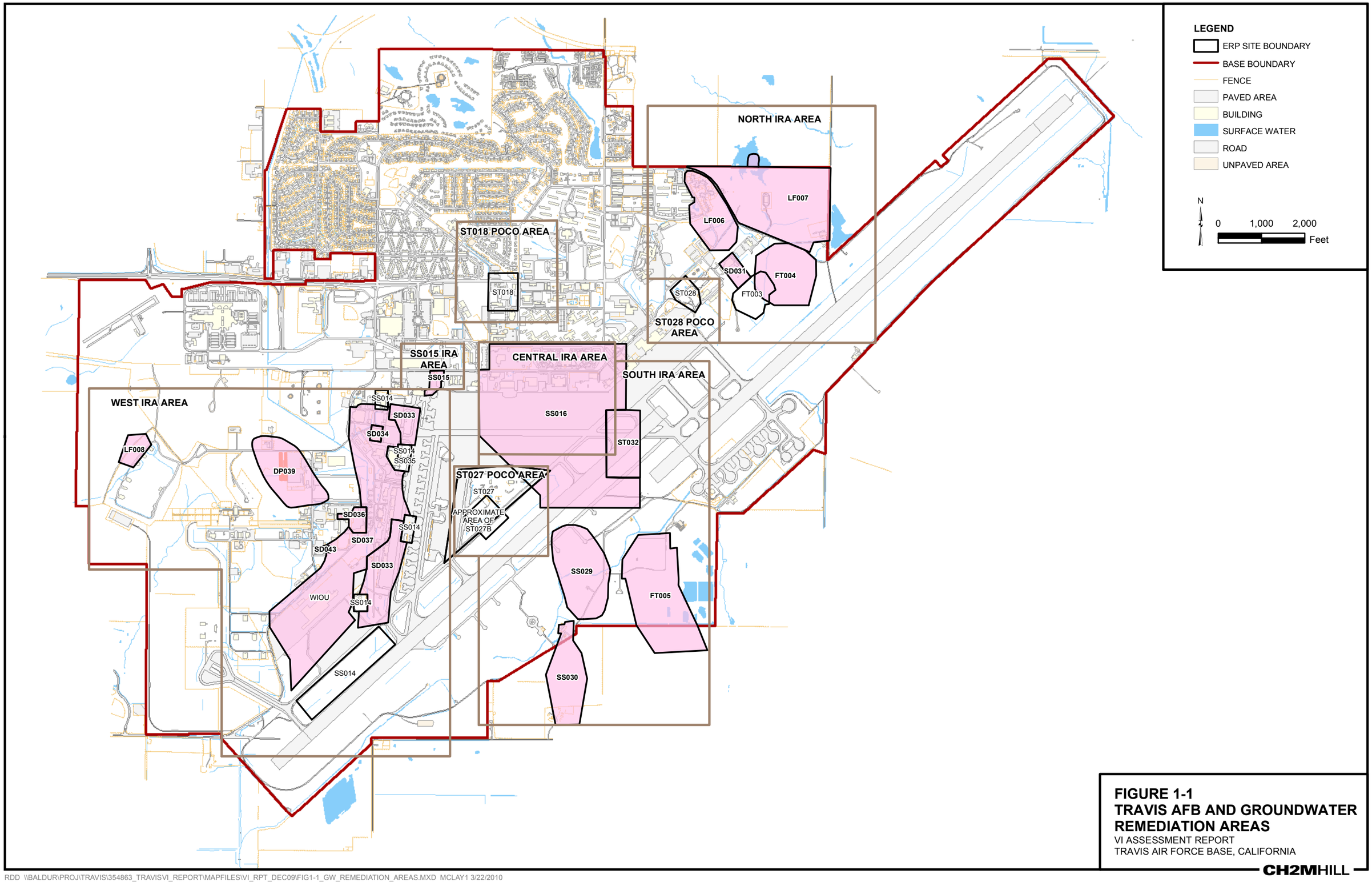


FIGURE 1-1
TRAVIS AFB AND GROUNDWATER REMEDIATION AREAS
VI ASSESSMENT REPORT
TRAVIS AIR FORCE BASE, CALIFORNIA

CH2MHILL

RDD \\BALDUR\PROJ\TRAVIS\354863_TRAVISVI_REPORT\MAPFILES\VI_RPT_DEC09\FIG1-1_GW_REMEDIATION_AREAS.MXD MCLAY1 3/22/2010

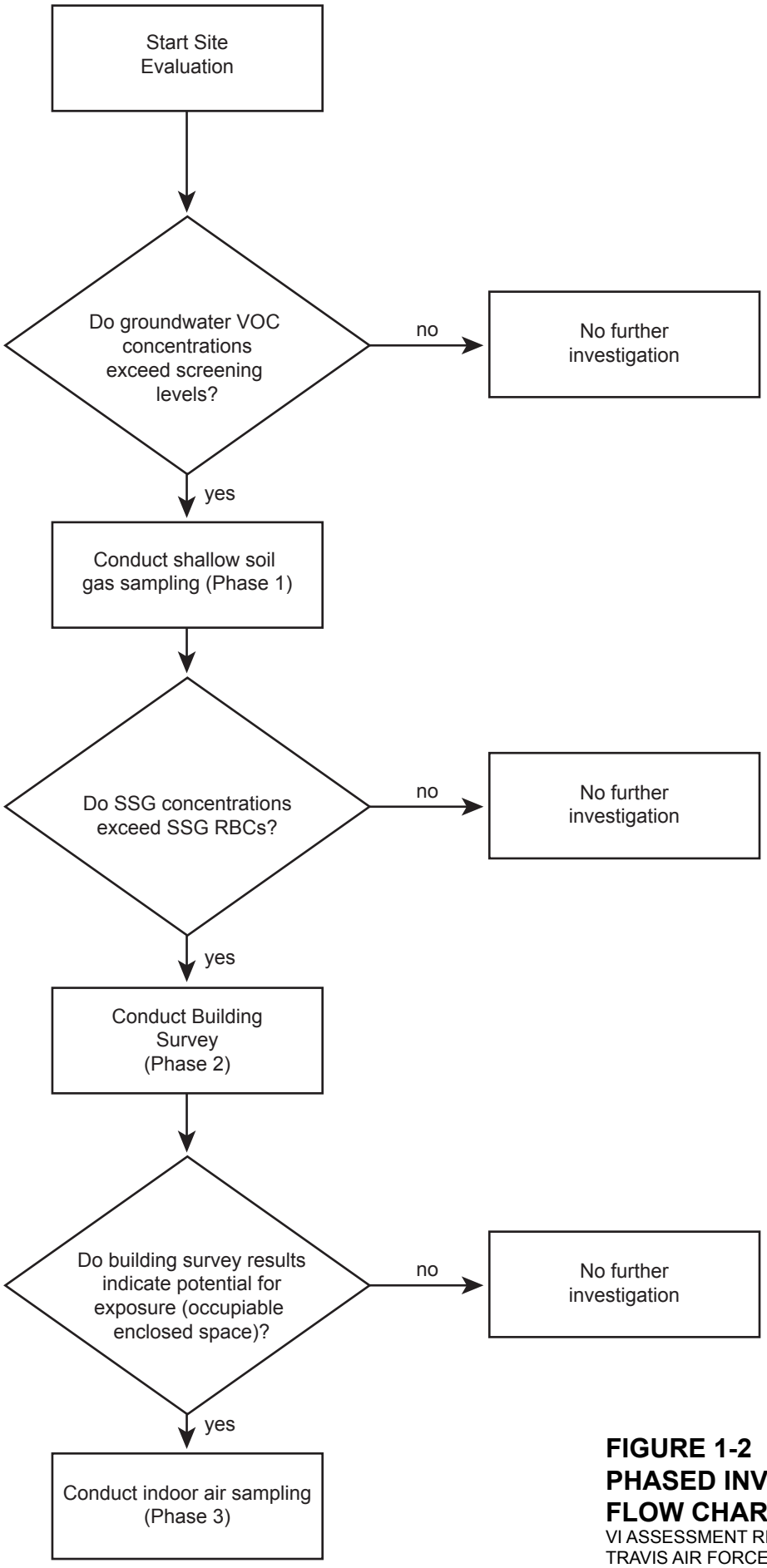


FIGURE 1-2
PHASED INVESTIGATION FLOW CHART
VI ASSESSMENT REPORT
TRAVIS AIR FORCE BASE, CALIFORNIA

SECTION 2

Site-specific Groundwater, Indoor Air, Subslab, and Shallow Soil Gas RBCs

Based on the results of the data comparisons described in Appendix G, site-specific groundwater, indoor air, subslab, and SSG RBCs were developed. These site-specific RBCs were used as screening tools to evaluate VI potential at each of the ERP sites and will be used to support the Basewide Groundwater ROD. The development of RBCs for each medium is described below.

2.1 Site-specific Groundwater RBCs

The groundwater screening levels listed in the Work Plan (CH2M HILL, 2008) were initially used to determine which sites and/or facilities required further investigation for the VI pathway. Multiple lines of evidence (i.e., comparison of modeled versus measured indoor air and comparison of modeled versus measured soil gas concentrations throughout the soil gas depth profile) indicate that the J&E groundwater model provides a conservative, but reasonable estimate of VOC migration from groundwater through the vadose zone to indoor air. Therefore, the groundwater screening levels presented in the Work Plan are protective of the indoor air pathway and will be retained as the site-specific groundwater RBCs. The industrial and residential groundwater RBCs presented in Tables 2-1 (industrial) and 2-2 (residential) will be considered during development of cleanup levels in the Basewide Groundwater ROD.

2.2 Indoor Air RBCs

RBCs for chemicals detected in indoor air samples are the industrial and residential air screening levels from *EPA's Regional Screening Levels for Chemical Contaminants at Superfund Sites* (EPA, 2008). These have been updated since the publication of the Work Plan (CH2M HILL, 2008). Indoor air regional screening levels (RSLs) are air concentrations that are protective of indoor air inhalation for residents and workers based on standard exposure parameters. Unit risk factors and reference concentrations used in the RSLs were selected based on the EPA hierarchy for human health toxicity values for Superfund risk assessments (EPA, 2003) and are consistent with Air Force guidance on selection of toxicity values for risk assessment (USAF, 2006).

The industrial indoor air RBCs are based on standard default assumptions for workers that correspond to the exposure scenario identified in the CSM (i.e., a person works in the building over a period of 25 years, 250 days per year, and 8 hours per day). For the constituents that potentially cause cancer, the RBCs are based on a target risk of 1 in a million (1×10^{-6}) excess lifetime cancer risk; for constituents exhibiting non-cancer health effects, the RBCs are based on a target hazard quotient of one. Industrial and residential screening levels for indoor air are presented in Tables 2-1 and 2-2, respectively.

2.3 Site-specific Shallow Soil Gas and Subslab RBCs

Site-specific industrial SSG RBCs are based on attenuation factors calculated from subslab soil gas and indoor air data collected at three facilities (755, 836, and 864) as documented in Appendix G. The most conservative attenuation factor from subslab to indoor air calculated at the three facilities sampled was 1 in 50. This attenuation factor was used with the indoor air RBCs to calculate site-specific industrial subslab soil gas RBCs.

The 1-in-10 attenuation factor between the shallow soil gas and the subslab soil gas concentrations used to calculate shallow soil gas screening levels in the Work Plan was retained. Therefore, a shallow soil gas to indoor air attenuation factor of 1 in 500 (i.e., combining the shallow soil gas to subslab soil gas attenuation factor of 1 in 10 and the subslab to indoor air attenuation factor of 1 in 50) was applied to calculate site-specific industrial SSG RBCs. This attenuation factor is more conservative than the generic attenuation factor of 1 in 1,000 (for existing commercial buildings with slab-on-grade construction) presented in the DTSC's interim final VI guidance (DTSC, 2005b). Table 2-1 presents the site-specific subslab and SSG RBCs for an industrial scenario.

Because the subslab to indoor air attenuation factor derived for an industrial building may not be representative of attenuation through a residential slab, the conservative attenuation factor of 1 in 100 used to calculate residential screening levels in the Work Plan was used to calculate the site-specific residential SSG RBCs presented in Table 2-2. This assumes a 1-in-10 attenuation factor through the subslab to indoor air, and a 1-in-10 attenuation factor from shallow soil gas to subslab. No residential buildings currently overlie groundwater plumes at Travis AFB.

TABLE 2-1

Site-specific Risk-Based Concentrations for Indoor Air, Subslab and Shallow Soil Gas, and Groundwater - Industrial Land Use

Vapor Intrusion Assessment Report, Travis Air Force Base, California

Analyte	CAS Number	Molecular Weight	Unit Risk ($\mu g/m^3)^{-1}$	Source for Unit Risk	Reference Concentration ($\mu g/m^3$)	Source for Reference Concentration	Indoor Air RBC ($\mu g/m^3$)		Indoor Air RBC (ppbv)		SubSlab Soil Gas RBC (ppbv)		Shallow Soil Gas RBC (ppbv)		Shallow Soil Gas RBC ($\mu g/m^3$)		Groundwater Screening Level ($\mu g/L$)	
							Carcinogenic	Non-carcinogenic	Carcinogenic	Non-carcinogenic	Carcinogenic	Non-carcinogenic	Carcinogenic	Non-carcinogenic	Carcinogenic	Non-carcinogenic	Carcinogenic	Non-carcinogenic
1,1,1-Trichloroethane	71-55-6	130	NA	NA	5,000	IRIS	NA	2.2E+04	NA	4.1E+03	NA	2.1E+05	NA	2.1E+06	NA	1.1E+07	NA	2.5E+05
1,1-Dichloroethane	75-34-3	99	1.6E-06	CalEPA	NA	NA	7.7E+00	NA	1.9E+00	NA	9.5E+01	NA	9.5E+02	NA	3.9E+03	NA	2.5E+02	NA
1,1-Dichloroethene	75-35-4	97	NA	NA	70	CalEPA	NA	3.1E+02	NA	8.0E+01	NA	4.0E+03	NA	4.0E+04	NA	1.6E+05	NA	5.5E+03
1,2,4-Trimethylbenzene	95-63-6	120	NA	NA	7	PPRTV	NA	3.1E+01	NA	6.3E+00	NA	3.2E+02	NA	3.2E+03	NA	2.0E+04	ND	ND
1,2-Dichlorobenzene	95-50-1	150	NA	NA	200	HEAST	NA	8.8E+02	NA	1.4E+02	NA	7.0E+03	NA	7.0E+04	NA	4.4E+05	NA	9.5E+04
1,3,5-Trimethylbenzene	108-67-8	120	NA	NA	6	PPRTV	NA	2.6E+01	NA	5.3E+00	NA	2.6E+02	NA	2.6E+03	NA	1.0E+04	ND	ND
1,3-Dichlorobenzene	541-73-1	150	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.3E+04
1,4-Dichlorobenzene	106-46-7	150	1.1E-05	CalEPA	800	IRIS	1.1E+00	3.5E+03	1.8E-01	5.7E+02	9.0E+00	2.9E+04	9.0E+01	2.9E+05	5.5E+02	1.8E+06	9.5E+01	3.1E+05
Acetone	67-64-1	58	NA	NA	31,000	ATSDR	NA	1.4E+05	NA	5.9E+04	NA	3.0E+06	NA	3.0E+07	NA	7.0E+07	NA	1.6E+07
Benzene	71-43-2	78	7.8E-06	IRIS	30	IRIS	1.6E+00	1.3E+02	5.0E-01	4.1E+01	2.5E+01	2.0E+03	2.5E+02	2.0E+04	8.0E+02	6.5E+04	4.8E+01	4.0E+03
Carbon Tetrachloride	56-23-5	150	1.5E-05	IRIS	40	CalEPA	8.2E-01	1.8E+02	1.3E-01	2.9E+01	6.7E+00	1.5E+03	6.7E+01	1.5E+04	4.1E+02	9.0E+04	5.3E+00	1.1E+03
Chlorobenzene	108-90-7	110	NA	NA	1,000	CalEPA	NA	4.4E+03	NA	9.8E+02	NA	4.9E+04	NA	4.9E+05	NA	2.2E+06	NA	2.4E+05
Chloroform	67-66-3	120	2.3E-05	IRIS	300	CalEPA	5.3E-01	1.3E+03	1.1E-01	2.6E+02	5.4E+00	1.3E+04	5.4E+01	1.3E+05	2.7E+02	6.5E+05	2.0E+01	5.0E+04
1,2-Dichloroethene (Total)	540-59-0	97	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	ND	ND
Cyclohexane	110-82-7	84	NA	NA	6,000	IRIS	NA	2.6E+04	NA	7.6E+03	NA	3.8E+05	NA	3.8E+06	NA	1.3E+07	ND	ND
Ethylbenzene	100-41-4	110	2.5E-06	CalEPA	1,000	IRIS	4.9E+00	4.4E+03	1.1E+00	9.8E+02	5.4E+01	4.9E+04	5.4E+02	4.9E+05	2.5E+03	2.2E+06	1.4E+02	1.2E+05
1,1,2-Trichlorotrifluoroethane	76-13-1	190	NA	NA	30,000	HEAST	NA	1.3E+05	NA	1.7E+04	NA	8.5E+05	NA	8.5E+06	NA	6.5E+07	NA	5.3E+04
M,p-xylene (sum of isomers)	106-42-3	110	NA	NA	700	CalEPA	NA	3.1E+03	NA	6.9E+02	NA	3.5E+04	NA	3.5E+05	NA	1.6E+06	NA	1.2E+04
Methylene chloride	75-09-2	85	4.7E-07	IRIS	400	CalEPA	2.6E+01	1.8E+03	7.5E+00	5.2E+02	3.7E+02	2.6E+04	3.7E+03	2.6E+05	1.3E+04	9.0E+05	1.5E+03	1.0E+05
Hexane	110-54-3	86	NA	NA	700	IRIS	NA	3.1E+03	NA	8.8E+02	NA	4.4E+04	NA	4.4E+05	NA	1.6E+06	ND	ND
O-xylene (1,2-dimethyl benzene)	95-47-6	110	NA	NA	700	CalEPA	NA	3.1E+03	NA	6.9E+02	NA	3.5E+04	NA	3.5E+05	NA	1.6E+06	NA	1.6E+04
Tetrachloroethylene (PCE)	127-18-4	170	5.9E-06	CalEPA	35	CalEPA	2.1E+00	1.5E+02	3.0E-01	2.2E+01	1.5E+01	1.1E+03	1.5E+02	1.1E+04	1.1E+03	8.0E+04	2.6E+01	1.9E+03
Toluene	108-88-3	92	NA	NA	300	CalEPA	NA	1.3E+03	NA	3.5E+02	NA	1.8E+04	NA	1.8E+05	NA	6.5E+05	NA	6.0E+05
Trichloroethylene (TCE)	79-01-6	130	2.0E-06	CalEPA	600	CalEPA	6.1E+00	2.6E+03	1.1E+00	4.9E+02	5.7E+01	2.5E+04	5.7E+02	2.5E+05	3.1E+03	1.3E+06	1.2E+02	5.0E+04
Styrene	100-42-5	100	NA	NA	900	CalEPA	NA	3.9E+03	NA	9.5E+02	NA	4.8E+04	NA	4.8E+05	NA	2.0E+06	ND	ND
Vinyl chloride	75-01-4	63	4.4E-06	IRIS	100	IRIS	2.8E+00	4.4E+02	1.1E+00	1.7E+02	5.4E+01	8.5E+03	5.4E+02	8.5E+04	1.4E+03	2.2E+05	1.4E+01	2.2E+03
1,1,2,2-Tetrachloroethane	79-34-5	168	5.8E-05	IRIS	NA	NA	2.1E-01	NA	3.1E-02	NA	1.5E+00	NA	1.5E+01	NA	1.1E+02	NA	ND	ND
1,1,2-Trichloroethane	79-00-5	133	1.6E-05	IRIS	NA	NA	7.7E-01	NA	1.4E-01	NA	7.1E+00	NA	7.1E+01	NA	3.9E+02	NA	ND	ND
1,2,4-Trichlorobenzene	120-82-1	181	NA	NA	4	PPRTV	NA	1.8E+01	NA	2.4E+00	NA	1.2E+02	NA	1.2E+03	NA	1.0E+04	ND	ND
1,2-Dibromoethane	106-93-4	188	6.0E-04	IRIS	0.8	CalEPA	2.0E-02	3.5E+00	2.6E-03	4.6E-01	1.3E-01	2.0E+01	1.3E+00	2.3E+02	1.0E+01	1.8E+03	ND	ND
1,2-Dichloroethane	107-06-2	99	2.6E-05	IRIS	2,400	ATSDR	4.7E-01	1.1E+04	1.2E-01	2.7E+03	5.8E+00	1.4E+05	5.8E+01	1.4E+06	2.4E+02	5.5E+06	5.7E+01	2.6E+03
1,2-Dichloropropane	78-87-5	113	1.0E-05	CalEPA	4	IRIS	1.2E+00	1.8E+01	2.6E-01	3.9E+00	1.3E+01	1.9E+02	1.3E+02	1.9E+03	6.0E+02	1.0E+04	7.5E+01	1.1E+03
1,2-Dichloro-1,1,2,2-tetrafluoroethane	76-14-2	171	NA	NA	30,000	SURROGATE	NA	1.3E+05	NA	1.9E+04	NA	9.5E+05	NA	9.5E+06	NA	6.5E+07	ND	ND
1,3-Butadiene	106-99-0	54	3.0E-05	IRIS	2	IRIS	4.1E-01	8.8E+00	1.9E-01	4.0E+00	9.3E+00	2.0E+02	9.3E+01	2.0E+03	2.1E+02	4.4E+03	ND	ND
2-Methylnaphthalene	91-57-6	142	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	ND	ND
Benzyl chloride	100-44-7	127	4.9E-05	CalEPA	1	PPRTV	2.5E-01	4.4E+00	4.8E-02	8.5E-01	2.4E+00	4.0E+01	2.4E+01	4.2E+02	1.3E+02	2.2E+03	ND	ND
Bromomethane	74-83-9	95	NA	NA	5	IRIS	NA	2.2E+01	NA	5.7E+00	NA	2.8E+02	NA	2.8E+03	NA	1.1E+04	ND	ND
Bromodichloromethane	75-27-4	164	3.7E-05	CalEPA	NA	NA	3.3E-01	NA	4.9E-02	NA	2.5E+00	NA	2.5E+01	NA	1.7E+02	NA	5.1E+01	4.7E+04
Carbon Disulfide	75-15-0	76	NA	NA	700	IRIS	NA	3.1E+03	NA	1.0E+03	NA	5.0E+04	NA	5.0E+05	NA	1.6E+06	NA	1.5E+05
Chloroethane	75-00-3	65	NA	NA	10,000	IRIS	NA	4.4E+04	NA	1.7E+04	NA	8.5E+05	NA	8.5E+06	NA	2.2E+07	ND	ND
Chloromethane	74-87-3	50	1.8E-06	HEAST	90	IRIS	6.8E+00	3.9E+02	3.3E+00	1.9E+02	1.6E+02	9.5E+03	1.6E+03	9.5E+04	3.4E+03	2.0E+05	ND	ND
cis-1,2-Dichloroethene	156-59-2	97	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.8E+03
cis-1,3-Dichloropropene	1006-10-15	111	4.0E-06	IRIS	20	IRIS	3.1E+00	8.8E+01	6.8E-01	1.9E+01	3.4E+01	9.7E+02	3.4E+02	9.7E+03	1.6E+03	4.4E+04	ND	ND
Trichlorofluoromethane	75-69-4	137	NA	NA	700	HEAST	NA	3.1E+03	NA	5.5E+02	NA	2.8E+04	NA	2.8E+05	NA	1.6E+06	ND	ND
Dichlorodifluoromethane	75-71-8	121	NA	NA	200	HEAST	NA	8.8E+02	NA	1.8E+02	NA	9.0E+03	NA	9.0E+04	NA	4.4E+05	NA	6.0E+02
Hexachlorobutadiene	87-68-3	261	2.2E-05	IRIS	NA	NA	5.6E-01	NA	5.3E-02	NA	2.6E+00	NA	2.6E+01	NA	2.8E+02	NA	ND	ND
Methanol	67-56-1	32	NA	NA	4,000	CalEPA	NA	1.8E+04	NA	1.4E+04	NA	7.0E+05	NA	7.0E+06	NA	9.0E+06	ND	ND
Methyl ethyl ketone (2-Butanone)	78-93-3	72	NA	NA	5,000	IRIS	NA	2.2E+04	NA	7.5E+03	NA	3.8E+05	NA	3.8E+06	NA	1.1E+07	NA	2.3E+07
Methyl isobutyl ketone	108-10-1	100	NA	NA	3,000	IRIS	NA	1.3E+04	NA	3.2E+03	NA	1.6E+05	NA	1.6E+06	NA	6.5E+06	ND	ND
tert-Butyl methyl ether (MTBE)	1634-04-4	88	2.6E-07	CalEPA	3,000	IRIS	4.7E+01	1.3E+04	1.3E+01	3.6E+03	6.5E+02	1.8E+05	6.5E+03	1.8E+06	2.4E+04	6.5E+06	7.5E+03	2.1E+06
Naphthalene	91-20-3	128	3.4E-05	CalEPA	3	IRIS	3.6E-01	1.3E+01	6.9E-02	2.5E+00	3.4E+00	1.2E+02	3.4E+01	1.2E+03	1.8E+02	6.5E+03	ND	ND
n-Butylbenzene	104-51-8	134	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	ND	ND
Heptane	142-82-5	100	NA	NA	700	SURROGATE	NA	3.1E+03	NA	7.6E+02	NA	3.8E+04	NA	3.8E+05	NA	1.6E+06	ND	ND
n-Propylbenzene	103-65-1	120	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	ND	ND
Hexane	110-54-3	86	NA	NA	700	IRIS	NA	3.1E+03	NA	8.8E+02	NA	4.4E+04	NA	4.4E+05	NA	1.6E+06	ND	ND
tert-Butyl Alcohol	75-65-0	74	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	ND	ND
trans-1,2-Dichloroethene	156-60-5	97	NA	NA	60	PPRTV	NA	2.6E+02	NA	6.6E+01	NA	3.3E+03	NA	3.3E+04	NA	1.3E+05	NA	6.4E+03
trans-1,3-Dichloropropene	1006-10-26	111	4.0E-06	IRIS	20	IRIS	3.1E+00	8.8E+01	6.8E-01	1.9E+01	3.4E+01	9.7E+02	3.4E+02	9.7E+03	1.6E+03	4.4E+04	ND	ND

Notes:

µg/L = microgram(s) per liter

$\mu g/m^3$ = microgram(s) per cubic meter

ATSDR = Agency for Toxic Substances and Disease Registry (Atlanta)

CalEPA = California Environmental Protection Agency

CAS = Chemical Abstracts Service

HEAST = EPA Health Effects Assessment Summary Table

IRIS = Integrated Risk Information System

NA = not applicable

ND = Not detected in groundwater, not a groundwater contaminant of concern

ppbv = part(s) per million by volume

PPRTV = EPA Provisional Peer-reviewed Toxicity Value

RBC = risk-based concentration

SURROGATE = hexane used for heptane; 1,1,2-trichlorotrifluoroethane (Freon 113) used for 1,2-dichloro-1,1,2,2-tetrafluoroethane (Freon 114)

TABLE 2-2

Site-specific Risk-Based Concentrations for Indoor Air, Subslab and Shallow Soil Gas, and Groundwater - Residential Land Use

Vapor Intrusion Assessment Report, Travis Air Force Base, California

Analyte	CAS No.	Molecular Weight	Unit Risk ($\mu g/m^3)^{-1}$	Source for Unit Risk	Reference Concentration ($\mu g/m^3$)	Source for Reference Concentration	Indoor Air RBC ($\mu g/m^3$)		Indoor Air RBC (ppbv)		SubSlab Soil Gas RBC (ppbv)		Soil Gas RBC (ppbv)		Soil Gas RBC ($\mu g/m^3$)		Groundwater Screening Level (µg/L)	
							Carcinogenic	Non-carcinogenic	Carcinogenic	Non-carcinogenic	Carcinogenic	Non-carcinogenic	Carcinogenic	Non-carcinogenic	Carcinogenic	Non-carcinogenic	Carcinogenic	Non-carcinogenic
1,1,1-Trichloroethane	71-55-6	130	NA	NA	5,000	IRIS	NA	5.2E+03	NA	9.8E+02	NA	9.8E+03	NA	9.8E+04	NA	5.2E+05	NA	1.8E+05
1,1-Dichloroethane	75-34-3	99	1.6E-06	CalEPA	NA	NA	1.5E+00	NA	3.7E-01	NA	3.7E+00	NA	3.7E+01	NA	1.5E+02	NA	1.5E+02	5.2E+04
1,1-Dichloroethene	75-35-4	97	NA	NA	70	CalEPA	NA	1.0E+02	NA	2.5E+01	NA	2.5E+02	NA	2.5E+03	NA	1.0E+04	NA	3.9E+03
1,2,4-Trimethylbenzene	95-63-6	120	NA	NA	7	PPRTV	NA	7.3E+00	NA	1.5E+00	NA	1.5E+01	NA	1.5E+02	NA	7.3E+02	ND	ND
1,2-Dichlorobenzene	95-50-1	150	NA	NA	200	HEAST	NA	2.1E+02	NA	3.4E+01	NA	3.4E+02	NA	3.4E+03	NA	2.1E+04	NA	6.8E+04
1,3,5-Trimethylbenzene	108-67-8	120	NA	NA	6	PPRTV	NA	6.3E+00	NA	1.3E+00	NA	1.3E+01	NA	1.3E+02	NA	6.3E+02	ND	ND
1,3-Dichlorobenzene	541-73-1	150	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.3E+04
1,4-Dichlorobenzene	106-46-7	150	1.1E-05	CalEPA	800	IRIS	2.2E-01	8.3E+02	3.6E-02	1.4E+02	3.6E-01	1.4E+03	3.6E+00	1.4E+04	2.2E+01	8.3E+04	5.6E+01	2.2E+05
Acetone	67-64-1	58	NA	NA	31,000	ATSDR	NA	3.2E+04	NA	1.3E+04	NA	1.3E+05	NA	1.3E+06	NA	3.2E+06	NA	1.2E+07
Benzene	71-43-2	78	7.8E-06	IRIS	30	IRIS	3.1E-01	3.1E+01	9.7E-02	9.7E+00	9.7E-01	9.7E+01	1.0E+01	9.7E+02	3.1E+01	3.1E+03	2.9E+01	2.9E+03
Carbon Tetrachloride	56-23-5	150	1.5E-05	IRIS	40	CalEPA	1.6E-01	6.0E+01	2.6E-02	9.8E+00	2.6E-01	9.8E+01	2.6E+00	9.8E+02	1.6E+01	6.0E+03	3.2E+00	8.2E+02
Chlorobenzene	108-90-7	110	NA	NA	1,000	CalEPA	NA	1.5E+03	NA	3.3E+02	NA	3.3E+03	NA	3.3E+04	NA	1.5E+05	NA	1.7E+05
Chloroform	67-66-3	120	2.3E-05	IRIS	300	CalEPA	1.1E-01	4.5E+02	2.2E-02	9.0E+01	2.2E-01	9.0E+02	2.2E+00	9.0E+03	1.1E+01	4.5E+04	1.2E+01	3.6E+04
1,2-Dichloroethene (Total)	540-59-0	97	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	ND	ND
Cyclohexane	110-82-7	84	NA	NA	6,000	IRIS	NA	6.3E+03	NA	1.8E+03	NA	1.8E+04	NA	1.8E+05	NA	6.3E+05	ND	ND
Ethylbenzene	100-41-4	110	2.5E-06	CalEPA	1,000	IRIS	9.7E-01	1.0E+03	2.2E-01	2.2E+02	2.2E+00	2.2E+03	2.2E+01	2.2E+04	9.7E+01	1.0E+05	8.1E+01	8.8E+04
1,1,2-Trichlorotrifluoroethane	76-13-1	190	NA	NA	30,000	HEAST	NA	3.1E+04	NA	4.0E+03	NA	4.0E+04	NA	4.0E+05	NA	3.1E+06	NA	3.8E+04
M,p-xylene (sum of isomers)	106-42-3	110	NA	NA	700	CalEPA	NA	1.0E+03	NA	2.2E+02	NA	2.2E+03	NA	2.2E+04	NA	1.0E+05	NA	8.8E+03
Methylene chloride	75-09-2	85	4.7E-07	IRIS	400	CalEPA	5.2E+00	6.0E+02	1.5E+00	1.7E+02	1.5E+01	1.7E+03	1.5E+02	1.7E+04	5.2E+02	6.0E+04	9.1E+02	7.3E+04
Hexane	110-54-3	86	NA	NA	700	IRIS	NA	7.3E+02	NA	2.1E+02	NA	2.1E+03	NA	2.1E+04	NA	7.3E+04	ND	ND
O-xylene (1,2-dimethyl benzene)	95-47-6	110	NA	NA	700	CalEPA	NA	1.0E+03	NA	2.3E+02	NA	2.3E+03	NA	2.3E+04	NA	1.0E+05	NA	1.1E+04
Tetrachloroethylene (PCE)	127-18-4	170	5.9E-06	CalEPA	35	CalEPA	4.1E-01	5.0E+01	5.9E-02	7.2E+00	5.9E-01	7.2E+01	5.9E+00	7.2E+02	4.1E+01	5.0E+03	1.5E+01	1.4E+03
Toluene	108-88-3	92	NA	NA	300	CalEPA	NA	4.5E+02	NA	1.2E+02	NA	1.2E+03	NA	1.2E+04	NA	4.5E+04	NA	4.3E+05
Trichloroethylene (TCE)	79-01-6	130	2.0E-06	CalEPA	600	CalEPA	1.2E+00	8.9E+02	2.3E-01	1.7E+02	2.3E+00	1.7E+03	2.3E+01	1.7E+04	1.2E+02	8.9E+04	6.9E+01	3.6E+04
Styrene	100-42-5	100	NA	NA	900	CalEPA	NA	1.3E+03	NA	3.2E+02	NA	3.2E+03	NA	3.2E+04	NA	1.3E+05	ND	ND
Vinyl chloride	75-01-4	63	4.4E-06	IRIS	100	IRIS	1.6E-01	1.0E+02	6.2E-02	3.9E+01	6.2E-01	3.9E+02	6.2E+00	3.9E+03	1.6E+01	1.0E+04	4.1E+00	1.5E+03
1,1,2,2-Tetrachloroethane	79-34-5	168	5.8E-05	IRIS	NA	NA	4.2E-02	NA	6.1E-03	NA	6.1E-02	NA	6.0E-01	NA	4.2E+00	NA	ND	ND
1,1,2-Trichloroethane	79-00-5	133	1.6E-05	IRIS	NA	NA	1.5E-01	NA	2.7E-02	NA	2.7E-01	NA	2.7E+00	NA	1.5E+01	NA	ND	ND
1,2,4-Trichlorobenzene	120-82-1	181	NA	NA	4	PPRTV	NA	4.2E+00	NA	5.7E-01	NA	5.7E+00	NA	5.7E+01	NA	4.2E+02	ND	ND
1,2-Dibromoethane	106-93-4	188	6.0E-04	IRIS	0.8	CalEPA	4.1E-03	1.2E+00	5.3E-04	1.6E-01	5.3E-03	1.6E+00	5.0E-02	1.6E+01	4.0E-01	1.2E+02	ND	ND
1,2-Dichloroethane	107-06-2	99	2.6E-05	IRIS	2,400	ATSDR	9.4E-02	2.5E+03	2.3E-02	6.2E+02	2.3E-01	6.2E+03	2.3E+00	6.2E+04	9.4E+00	2.5E+05	3.4E+01	1.8E+03
1,2-Dichloropropane	78-87-5	113	1.0E-05	CalEPA	4	IRIS	2.4E-01	4.2E+00	5.2E-02	9.1E-01	5.2E-01	9.1E+00	5.2E+00	9.1E+01	2.4E+01	4.2E+02	4.5E+01	7.9E+02
1,2-Dichloro-1,1,2,2-tetrafluoroethane	76-14-2	171	NA	NA	30,000	SURROGATE	NA	3.1E+04	NA	4.4E+03	NA	4.4E+04	NA	4.4E+05	NA	3.1E+06	ND	ND
1,3-Butadiene	106-99-0	54	3.0E-05	IRIS	2	IRIS	8.1E-02	2.1E+00	3.7E-02	9.5E-01	3.7E-01	9.5E+00	3.7E+00	9.5E+01	8.1E+00	2.1E+02	ND	ND
2-Methylnaphthalene	91-57-6	142	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	ND	ND
Benzyl chloride	100-44-7	127	4.9E-05	CalEPA	1	PPRTV	1.0E+00	1.0E+00	1.9E-01	1.9E-01	1.9E+00	1.9E+00	1.9E+01	1.9E+01	1.0E+02	1.0E+02	ND	ND
Bromomethane	74-83-9	95	NA	NA	5	IRIS	NA	5.2E+00	NA	1.3E+00	NA	1.3E+01	NA	1.3E+02	NA	5.2E+02	ND	ND
Bromodichloromethane	75-27-4	164	3.7E-05	CalEPA	NA	NA	6.6E-02	NA	9.8E-03	NA	9.8E-02	NA	1.0E+00	NA	6.6E+00	NA	3.0E+01	3.4E+04
Carbon Disulfide	75-15-0	76	NA	NA	700	IRIS	NA	7.3E+02	NA	2.3E+02	NA	2.3E+03	NA	2.3E+04	NA	7.3E+04	3.2E+00	8.2E+02
Chloroethane	75-00-3	65	NA	NA	10,000	IRIS	NA	1.0E+04	NA	3.8E+03	NA	3.8E+04	NA	3.8E+05	NA	1.0E+06	ND	ND
Chloromethane	74-87-3	50	1.8E-06	HEAST	90	IRIS	1.4E+00	9.4E+01	6.8E-01	4.6E+01	6.8E+00	4.6E+02	6.8E+01	4.6E+03	1.4E+02	9.4E+03	ND	ND
cis-1,2-Dichloroethene	156-59-2	97	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.8E+03
cis-1,3-Dichloropropene	1006-10-15	111	4.0E-06	IRIS	20	IRIS	6.1E-01	2.1E+01	1.3E-01	4.6E+00	1.3E+00	4.6E+01	1.3E+01	4.6E+02	6.1E+01	2.1E+03	ND	ND
Trichlorofluoromethane	75-69-4	137	NA	NA	700	HEAST	NA	7.3E+02	NA	1.3E+02	NA	1.3E+03	NA	1.3E+04	NA	7.3E+04	ND	ND
Dichlorodifluoromethane	75-71-8	121	NA	NA	200	HEAST	NA	2.1E+02	NA	4.0E+01	NA	4.0E+02	NA	4.0E+03	NA	2.1E+04	NA	4.3E+02
Hexachlorobutadiene	87-68-3	261	2.2E-05	IRIS	NA	NA	1.1E-01	NA	1.0E-02	NA	1.0E-01	NA	1.0E+00	NA	1.1E+01	NA	ND	ND
Methanol	67-56-1	32	NA	NA	4,000	CalEPA	NA	4.2E+03	NA	3.2E+03	NA	3.2E+04	NA	3.2E+05	NA	4.2E+05	ND	ND
Methyl ethyl ketone (2-Butanone)	78-93-3	72	NA	NA	5,000	IRIS	NA	5.2E+03	NA	1.8E+03	NA	1.8E+04	NA	1.8E+05	NA	5.2E+05	NA	1.7E+07
Methyl isobutyl ketone	108-10-1	100	NA	NA	3,000	IRIS	NA	3.1E+03	NA	7.6E+02	NA	7.6E+03	NA	7.6E+04	NA	3.1E+05	ND	ND
tert-butyl methyl ether	1634-04-4	88	2.6E-07	CalEPA	3,000	IRIS	9.4E+00	3.1E+03	2.6E+00	8.6E+02	2.6E+01	8.6E+03	2.6E+02	8.6E+04	9.4E+02	3.1E+05	4.5E+03	1.5E+06
Naphthalene	91-20-3	128	3.4E-05	CalEPA	3	IRIS	7.2E-02	3.1E+00	1.4E-02	5.9E-01	1.4E-01	5.9E+00	1.4E+00	5.9E+01	7.2E+00	3.1E+02	ND	ND
n-butylbenzene	104-51-8	134	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	ND	ND
Heptane	142-82-5	100	NA	NA	700	SURROGATE	NA	7.3E+02	NA	1.8E+02	NA	1.8E+03	NA	1.8E+04	NA	7.3E+04	ND	ND
n-Propylbenzene	103-65-1	120	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	ND	ND
Hexane	110-54-3	86	NA	NA	700	IRIS	NA	7.3E+02	NA	2.1E+02	NA	2.1E+03	NA	2.1E+04	NA	7.3E+04	ND	ND
tert-Butyl Alcohol	75-65-0	74	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	ND	ND
trans-1,2-Dichloroethene	156-60-5	97	NA	NA	60	PPRTV	NA	6.3E+01	NA	1.6E+01	NA	1.6E+02	NA	1.6E+03	NA	6.3E+03	NA	4.6E+03
trans-1,3-Dichloropropene	1006-10-26	111	4.0E-06	IRIS	20	IRIS	6.1E-01	2.1E+01	1.3E-01	4.6E+00	1.3E+00	4.6E+01	1.3E+01	4.6E+02	6.1E+01	2.1E+03	ND	ND

Notes:

µg/L = microgram(s) per liter

$\mu g/m^3$ = microgram(s) per cubic meter

ATSDR = Agency for Toxic Substances and Disease Registry (Atlanta)

CalEPA = California Environmental Protection Agency

CAS = Chemical Abstracts Service

HEAST = EPA Health Effects Assessment Summary Table

IRIS = Integrated Risk Information System

NA = not applicable

ND = not detected in groundwater, not a groundwater contaminant of concern

ppbv = part(s) per million by volume

PPRTV = EPA Provisional Peer-reviewed Toxicity Value

RBC = risk-based concentration

SURROGATE = cis-1,2-dichloropropene used for trans-1,3-dichloropropene; hexane used for heptane; Freon 113 used for Freon 114; and naphthalene used for 2-methylnaphthalene

SECTION 3

Summary of Phases 1 and 2 Results

The Phase 1 and Phase 2 VI assessment field activities were performed at Travis AFB from June 23 through October 15, 2008. During Phase 1, shallow soil gas, subslab soil vapor, indoor air, and outdoor air samples were collected from each investigation area in accordance with the *Vapor Intrusion Assessment Work Plan* (CH2M HILL, 2008). During Phase 2, building surveys were performed at buildings identified in the Work Plan or identified upon review of the Phase 1 soil gas data. Pressure differential measurements were made at three buildings (Facilities 755, 836, and 864) to assess pressure differences between the vadose zone and the buildings that may increase or decrease the likelihood of VI. Collecting concurrent subslab soil vapor and indoor air samples at these three buildings was described in the Work Plan to support development of a site-specific soil gas attenuation factor for industrial buildings. Field activities followed the standard operating procedures (SOPs) provided in the Field Sampling Plan (FSP), Appendix A of the Work Plan.

3.1 Phase 1 Soil Gas Sampling

3.1.1 Phase 1 Soil Gas Sampling Locations

Phase 1 of the field effort consisted of collecting shallow soil gas samples. The objective of the shallow soil gas sampling was to measure the concentrations of VOCs in soil gas above groundwater plumes in order to evaluate whether the VI pathway may be complete and/or significant, considering both current and future land use. Four ERP groundwater sites or areas (FT004, SS029, DP039 and the WIOU, a commingled VOC plume that includes Sites SD033, SD034, SS035, SD036, and SD037) were selected in the Work Plan for soil gas sampling.

The general approach was to collect shallow soil gas samples in a grid above the groundwater plume. Samples were also collected adjacent to existing buildings that are not scheduled for demolition. Historical soil gas data collected during remedial investigations (RIs) (Weston, 1995; Radian Corporation [Radian], 1995 and 1996; and CH2M HILL, 1997) were reviewed, and some soil gas locations were selected to confirm past soil gas detections. Note that the RI data are primarily field screening data, and most of the analytical results are flagged as "tentatively identified compounds." Also, because active groundwater remediation is being performed at these sites, soil gas concentrations are expected to have declined over the last several years as groundwater VOC concentrations have declined. Samples were collected approximately 2 feet above the water table and at depths greater than 5 feet bgs, in accordance with DTSC's interim final VI guidance (DTSC, 2005b). The sample locations and purpose for each location are summarized in Table 3-1. Actual sample depths are also provided in this table. Sample collection was attempted at 85 locations. The formation was too tight to collect a soil gas sample at 16 locations. At five locations, water entered the sampling line, indicating the sample depth (8 to 9 feet bgs) was within the capillary fringe. No soil gas sample was collected at these locations. Shallow soil gas samples were collected at a total of 64 locations. Table 3-1 summarizes which sampling locations were successful and provides reasons if the sampling attempt was unsuccessful.

3.1.2 Soil Gas Sampling Procedure

Temporary soil gas sample probes were installed in accordance with Attachment A1 of the FSP (CH2M HILL, 2008), Standard Operating Procedure for the Installation of Shallow Soil Gas Sampling Probes in Conjunction with Indoor Vapor Intrusion Assessments (Post Run Tubing [PRT] Soil Gas Probes) and were sampled in accordance with Attachment A3, Standard Operating Procedure for the Collection of Soil Gas Samples from Soil Gas Probes (GeoProbe System – PRT) using Summa™ Canisters and a Helium Leak Check. The soil gas sampling procedures are generally consistent with guidance provided by the DTSC and California Regional Water Quality Control Board (RWQCB), Los Angeles Region (DTSC and California RWQCB, 2003; California RWQCB, 1997). These procedures were used at Site FT004, part of the WIOU, and part of Site SS029. However, because of the nature of the impermeable clay soils, some locations required several attempts to ensure a leak-free sample, and other locations were too impermeable to collect a soil gas sample. To increase efficiency, the field procedure was modified to use temporary soil gas sampling implants rather than collecting the sample through the PRT soil gas probes. The SOP for the Installation of Temporary Soil Gas Sampling Implants is provided as Appendix H in this report. A period of at least 24 hours elapsed prior to sample collection to allow the soil gas around the implant to come to equilibrium after the initial soil disturbance. The DTSC recommends a 30-minute equilibration time for PRT probes because of the minimal impact on the surrounding soil (DTSC and California RWQCB, 2003). Implants were sampled by following the procedures outlined in Attachment A3 of the FSP and were the same as used with the shallow soil gas sampling probes. The sampling method (GeoProbe or implant) is identified for each location listed in Table 3-1.

A helium leak check was performed prior to sampling to ensure the probe and implants were installed correctly. The probe and implants were purged with a sampling manifold (consisting of stainless steel Swagelok gas-tight valves and fittings and Teflon tubing) and an air pump. Three probe or implant volumes of soil gas were purged at approximately 200 milliliters per minute (mL/min). Soil gas samples were collected in 1-liter (L) Summa™ canisters equipped with flow controllers. The flow controllers were regulated to sample at a rate of 150 mL/min. The evacuated stainless steel Summa™ canisters were certified and provided by the analytical laboratory Applied Sciences Laboratory (ASL). The flow controllers were also provided by the laboratory. The samples were analyzed by ASL using Method TO-14A. The target analyte list included the chlorinated and non-chlorinated VOCs detected in groundwater at the site. Completed soil gas sample collection forms, which document the field procedures for each location, are provided in Appendix E.

3.1.3 Deviations from the Work Plan

The following deviations from the Work Plan (CH2M HILL, 2008) occurred during the soil gas sampling:

- As described in Section 3.1.2, some soil gas samples were collected using temporary implants rather than through the GeoProbe. The change in methodology was made to increase the efficiency of sample collection.
- Soil gas sample collection was not possible at some locations at Site FT004 and in the WIOU because of the impermeable nature of the predominantly clay lithology. When

sampling using the PRT soil gas probes, the probe was retracted in 6-inch intervals to create an annual space, and an attempt was made to collect a sample after each retraction. Prior to each sample collection attempt, the helium leak check was performed. The probe was retracted until a soil gas sample was successfully collected or a depth of 5 feet bgs was reached. If a sample was not collected from the original sampling location, a second borehole was attempted a few feet away and the process was repeated.

- At the locations where implants were used, sampling was attempted one time. The implants were installed with a 2-foot air permeable filter pack (entirely below 5 feet bgs) to maximize the likelihood of encountering a permeable lithologic zone.
- At a few sample locations where implants were used, water entered the sampling line at depths of (8 or 9 feet bgs), indicating the capillary fringe had been encountered and therefore no sample was collected.

Locations where samples were not obtained are identified in Table 3-1, and the reason is provided.

3.1.4 Phase 1 Soil Gas Sampling Results

A statistical summary of the VOCs detected in soil gas samples collected during Phase 1 is presented in Table 3-2. The complete data set is provided in Appendix A. As Table 3-2 shows, the site-specific SSG RBCs were exceeded by one or more chemicals at each site.

As expected based on the nature of groundwater contamination, trichloroethene (TCE) was the most commonly detected VOC in soil gas, and it was detected at the highest concentrations. The distribution of TCE detected in soil gas at Sites FT004, SS029, DP039, and the WIOU during Phase 1 is presented on Figures 3-1 through 3-4. The highest TCE concentrations were detected at Site SS029 where TCE exceeded 1,000 parts per billion by volume (ppbv) at three locations.

3.2 Phase 1 Subslab, Indoor Air, and Outdoor Air Sampling

3.2.1 Subslab and Indoor Air Sampling Locations

During Phase 1, in addition to the shallow soil gas samples, subslab soil vapor, indoor air, and outdoor air samples were collected at Facilities 755, 836, and 864 concurrently on July 29, 2008, over an 8-hour period from morning to early evening (working hours). These samples were collected to support the development of site-specific attenuation factors. Building surveys and long-term differential pressure measurements were performed at each of the three locations prior to sample collection (see Appendixes C and D). Subslab soil vapor samples were collected in accordance with Work Plan (CH2M HILL, 2008).

A total of nine VI investigation samples were collected in 6-L evacuated stainless steel Summa™ canisters certified and provided by the analytical laboratory, Columbia Analytical Services:

- Four indoor air samples (including one field duplicate)
- Three subslab soil vapor samples

- Two outdoor air samples

The locations of these concurrent subslab soil vapor and indoor air samples are illustrated on Figures 3-5 through 3-7. Each of the three facilities had one subslab/indoor air sampling location. An indoor air field duplicate was collected at Facility 864.

Two outdoor air samples were also collected over the same 8-hour period; one outside of Facility 755 and one between Facilities 836 and 864. The samples were collected upwind (west) of the facilities. During the sampling period, strong gusty wind was blowing from the southwest (the prevalent wind direction at Travis AFB). The purpose of the outdoor air samples was to assess the potential for VOCs from outdoor air to influence conditions within the buildings.

3.2.2 Subslab, Indoor, and Outdoor Air Sampling Procedures

Subslab soil vapor samples were collected in accordance with Attachment A8 of the FSP. Subslab probes were installed in the facility foundation at appropriate locations near the center of the facilities. The locations were cleared for utilities through the dig permit process and by the utility locator subcontractor Subtronics prior to installation. A helium leak check was performed prior to sampling to ensure the probe was installed correctly.

Subslab samples were collected over an 8-hour period in 6-L Summa™ canisters. The Summa™ canisters were equipped with flow controllers (calibrated by the analytical laboratory) to allow for time-weighted sample collection over the 8-hour period. The samples were analyzed by TO-14 selective ion monitoring (SIM). The target analyte list included, but was not limited to the chlorinated and non-chlorinated VOCs detected in groundwater at Travis AFB (CH2M HILL, 2008). The target analyte list is provided in Appendix B of the Work Plan (Supplemental Quality Assurance Project Plan).

Indoor air and outdoor air samples were collected in accordance with Attachment A5 of the FSP, TO-14/15 (Summa™ Canister) Integrated Ambient Air, Crawl Space Air and Outdoor Air Sampling Method for Trace VOCs. Indoor air samples were collected in the same room as the subslab sampling probe and collected concurrently with the subslab sample. The indoor air Summa™ canisters were placed on desks, to be within the breathing zone of office workers. Indoor air samples were collected over an 8-hour period in 6-L Summa™ canisters equipped with flow controllers calibrated by the laboratory.

3.2.3 Phase 1 Subslab, Indoor Air, and Outdoor Air Analytical Results

Concurrent subslab, indoor air, and outdoor air samples were collected at Facilities 755, 836, and 864 to support the development of site-specific attenuation factors for use in refining the screening levels for site-specific subsurface conditions. Facility 755 was demolished in 2009. The analytical results for these samples are presented in Tables 3-3 through 3-5. As these tables show, several VOCs were detected in subslab soil gas, indoor air, and outdoor air. No VOC concentrations detected in indoor air exceeded indoor air industrial RBCs. Concentrations detected in subslab soil vapor, indoor air, and outdoor air were generally similar (not indicative of a subslab source), with the exception of TCE. TCE concentrations detected beneath the subslabs of these facilities were one or more orders of magnitude higher than the indoor air concentrations, which is indicative of a subslab source. However,

TCE was also detected in the outdoor air samples; therefore, some or all of the TCE detected in indoor air may be due to sources other than VI.

3.3 Phase 2 Building Surveys

Phase 2 of the field effort consisted of performing building surveys in areas of interest. These buildings were either scheduled for building surveys in the Work Plan or were identified after reviewing the soil gas data obtained in Phase 1. The building surveys were performed to confirm the current building usage; identify potential soil gas migration routes (such as cracks in the foundation or sumps); confirm normal heating, ventilation, and air conditioning (HVAC) operation; and identify potential sources of chemicals of concern (COCs) and other VOCs within the buildings. Two rounds of building surveys were performed (in June 2008 and September to October 2008). Building surveys were performed in accordance with the Work Plan (CH2M HILL, 2008). Building surveys included interviews of the building custodians, when possible. The completed building survey forms are presented in Appendix C.

On June 9 and 16, 2008, building surveys were performed at Facilities 755, 836, and 864 to support the subslab soil vapor and indoor air sampling that occurred in July 2008. The purpose of the subslab soil vapor and indoor air sampling was to support development of a site-specific industrial soil gas attenuation factor to use in developing site-specific SSG RBCs.

Building surveys were also performed from September 19 to October 15, 2008, at the following facilities identified in the Work Plan:

- 16: former maintenance shop (Site SS016)
- 18: former degreasing facility and storage area (Site SS016)
- 22: maintenance shop (Site SS016)
- 811: maintenance shop (WIOU)

Facility 1001, a test cell located at Site SS016, was not surveyed although it was specified in the Work Plan, because it was discovered upon contacting the facility custodian that the building was no longer in use and would be demolished. An indoor air sample was collected at Facility 1001 by the Air Force Institute of Occupational Health (AFIOH) on May 14, 2008. The sample was analyzed for VOCs by Method TO 15. No VOCs exceeded the industrial indoor air RBCs. The analytical data collected during the AFIOH field effort is provided in Appendix A.

Facility 919, a vehicle maintenance shop in the WIOU, was included in the building survey, because it is close to elevated groundwater contamination (exceeding screening levels), and an attempt to collect shallow soil gas sample near the facility during Phase 1 was unsuccessful.

TABLE 3-1
Shallow Soil Gas Sampling Locations
Vapor Intrusion Assessment Report, Travis Air Force Base, California

ERP Site	Location ID	Sample Collection Successful?	Sample Method	Sample Depth (feet bgs)	QA/QC	Purpose
FT004	SB700x04	Yes	Geoprobe	8	FD	Define distribution of VOCs in SSG above groundwater plume.
	SB701x04	Yes	Geoprobe	8		Define distribution of VOCs in SSG above groundwater plume. Located near MW131x04 for comparison with groundwater data.
	SB702x04	Yes	Geoprobe	6		Define distribution of VOCs in SSG above groundwater plume.
	SB703x04	Yes	Geoprobe	7.5		Define distribution of VOCs in SSG above groundwater plume.
	SB704x04	No—soils too tight	Geoprobe	NA		Define distribution of VOCs in SSG above groundwater plume.
	SB705x04	No—soils too tight	Geoprobe	NA		Define distribution of VOCs in SSG above groundwater plume.
	SB706x04	Yes	Geoprobe	7		Define distribution of VOCs in SSG above groundwater plume. Located near MW266x04 for comparison with groundwater data.
	SB707x04	No—soils too tight	Geoprobe	NA		Define distribution of VOCs in SSG above groundwater plume.
	SB708x04	No—soils too tight	Geoprobe	NA		Define distribution of VOCs in SSG above groundwater plume. Located near EW576x04 for comparison with groundwater data.
SS029	SB709x29	Yes	Implant	10		Define distribution of VOCs in SSG above groundwater plume. Located near MW329x29 for comparison with groundwater data.
	SB710x29	Yes	Implant	8.5	FD	Define distribution of VOCs in SSG above groundwater plume.
	SB711x29	Yes	Implant	10		Define distribution of VOCs in SSG above groundwater plume.
	SB712x29	Yes	Implant	10		Define distribution of VOCs in SSG above groundwater plume.
	SB713x29	Yes	Implant	10		Define distribution of VOCs in SSG above groundwater plume. Located near MW1032x29 for comparison with groundwater data.
	SB714x29	Yes	Implant	10		Define distribution of VOCs in SSG above groundwater plume.
	SB715x29	Yes	Implant	10		Define distribution of VOCs in SSG above groundwater plume. Located near EW01x29 for comparison with groundwater data.

TABLE 3-1
Shallow Soil Gas Sampling Locations
Vapor Intrusion Assessment Report, Travis Air Force Base, California

ERP Site	Location ID	Sample Collection Successful?	Sample Method	Sample Depth (feet bgs)	QA/QC	Purpose
SS029	SB716x29	Yes	Implant	8.5		Define distribution of VOCs in SSG above groundwater plume. Located near EW02x29 for comparison with groundwater data.
	SB717x29	Yes	Implant	10	FD added	Define distribution of VOCs in SSG above groundwater plume.
	SB718x29	Yes	Geoprobe	9.5		Define distribution of VOCs in SSG above groundwater plume.
	SB719x29	Yes	Geoprobe	10		Define distribution of VOCs in SSG above groundwater plume.
	SB720x29	Yes	Geoprobe	9.5		Define distribution of VOCs in SSG above groundwater plume.
	SB721x29	Yes	Geoprobe	9		Define distribution of VOCs in SSG above groundwater plume. Located adjacent to Facility 1130 (Communication Transmitter).
	SB722x29	Yes	Geoprobe	10		Define distribution of VOCs in SSG above groundwater plume.
	SB723x29	Yes	Geoprobe	6.5		Define distribution of VOCs in SSG above groundwater plume. Located near EW06x29 for comparison with groundwater data.
WIOU	SB724x33	No—encountered capillary fringe at 9 feet bgs	Implant	NA		Evaluate current TCE soil gas concentrations near Facility 810. Located in area where TCE concentrations were detected at concentrations exceeding SSG RBCs by field screening method during RI (Radian, 1996).
	SB725x33	Yes	Implant	9		Evaluate current TCE soil gas concentrations near Facility 810. Located in area where TCE concentrations were detected at concentrations exceeding SSG RBCs by field screening method during RI (Radian, 1996).
	SB726x34	Yes	Implant	9		Evaluate PCE concentration in soil gas near MWSNSM4x37, where PCE was detected at concentrations exceeding groundwater screening levels.
	SB727x34	No—soils too tight	Implant	NA		Evaluate concentration of the volatile fraction of Stoddard solvent in soil gas overlying the Stoddard solvent floating product near Facility 811.
	SB728x34	Yes	Implant	9		Evaluate VOC concentrations in soil gas near Facility 801, in area where historical VOC concentrations exceeded groundwater screening levels and no recent groundwater data are available.

TABLE 3-1
Shallow Soil Gas Sampling Locations
Vapor Intrusion Assessment Report, Travis Air Force Base, California

ERP Site	Location ID	Sample Collection Successful?	Sample Method	Sample Depth (feet bgs)	QA/QC	Purpose
WIOU	SB729x35	No—soils too tight	Implant	NA		Evaluate VOC concentrations in soil gas near Facility 806, in area where historical VOC concentrations exceeded groundwater screening levels and no recent groundwater data are available.
	SB730x35	Yes	Geoprobe	8	FD	Evaluate VOC concentrations in soil gas near Facility 819 and define distribution of VOCs in SSG above main WIOU groundwater plume.
	SB731x35	No—soils too tight	Implant	NA		Evaluate current TCE soil gas concentrations near Facility 818. Located in area where TCE was detected at concentrations exceeding SSG RBCs by field screening method during RI (Radian, 1996).
	SB732x37	Yes	Implant	8		Define distribution of VOCs in SSG above main WIOU groundwater plume. Located near MW540x37 for comparison with groundwater data.
	SB733x37	Yes	Geoprobe	8		Define distribution of VOCs in SSG above main WIOU groundwater plume.
	SB734x37	No—soils too tight	Implant	NA		Define distribution of VOCs in SSG above main WIOU groundwater plume.
	SB735x37	No—encountered capillary fringe at 8 feet bgs	Implant	NA		Define distribution of VOCs in SSG above main WIOU groundwater plume (Facility 828 is on demolition list).
	SB736x37	No—soils too tight	Implant	NA		Define distribution of VOCs in SSG above main WIOU groundwater plume.
	SB737x37	No—encountered capillary fringe at 8 feet bgs	Implant	NA		Evaluate VOC concentrations in soil gas near Facility 861 (beyond footprint of VOC plume).
	SB738x37	No—soils too tight	Implant	NA		Define distribution of VOCs in SSG above main WIOU groundwater plume. Located near MW528x37 for comparison with groundwater data.
	SB739x37	Yes	Geoprobe	8		Define distribution of VOCs in SSG above the main groundwater plume, in highest concentration area. Located near EW599x37 for comparison with groundwater data. Building 835 has been demolished.
	SB740x37	Yes	Geoprobe	8	FD	Define distribution of VOCs in SSG above main WIOU groundwater plume (Facility 835 has been demolished).

TABLE 3-1
Shallow Soil Gas Sampling Locations
Vapor Intrusion Assessment Report, Travis Air Force Base, California

ERP Site	Location ID	Sample Collection Successful?	Sample Method	Sample Depth (feet bgs)	QA/QC	Purpose
WIOU	SB741x37	Yes	Implant	8		Define distribution of VOCs in SSG above main WIOU groundwater plume.
	SB742x37	Yes	Implant	6.5		Define distribution of VOCs in SSG above main WIOU groundwater plume.
	SB743x37	No—soils too tight	Implant	NA		Define distribution of VOCs in SSG above main WIOU groundwater plume. Located near MW531x37 for comparison with groundwater data.
	SB744x37	Yes	Subslab	0.5		Subslab sample used to develop site-specific attenuation factor. Also to evaluate VOC soil gas concentrations near Facility 836 (adjacent to area where TCE in groundwater exceeds screening levels). Note that an indoor air sample was collected in conjunction with the subslab sample.
	SB745x37	No—soils too tight	Implant	NA		Evaluate VOC soil gas concentrations near Facility 836 (adjacent to area where TCE in groundwater exceeds screening levels).
	SB746x37	Yes	Subslab	0.5		Subslab sample used to develop site-specific attenuation factor. Evaluate VOC soil gas concentrations near Facility 864. Note that an indoor air sample was collected in conjunction with the subslab sample.
	SB747x37	Yes	Implant	8		Evaluate VOC soil gas concentrations near Facility 864.
	SB748x36	No—encountered capillary fringe at 8 feet bgs	Implant	NA		Evaluate VOC soil gas concentrations near Facility 887. Facility 887 is open on one side (not a closed building).
	SB749x36	Yes	Implant	8		Define distribution of VOCs in SSG above main WIOU groundwater plume.
	SB750x36	No—soils too tight	Implant	NA	FD	Define distribution of VOCs in SSG above main WIOU groundwater plume.
	SB751x37	Yes	Implant	8		Define distribution of VOCs in SSG above main WIOU groundwater plume. Located near EW705x37 for comparison with groundwater data.
	SB752x37	Yes	Implant	8		Define distribution of VOCs in SSG above main WIOU groundwater plume (Facility 894 is on demolition list).
	SB753x37	Yes	Implant	8		Define distribution of VOCs in SSG above main WIOU groundwater plume.

TABLE 3-1
Shallow Soil Gas Sampling Locations
Vapor Intrusion Assessment Report, Travis Air Force Base, California

ERP Site	Location ID	Sample Collection Successful?	Sample Method	Sample Depth (feet bgs)	QA/QC	Purpose
WIOU	SB754x33	Yes	Implant	8		Evaluate current TCE soil gas concentrations near Facility 844. Located in area where TCE concentrations in groundwater historically exceeded 100 µg/L, but no recent groundwater data are available. Facility 844 is on demolition list.
	SB755x37	Yes	Implant	8		Define distribution of VOCs in SSG above main WIOU groundwater plume. Facility 845 on demolition list.
	SB756x37	Yes	Implant	8		Define distribution of VOCs in SSG above main WIOU groundwater plume. Facility 847 on demolition list.
	SB757x37	Yes	Implant	8		Define distribution of VOCs in SSG above main WIOU groundwater plume. Facility 893 on demolition list.
	SB758x37	Yes	Implant	8		Define distribution of VOCs in SSG above main WIOU groundwater plume.
	SB759x37	Yes	Geoprobe	8		Evaluate VOC soil gas concentrations near Facility 919.
	SB760x37	No—encountered capillary fringe at 8 feet bgs	Implant	NA	FD	Evaluate VOC soil gas concentrations near Facility 919.
	SB761x37	Yes	Implant	8		Evaluate northeastern extent of VOCs in soil gas.
	SB762x36	Yes	Implant	8		Located near EW503X33 for comparison with groundwater data.
	SB763x37	No—soils too tight	Implant	NA		Define distribution of VOCs in SSG above main WIOU groundwater plume. Facility 827 on demolition list.
	SB782x37	Yes	Geoprobe	6		Define distribution of VOCs in SSG along the eastern edge of the groundwater plume. Buildings 839, 835, and 840 have been demolished, and area is an active construction site, limiting accessibility in this area.
	SB783x37	No—soils too tight	Implant	NA		Define distribution of VOCs in SSG along the eastern edge of the groundwater plume. Buildings 839, 835, and 840 have been demolished, and area is an active construction site, limiting accessibility in this area.

TABLE 3-1
Shallow Soil Gas Sampling Locations
Vapor Intrusion Assessment Report, Travis Air Force Base, California

ERP Site	Location ID	Sample Collection Successful?	Sample Method	Sample Depth (feet bgs)	QA/QC	Purpose
WIOU	SB784x36	No—soils too tight	Implant	NA		Define distribution of VOCs in SSG above the main groundwater plume, in highest concentration area. Located near EW549x36 for comparison with groundwater data.
DP039	SB764x39	Yes	Subslab	0.5		Subslab sample, used to develop site-specific attenuation factor. Also to evaluate extent of elevated VOC concentrations in soil gas downgradient of source area (Building 755 is on demolition list). Note that an indoor air sample was collected in conjunction with the subslab sample.
	SB765x39	Yes	Implant	7		Define distribution of VOCs in SSG above groundwater plume. Located near MW780x39 for comparison with groundwater data.
	SB766x39	Yes	Implant	7		Define distribution of VOCs in SSG above groundwater plume. Located near MW751x39 for comparison with groundwater data.
	SB767x39	Yes	Implant	7		Define distribution of VOCs in SSG above groundwater plume. Located near MW781x39 for comparison with groundwater data.
	SB768x39	Yes	Implant	7		Define distribution of VOCs in SSG above groundwater plume. Located near MW784Sx39 for comparison with groundwater data.
	SB769x39	Yes	Implant	7		Define distribution of VOCs in SSG above groundwater plume.
	SB770x39	Yes	Implant	7	FD	Define distribution of VOCs in SSG above groundwater plume.
	SB771x39	Yes	Implant	7		Define distribution of VOCs in SSG above groundwater plume.
	SB772x39	Yes	Implant	7		Define distribution of VOCs in SSG above groundwater plume.
	SB773x39	Yes	Implant	7		Define distribution of VOCs in SSG above groundwater plume.
	SB774x39	Yes	Implant	7		Define distribution of VOCs in SSG above groundwater plume.
	SB775x39	Yes	Implant	7		Evaluate VOC soil gas concentrations near Facility 888 (overlying area where TCE in groundwater exceeds screening levels). Located near waterline, which may provide preferential pathway for soil gas.

TABLE 3-1
Shallow Soil Gas Sampling Locations
Vapor Intrusion Assessment Report, Travis Air Force Base, California

ERP Site	Location ID	Sample Collection Successful?	Sample Method	Sample Depth (feet bgs)	QA/QC	Purpose
DP039	SB776x39	Yes	Implant	7		Evaluate VOC soil gas concentrations near Facility 888 (overlying area where TCE in groundwater exceeds screening levels).
	SB777x39	Yes	Implant	7		Evaluate VOC soil gas concentrations near Facility 886 (located within 100 feet of 100 µg/L TCE isoconcentration contour in groundwater).
	SB778x39	Yes	Implant	7		Evaluate VOC soil gas concentrations near Facility 869 (located beyond expected extent of soil gas contamination).
	SB779x39	Yes	Implant	7		Define distribution of VOCs in SSG above groundwater plume. Located near MW785x39 for comparison with groundwater data.
	SB780x39	Yes	Implant	7	FD	Define distribution of VOCs in SSG above groundwater plume.
	SB781x39	Yes	Implant	6		Define distribution of VOCs in SSG above groundwater plume.

Notes:
µg/L = microgram(s) per liter
FD = field duplicate
NA = Not applicable, no sample collected
PCE = tetrachloroethene
QA/QC = quality assurance/quality control
SSG = shallow soil gas
TCE = trichloroethene
VOC = volatile organic compound
WIOU = West Industrial Operable Unit

TABLE 3-2
Summary of Analytes Detected in Shallow Soil Gas Samples
Vapor Intrusion Assessment Report, Travis Air Force Base, California

Site	Analyte	Number of Samples	Number of Detections	Minimum Concentration Detected (ppbv)	Maximum Concentration Detected (ppbv)	Average of Detected Concentrations (ppbv)	Standard Deviation of Detected Concentrations (ppbv)	Median of Detected Concentrations (ppbv)	Residential Site-specific SSG RBCs (ppbv)	Industrial Site-specific SSG RBCs (ppbv)
FT004	Acetone	5	4	21.2	44	31.5	10.7	30.4	1,300,000	30,000,000
	Bromomethane	5	1	3.77	3.77	3.8	NA	3.77	130	2800
	Benzene	5	4	0.75	0.95	0.8	0.1	0.845	10	250
	Toluene	5	5	2.09	7.29	3.4	2.2	2.56	12,000	180,000
	hexane	5	4	0.64	31.2	8.4	15.2	0.89	21,000	1.8E+05
	Chlorobenzene	5	1	0.07	0.07	0.1	NA	0.07	33,000	1.8E+05
	Chloromethane	5	3	0.46	0.54	0.5	0.0	0.51	68	1.8E+05
	1,1-DCA	5	2	0.17	0.63	0.4	0.3	0.4	37	950
	1,2-DCA	5	3	0.07	0.16	0.1	0.0	0.15	2.3	58
	1,1-DCE	5	2	0.23	0.59	0.4	0.3	0.41	2,500	40,000
	Cis-1,2-DCE	5	1	4.14	4.14	4.1	NA	4.14	NA	NA
	1,2-Dichloropropane	5	4	0.24	4.05	1.3	1.9	0.375	5.2	130
	Ethylbenzene	5	4	0.29	0.34	0.3	0.0	0.305	22	540
	Trichlorofluoromethane	5	4	0.02	0.26	0.1	0.1	0.135	NA	NA
	Freon 113	5	2	0.08	0.19	0.1	0.1	0.135	NA	NA
	Dichlorodifluoromethane	5	3	0.32	0.57	0.4	0.1	0.4	4,000	90,000
	MEK	5	5	3.66	24.5	11.2	8.4	8.68	180,000	3,800,000
	MIBK	5	4	0.45	43.5	11.3	21.5	0.63	76,000	1,600,000
	Methylene chloride	5	1	7.87	7.87	7.9	NA	7.87	150	3,700
	Naphthalene	5	1	2.91	2.91	2.9	NA	2.91	1.4	34
	PCE	5	5	0.07	1.31	0.5	0.5	0.32	5.9	150
	MTBE	5	1	17.5	17.5	17.5	NA	17.5	260	6,500
	1,1,1-TCA	5	2	0.24	0.65	0.4	0.3	0.445	98,000	2,100,000
	TCE	5	5	34.8	1740	379.7	760.4	43.6	23	570
	Chloroform	5	3	0.05	1.74	0.6	1.0	0.06	2.2	54
	1,2,4-Trimethylbenzene	5	1	0.32	0.32	0.3	NA	0.32	150	3,200
	m,p-Xylene	5	3	0.8	0.9	0.8	0.1	0.83	22,000	350,000
SS029	Acetone	15	14	15.3	615	122.9	165.3	49.2	1,300,000	30,000,000
	Bromodichloromethane	15	1	0.47	0.47	0.5	NA	0.47	1	25
	Bromomethane	15	5	1.31	2.69	2.1	0.6	2.13	130	2,800
	Benzene	15	7	0.96	11	4.3	3.5	2.91	10	250
	Toluene	15	14	2.46	1,830	174.5	490.7	5.66	12,000	180,000
	hexane	15	15	1.54	55.1	10.2	15.5	3.66	21,000	440,000
	Chlorobenzene	15	1	1.08	1.08	1.1	NA	1.08	33,000	490,000
	Chloromethane	15	6	0.42	2.08	1.1	0.6	0.935	68	1,600
	1,1-DCA	15	7	1.75	74.1	37.8	28.8	50.4	37	950
	1,2-DCA	15	8	0.1	17.7	3.9	6.3	0.16	2.3	58
	1,2-DCB	15	2	0.59	17.5	9.0	12.0	9.045	3,400	70,000
	1,4-DCB	15	1	1.04	1.04	1.0	NA	1.04	3.6	90
	1,1-DCE	15	7	2.06	143	51.4	50.1	45	2,500	40,000
	Cis-1,2-DCE	15	11	0.13	165	27.8	53.1	2.58	NA	NA
	trans-1,2-DCE	15	2	0.42	1.26	0.8	0.6	0.84	1,600	33,000
	trans-1,3-Dichloropropene	15	1	2.15	2.15	2.2	NA	2.15	13	9,700
	1,2-Dichloropropane	15	2	0.42	0.73	0.6	0.2	0.575	5.2	130
	Ethylbenzene	15	10	0.52	124	14.8	38.6	1.33	22	540
	EDB	15	3	0.14	3.18	1.2	1.8	0.15	0.05	1.3
	Trichlorofluoromethane	15	10	0.2	0.32	0.2	0.0	0.23	NA	NA
	Freon 113	15	10	0.08	20.7	4.9	7.0	0.43	NA	NA
	Dichlorodifluoromethane	15	9	0.43	0.58	0.5	0.1	0.54	4,000	90,000

TABLE 3-2
Summary of Analytes Detected in Shallow Soil Gas Samples
Vapor Intrusion Assessment Report, Travis Air Force Base, California

Site	Analyte	Number of Samples	Number of Detections	Minimum Concentration Detected (ppbv)	Maximum Concentration Detected (ppbv)	Average of Detected Concentrations (ppbv)	Standard Deviation of Detected Concentrations (ppbv)	Median of Detected Concentrations (ppbv)	Residential Site-specific SSG RBCs (ppbv)	Industrial Site-specific SSG RBCs (ppbv)
	MEK	15	15	1.97	219	33.7	58.7	9	180,000	3,800,000
	MIBK	15	12	0.45	6,160	721.4	1,752.6	2.33	76,000	1,600,000
	Methylene chloride	15	5	71	553	282.4	179.3	274	150	3,700
	Naphthalene	15	2	0.7	0.72	0.7	0.0	0.71	1.4	34
	PCE	15	12	0.07	251	55.2	79.9	5.165	5.9	150
	Styrene	15	5	0.36	2.98	1.2	1.0	1.08	32,000	480,000
	MTBE	15	3	7.31	39	21.4	16.1	17.9	260	6,500
	1,1,1-TCA	15	8	0.07	193	74.1	75.7	56.1	98,000	2,100,000
	1,1,2-TCA	15	3	1.88	9.81	4.6	4.5	2.06	2.7	71
	1,2,4-Trichlorobenzene	15	1	2.97	2.97	3.0	NA	2.97	NA	NA
	TCE	15	16	4.81	5420	703.6	1,388.4	154.5	23	570
	Chloroform	15	12	0.06	4.55	1.6	1.7	0.96	2.2	54
	1,2,4-Trimethylbenzene	15	7	0.28	2.15	0.9	0.7	0.6	150	3,200
	1,3,5-Trimethylbenzene	15	2	0.53	1.54	1.0	0.7	1.035	130	2,600
	Vinyl chloride	15	3	0.37	2.59	1.3	1.2	0.92	6.2	540
	m,p-Xylene	15	10	1.22	410	48.7	127.6	2.095	22,000	350,000
	o-Xylene	15	9	0.4	192	28.9	63.3	0.87	23,000	350,000
WIOU	Acetone	24	23	3.78	749	75.4	149.4	49	1,300,000	30,000,000
	Bromodichloromethane	24	1	1.22	1.22	1.2	NA	1.22	1	25
	Bromomethane	24	3	0.25	6.09	3.7	3.1	4.72	130	2,800
	Benzene	24	14	0.73	170	15.8	44.5	2.23	10	250
	Toluene	24	21	0.84	23.5	4.8	6.1	2.49	12,000	180,000
	hexane	24	17	0.89	92.2	13.4	28.0	2.16	21,000	440,000
	Chlorobenzene	24	4	0.05	38.4	10.1	18.9	0.965	33,000	490,000
	Chloroethane	24	1	0.75	0.75	0.8	NA	0.75	380,000	8,500,000
	Chloromethane	24	11	0.47	22	4.1	6.2	1.59	68	1,600
	1,1-DCA	24	5	0.19	9.53	4.1	3.9	4.14	37	950
	1,2-DCA	24	6	0.11	56.1	9.7	22.7	0.515	2.3	58
	1,2-DCB	24	2	2.51	3.15	2.8	0.5	2.83	3,400	70,000
	1,4-DCB	24	2	1.1	6.55	3.8	3.9	3.825	3.6	90
	1,1-DCE	24	4	1.11	19.3	7.5	8.6	4.8	2,500	40,000
	Cis-1,2-DCE	24	5	0.19	247	82.5	112.4	10.1	NA	NA
	trans-1,2-DCE	24	4	0.39	19.7	8.0	9.3	5.905	1,600	33,000
	trans-1,3-Dichloropropene	24	1	3.26	3.26	3.3	NA	3.26	13	9,700
	1,2-Dichloropropane	24	5	0.36	252	51.0	112.3	1.11	5.2	130
	Ethylbenzene	24	10	0.27	3.07	1.5	0.9	1.51	22	540
	EDB	24	2	0.34	0.93	0.6	0.4	0.635	0.05	1.3
	Trichlorofluoromethane	24	6	0.24	0.45	0.3	0.1	0.31	NA	NA
	Freon 113	24	5	0.08	3.65	1.5	1.8	0.38	NA	NA
	Dichlorodifluoromethane	24	17	0.5	0.7	0.6	0.1	0.61	4,000	90,000
	MEK	24	21	2.16	24.8	8.8	5.5	8.04	180,000	3,800,000
	MIBK	24	13	0.39	1.78	1.0	0.5	0.69	76,000	1,600,000
	Methylene chloride	24	4	1.32	96	33.7	43.2	18.765	150	3,700
	Naphthalene	24	6	0.6	17.4	5.7	6.7	3.13	1.4	34
	1,1,2,2-Tetrachloroethane	24	2	2.29	12.7	7.5	7.4	7.495	0.6	15
	PCE	24	16	0.13	31.3	5.7	8.6	1.625	5.9	150
	Styrene	24	3	1.4	2.59	1.9	0.6	1.56	32,000	480,000
	MTBE	24	9	0.54	12.5	2.1	3.9	0.67	260	6,500
	1,1,1-TCA	24	4	0.07	74.9	20.6	36.3	3.76	98,000	2,100,000

TABLE 3-2
Summary of Analytes Detected in Shallow Soil Gas Samples
Vapor Intrusion Assessment Report, Travis Air Force Base, California

Site	Analyte	Number of Samples	Number of Detections	Minimum Concentration Detected (ppbv)	Maximum Concentration Detected (ppbv)	Average of Detected Concentrations (ppbv)	Standard Deviation of Detected Concentrations (ppbv)	Median of Detected Concentrations (ppbv)	Residential Site-specific SSG RBCs (ppbv)	Industrial Site-specific SSG RBCs (ppbv)
	1,1,2-TCA	24	3	0.06	0.89	0.4	0.4	0.35	2.7	71
	TCE	24	21	0.41	464	27.6	100.3	3.19	23	570
	Chloroform	24	21	0.11	24.7	3.7	6.2	1.29	2.2	54
	1,2,4-Trimethylbenzene	24	11	0.48	3.74	1.3	0.9	1.07	150	3,200
	1,3,5-Trimethylbenzene	24	2	0.68	1.82	1.3	0.8	1.25	130	2,600
	Vinyl chloride	24	3	0.29	41.4	14.2	23.6	0.85	6.2	540
	m,p-Xylene	24	9	0.81	13.8	4.2	4.3	2.94	22,000	350,000
	o-Xylene	24	11	0.68	6.03	1.8	1.5	1.37	23,000	350,000
DP039	Acetone	17	16	13.6	280	46.0	64.0	27.5	1,300,000	30,000,000
	Bromodichloromethane	17	1	0.19	0.19	0.2	NA	0.19	1	25
	Bromomethane	17	4	0.86	11.4	4.6	4.7	3.165	130	2,800
	Benzene	17	9	0.63	7.78	2.9	2.3	2.93	10	250
	Toluene	17	15	1.05	8.54	3.8	2.7	2.23	12,000	180,000
	hexane	17	11	0.51	67.5	11.0	19.4	2.84	21,000	440,000
	Chloroethane	17	2	0.9	1.32	1.1	0.3	1.11	380,000	8,500,000
	Chloromethane	17	9	0.47	2.45	1.1	0.8	0.69	68	1,600
	1,1-DCA	17	2	0.05	12.5	6.3	8.8	6.275	37	950
	1,1-DCE	17	6	0.35	240	46.3	95.2	8.505	2,500	40,000
	Cis-1,2-DCE	17	4	0.05	0.63	0.3	0.3	0.32	NA	NA
	1,2-Dichloropropane	17	1	0.43	0.43	0.4	NA	0.43	5.2	130
	Ethylbenzene	17	11	0.36	3.86	1.4	1.1	0.86	22	540
	Trichlorofluoromethane	17	7	0.26	0.96	0.5	0.3	0.29	NA	NA
	Freon 113	17	6	0.09	6.18	1.5	2.4	0.195	NA	NA
	Dichlorodifluoromethane	17	12	0.47	3.7	0.8	0.9	0.575	4,000	90,000
	MEK	17	16	1.88	46.1	9.9	11.8	6.24	180,000	3,800,000
	MIBK	17	12	0.56	40.2	4.6	11.3	0.875	76,000	1,600,000
	Methylene chloride	17	2	8.66	73.2	40.9	45.6	40.93	150	3,700
	Naphthalene	17	4	0.26	14.6	4.0	7.1	0.495	1.4	34
	1,1,2,2-Tetrachloroethane	17	3	0.44	1.56	1.0	0.6	0.96	0.6	15
	PCE	17	9	0.1	23.2	3.2	7.6	0.23	5.9	150
	Styrene	17	4	0.32	1.58	0.8	0.6	0.68	32,000	480,000
	MTBE	17	5	0.26	0.7	0.5	0.2	0.55	260	6,500
	1,1,1-TCA	17	3	0.07	68.9	23.4	39.4	1.22	98,000	2,100,000
	1,1,2-TCA	17	1	4.03	4.03	4.0	NA	4.03	2.7	71
	TCE	17	16	0.5	2120	216.6	567.4	7.965	23	570
	Chloroform	17	13	0.27	4.34	1.6	1.5	0.87	2.2	54
	1,2,4-Trimethylbenzene	17	6	0.29	2.45	1.1	0.8	0.965	150	3,200
	1,3,5-Trimethylbenzene	17	2	0.36	2.24	1.3	1.3	1.3	130	2,600
	m,p-Xylene	17	9	0.79	4.8	2.5	1.3	2.77	22,000	350,000
	o-Xylene	17	10	0.49	3.58	1.6	1.0	1.32	23,000	350,000

Notes:
DCA = dichloroethane
DCB = dichlorobenzene
DCE = dichloroethene
EDB = dibromoethane
MEK = 2-Butanone
MIBK = methyl isobutyl ketone
MTBE = methyl tert-butyl ether
NA = not applicable
ppbv = part(s) per billion by volume
SSG RBC = shallow soil gas risk-based concentration
TCA = trichloroethane
TCE = trichloroethene
WIOU = West Industrial Operable Unit

TABLE 3-3
Analytes Detected at Facility 755
Vapor Intrusion Assessment Report, Travis Air Force Base, California

Analyte	Indoor Air Concentration (ppbv)	Flag	Industrial Indoor Air RBC	Subslab Soil Vapor Concentration (ppbv)	Flag	Industrial Site Specific Subslab Soil Vapor RBC	Outdoor Air Concentration (ppbv)	Flag
1,1,1-Trichloroethane	2.10E-02		4.1E+03	7.40E-01		2.1E+05	1.10E-02	
1,1,2,2-Tetrachloroethane	ND		3.1E-02	ND		1.5E+00	ND	
1,1,2-Trichloro-1,2,2-trifluoroethane	4.40E-02		NA	4.90E-02		NA	4.50E-02	
1,1,2-Trichloroethane	ND		1.4E-01	ND		7.1E+00	ND	
1,1-Dichloroethane	ND		1.9E+00	2.10E-02		9.5E+01	ND	
1,1-Dichloroethene	9.70E-03		8.0E+01	6.50E-01		4.0E+03	ND	
1,2,4-Trichlorobenzene	1.10E-01		2.4E+00	ND		1.2E+02	ND	
1,2,4-Trimethylbenzene	2.50E-02	J	6.3E+00	1.50E-01		3.2E+02	ND	
1,2-Dibromoethane (ethylene dibromide)	ND		2.60E-03	7.30E-04	J	1.30E-01	ND	
1,2-Dichloro-1,1,2,2-tetrafluoroethane (CFC 114)	1.50E-02	J	1.9E+04	1.40E-02	J	9.5E+05	ND	
1,2-Dichlorobenzene	2.60E-03	J	1.4E+02	ND		7.0E+03	ND	
1,2-Dichloroethane	8.50E-03	J	1.2E-01	6.90E-03	J	5.8E+00	8.80E-03	J
1,2-Dichloropropane	1.40E-03	J	2.6E-01	2.20E-03	J	1.3E+01	1.40E-03	J
1,3,5-Trimethylbenzene (mesitylene)	ND		5.3E+00	3.80E-02	J	2.6E+02	ND	
1,3-Dichlorobenzene	1.90E-03	J	NA	8.80E-04	J	NA	8.50E-04	J
1,4-Dichlorobenzene	6.50E-03		1.8E-01	9.80E-03		9.0E+00	2.00E-03	J
Acetone	5.00E+00		5.9E+04	2.50E+00	J	3.0E+06	4.50E+00	
Benzene	ND		5.0E-01	ND		2.5E+01	ND	
Bromodichloromethane	ND		5.0E-02	ND		2.5E+00	ND	
Bromomethane	ND		5.7E+00	ND		2.8E+02	ND	
Carbon tetrachloride	8.00E-02		1.3E-01	8.00E-02		6.7E+00	8.10E-02	
Chlorobenzene	3.10E-03	J	9.8E+02	2.10E-03	J	4.9E+04	1.50E-03	J
Chloroethane	6.50E-03	J	1.7E+04	ND		8.5E+05	8.10E-03	J
Chloroform	ND		1.1E-01	ND		5.4E+00	ND	
Chloromethane	5.10E-01		3.3E+00	2.20E-01		1.6E+02	5.60E-01	
cis-1,2-Dichloroethylene	1.20E-03	J	NA	6.90E-02		NA	ND	

TABLE 3-3
Analytes Detected at Facility 755
Vapor Intrusion Assessment Report, Travis Air Force Base, California

Analyte	Indoor Air Concentration (ppbv)	Flag	Industrial Indoor Air RBC	Subslab Soil Vapor Concentration (ppbv)	Flag	Industrial Site Specific Subslab Soil Vapor RBC	Outdoor Air Concentration (ppbv)	Flag
cis-1,3-Dichloropropene	ND		6.8E-01	ND		3.4E+01	ND	
Dichlorodifluoromethane	4.70E-01		1.8E+02	4.60E-01		9.0E+03	4.60E-01	
Ethylbenzene	3.00E-02	J	1.1E+00	8.90E-02		5.5E+01	2.80E-02	J
Hexachlorobutadiene	ND		5.3E-02	ND		2.6E+00	ND	
m,p-Xylene	1.30E-01		6.9E+02	4.40E-01		3.5E+04	1.20E-01	
MEK	6.00E-01		7.5E+03	3.60E-01		3.8E+05	5.90E-01	
MIBK	ND		3.2E+03	1.90E-02	J	1.6E+05	ND	
Methylene chloride	ND		7.5E+00	ND		3.7E+02	ND	
Naphthalene	ND		6.9E-02	ND		3.4E+00	ND	
n-Hexane	7.20E-02	J	NA	4.80E-02	J	NA	4.70E-02	J
o-Xylene	4.60E-02		6.9E+02	1.50E-01		3.5E+04	3.40E-02	J
Styrene	ND		9.5E+02	ND		4.8E+04	ND	
tert-Butyl methyl ether	ND		1.30E+01	ND		6.50E+02	ND	
PCE	7.60E-03		3.0E-01	4.90E-02		1.50E+01	7.10E-03	
Toluene	9.90E-02		3.5E+02	3.80E-01		1.8E+04	8.30E-02	
trans-1,2-Dichloroethene	ND		6.6E+01	2.60E-03	J	3.3E+03	ND	
trans-1,3-Dichloropropene	ND		6.8E-01	ND		3.4E+01	ND	
TCE	2.10E-02		1.2E+00	2.40E+00		5.7E+01	7.20E-03	J
Trichlorofluoromethane	2.30E-01		5.5E+02	2.30E-01		2.8E+04	2.20E-01	
Vinyl chloride	ND		1.1E+00	8.50E-03	J	5.4E+01	ND	

Notes:

J flag = Result is greater than or equal to the method detection limit and less than the primary quantitation limit, or analyte concentration is an estimated value.
MEK = 2-Butanone
MIBK = Methyl isobutyl ketone
NA = not applicable
ND = not detected
PCE = Tetrachloroethylene
ppbv = part(s) per billion by volume
RBC = risk-based concentration
TCE = Trichloroethylene

TABLE 3-4
Analytes Detected at Facility 836
Vapor Intrusion Assessment Report, Travis Air Force Base, California

Analyte	Indoor Air Concentration (ppbv)	Flag	Indoor Air RBC	Subslab Soil Vapor Concentration (ppbv)	Flag	Site Specific Subslab Soil Vapor RBC	Outdoor Air Concentration (ppbv)	Flag
1,2,4-Trichlorobenzene	ND		2.4E+00	ND		1.2E+02	ND	
1,1,1-Trichloroethane	1.10E-02		3.1E-02	9.00E-03		1.5E+00	1.00E-02	
1,1,2,2-Tetrachloroethane	ND		3.1E-02	ND		1.5E+00	ND	
1,1,2-Trichloro-1,2,2-trifluoroethane	4.40E-02		1.4E-01	4.00E-02		7.1E+00	4.60E-02	
1,1,2-Trichloroethane	ND		1.9E+00	ND		9.5E+01	ND	
1,1-Dichloroethane	ND		1.9E+00	ND		9.5E+01	ND	
1,1-Dichloroethene	2.50E-03	J	8.0E+01	1.70E-03	J	4.0E+03	2.20E-03	J
1,2,4-Trimethylbenzene	1.90E-01	J	6.3E+00	2.60E+00		3.2E+02	2.40E-02	J
1,2-Dibromoethane (ethylene dibromide)	ND		2.60E-03	ND		1.30E-01	ND	
1,2-Dichloro-1,1,2,2-tetrafluoroethane (CFC 114)	2.30E-02	J	1.9E+04	1.60E-02	J	9.5E+05	1.50E-02	J
1,2-Dichlorobenzene	ND		1.4E+02	ND		7.0E+03	ND	
1,2-Dichloroethane	2.90E-02		1.2E-01	1.40E-03	J	5.8E+00	8.20E-03	J
1,2-Dichloropropane	1.50E-03	J	2.6E-01	1.00E-03	J	1.3E+01	1.60E-03	J
1,3,5-Trimethylbenzene (mesitylene)	8.00E-02	J	5.3E+00	1.40E+00		2.6E+02	ND	
1,3-Dichlorobenzene	2.10E-03	J	NA	6.80E-04	J	NA	1.20E-03	J
1,4-Dichlorobenzene	3.70E-03	J	1.8E-01	1.20E-02		9.0E+00	2.60E-03	J
Acetone	1.50E+01		5.9E+04	9.80E+00		3.0E+06	2.80E+00	J
Benzene	ND		5.0E-01	ND		2.5E+01	ND	
Bromodichloromethane	ND		5.0E-02	ND		2.5E+00	ND	
Bromomethane	ND		5.7E+00	1.90E-02	J	2.8E+02	2.70E-02	J
Carbon tetrachloride	7.60E-02		1.3E-01	7.20E-02		6.7E+00	7.60E-02	
Chlorobenzene	2.00E-03	J	9.8E+02	1.50E-03	J	4.9E+04	1.30E-03	J
Chloroethane	6.50E-03	J	1.7E+04	3.40E-02		8.5E+05	8.20E-03	J
Chloroform	ND		1.1E-01	1.90E-01		5.4E+00	ND	
Chloromethane	5.70E-01		3.3E+00	9.10E-02		1.6E+02	5.20E-01	
cis-1,2-Dichloroethylene	ND		NA	7.30E-02		NA	ND	

TABLE 3-4
Analytes Detected at Facility 836
Vapor Intrusion Assessment Report, Travis Air Force Base, California

Analyte	Indoor Air Concentration (ppbv)	Flag	Indoor Air RBC	Subslab Soil Vapor Concentration (ppbv)	Flag	Site Specific Subslab Soil Vapor RBC	Outdoor Air Concentration (ppbv)	Flag
cis-1,3-Dichloropropene	ND		6.8E-01	ND		3.4E+01	ND	
Dichlorodifluoromethane	4.80E-01		1.8E+02	4.60E-01		9.0E+03	4.60E-01	
Ethylbenzene	1.40E-01		1.1E+00	1.10E-01		5.5E+01	1.60E-02	J
Hexachlorobutadiene	ND		5.3E-02	ND		2.6E+00	ND	
m,p-Xylene	5.90E-01		6.9E+02	7.10E-01		3.5E+04	5.60E-02	
MEK	5.70E-01		7.5E+03	5.60E-01		3.8E+05	3.30E-01	
MIBK	2.20E-01	J	3.2E+03	9.40E-02	J	1.6E+05	ND	
Methylene chloride	ND		7.5E+00	ND		3.7E+02	ND	
Naphthalene	ND		6.9E-02	ND		3.4E+00	ND	
n-Hexane	6.00E-02	J	NA	5.30E-02	J	NA	ND	
o-Xylene	2.10E-01		6.9E+02	3.90E-01		3.5E+04	2.20E-02	J
Styrene	3.80E-02	J	9.5E+02	ND		4.8E+04	ND	
tert-Butyl methyl ether	ND		1.30E+01	ND		6.50E+02	ND	
PCE	1.00E-02		3.0E-01	4.30E-02		1.5E+01	5.20E-03	J
Toluene	9.40E-01		3.5E+02	5.60E-01		1.8E+04	1.00E-01	
trans-1,2-Dichloroethene	ND		6.6E+01	ND		3.3E+03	ND	
trans-1,3-Dichloropropene	ND		6.8E-01	ND		3.4E+01	ND	
TCE	1.10E-02		1.2E+00	6.00E-01		5.7E+01	1.60E-03	J
Trichlorofluoromethane	2.50E-01		5.5E+02	2.30E-01		2.8E+04	2.20E-01	
Vinyl chloride	ND		1.1E+00	ND		5.4E+01	ND	

Notes:

J flag = Result is greater than or equal to the method detection limit and less than the primary quantitation limit, or analyte concentration is an estimated value.
NA = not applicable
ND = not detected
MEK = 2-Butanone
MIBK = Methyl isobutyl ketone
PCE = Tetrachloroethylene
ppbv = part(s) per billion by volume
RBC = risk-based concentration
TCE = Trichloroethylene

TABLE 3-5
Analytes Detected at Facility 864
Vapor Intrusion Assessment Report, Travis Air Force Base, California

Analyte	Indoor Air Concentration (ppbv)	Flag	Indoor Air RBC	Subslab Soil Vapor Concentration (ppbv)	Flag	Site Specific Subslab Soil Vapor RBC	Outdoor Air Concentration (ppbv)	Flag
1,1,1-Trichloroethane	1.50E-02		4.1E+03	2.30E-01		2.1E+05	1.00E-02	
1,1,2,2-Tetrachloroethane	ND		3.1E-02	ND		1.5E+00	ND	
1,1,2-Trichloro-1,2,2-trifluoroethane	4.50E-02		NA	8.40E-02		NA	4.60E-02	
1,1,2-Trichloroethane	ND		1.4E-01	1.70E-02		7.1E+00	ND	
1,1-Dichloroethane	ND		1.9E+00	5.10E-03	J	9.5E+01	ND	
1,1-Dichloroethene	2.10E-03	J	8.0E+01	2.90E-02		4.0E+03	2.20E-03	J
1,2,4-Trichlorobenzene	ND		2.4E+00	ND		1.2E+02	ND	
1,2,4-Trimethylbenzene	4.10E-02	J	6.3E+00	2.70E-01		3.2E+02	2.40E-02	J
1,2-Dibromoethane (ethylene dibromide)	ND		2.60E-03	2.90E-03	J	1.30E-01	ND	
1,2-Dichloro-1,1,2,2-tetrafluoroethane (CFC 114)	1.50E-02	J	1.9E+04	1.50E-02	J	9.5E+05	1.50E-02	J
1,2-Dichlorobenzene	ND		1.4E+02	1.90E-03	J	7.0E+03	ND	
1,2-Dichloroethane	1.90E-02		1.2E-01	4.80E-03	J	5.8E+00	8.20E-03	J
1,2-Dichloropropane	1.60E-03	J	2.6E-01	ND		1.3E+01	1.60E-03	J
1,3,5-Trimethylbenzene (mesitylene)	ND		5.3E+00	6.90E-02	J	2.6E+02	ND	
1,3-Dichlorobenzene	1.10E-03	J	NA	1.90E-03	J	NA	1.20E-03	J
1,4-Dichlorobenzene	3.30E-03	J	1.8E-01	2.10E-02		9.0E+00	2.60E-03	J
Acetone	8.50E+00		5.9E+04	8.10E+00		3.0E+06	2.80E+00	J
Benzene	ND		5.0E-01	1.30E-01		2.5E+01	ND	
Bromodichloromethane	ND		5.0E-02	ND		2.5E+00	ND	
Bromomethane	2.10E-02	J	5.7E+00	2.90E-02	J	2.8E+02	2.70E-02	J
Carbon tetrachloride	7.90E-02		1.3E-01	2.50E-02		6.7E+00	7.60E-02	
Chlorobenzene	3.50E-03	J	9.8E+02	4.20E-03	J	4.9E+04	1.30E-03	J
Chloroethane	1.90E-02		1.7E+04	3.60E-02		8.5E+05	8.20E-03	J
Chloroform	ND		1.1E-01	1.10E-01		5.4E+00	ND	
Chloromethane	6.90E-01		3.3E+00	1.80E-01		1.6E+02	5.20E-01	
cis-1,2-Dichloroethylene	ND		NA	2.10E-01		NA	ND	

TABLE 3-5
Analytes Detected at Facility 864
Vapor Intrusion Assessment Report, Travis Air Force Base, California

Analyte	Indoor Air Concentration (ppbv)	Flag	Indoor Air RBC	Subslab Soil Vapor Concentration (ppbv)	Flag	Site Specific Subslab Soil Vapor RBC	Outdoor Air Concentration (ppbv)	Flag
cis-1,3-Dichloropropene	ND		6.8E-01	3.60E-03	J	3.4E+01	ND	
Dichlorodifluoromethane	4.90E-01		1.8E+02	4.60E-01		9.0E+03	4.60E-01	
Ethylbenzene	4.10E-02		1.1E+00	1.50E-01		5.5E+01	1.60E-02	J
Hexachlorobutadiene	ND		5.3E-02	ND		2.6E+00	ND	
m,p-Xylene	1.60E-01		6.9E+02	7.30E-01		3.5E+04	5.60E-02	
MEK	9.30E-01		7.5E+03	9.60E-01		3.8E+05	3.30E-01	
MIBK	3.90E-01		3.2E+03	9.70E-02	J	1.6E+05	ND	
Methylene chloride	ND		7.5E+00	ND		3.7E+02	ND	
Naphthalene	ND		6.9E-02	ND		3.4E+00	ND	
n-Hexane	ND		NA	7.70E-02	J	NA	ND	
o-Xylene	4.40E-02		6.9E+02	2.30E-01		3.5E+04	2.20E-02	J
Styrene	ND		9.5E+02	ND		4.8E+04	ND	
tert-Butyl methyl ether	ND		1.30E+01	ND		6.50E+02	ND	
PCE	1.10E-02		3.0E-01	2.00E+00		1.5E+01	5.20E-03	J
Toluene	2.00E-01		3.5E+02	1.20E+01		1.8E+04	1.00E-01	
trans-1,2-Dichloroethene	ND		6.6E+01	6.70E-03	J	3.3E+03	ND	
trans-1,3-Dichloropropene	ND		6.8E-01	ND		3.4E+01	ND	
TCE	6.20E-03	J	1.2E+00	9.90E+00		5.7E+01	1.60E-03	J
Trichlorofluoromethane	2.90E-01		5.5E+02	2.50E-01		2.8E+04	2.20E-01	
Vinyl chloride	2.40E-03	J	1.1E+00	6.20E-03	J	5.4E+01	ND	

Notes:

J flag = Result is greater than or equal to the method detection limit and less than the primary quantitation limit, or analyte concentration is an stimated value.
NA = not applicable
ND = not detected
MEK = 2-Butanone
MIBK = Methyl isobutyl ketone
PCE = Tetrachloroethylene
ppbv = part(s) per billion by volume
RBC = risk-based concentration
TCE = Trichloroethylene

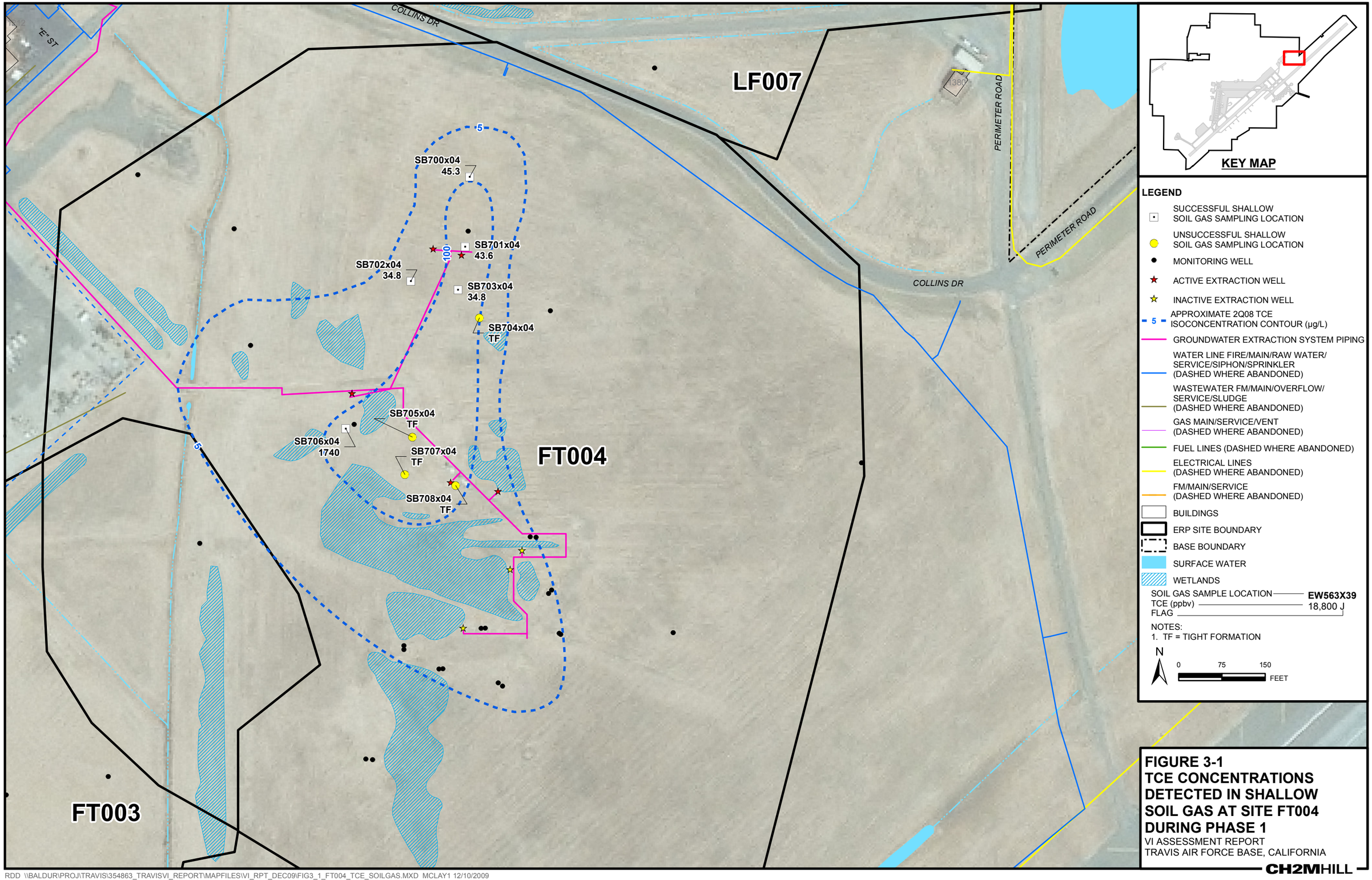


FIGURE 3-1
TCE CONCENTRATIONS DETECTED IN SHALLOW SOIL GAS AT SITE FT004 DURING PHASE 1
VI ASSESSMENT REPORT
TRAVIS AIR FORCE BASE, CALIFORNIA

CH2MHILL

RDD \\BALDUR\PROJ\TRAVIS\354863_TRAVISVI_REPORT\MAPFILES\VI_RPT_DEC09\FIG3_1_FT004_TCE_SOILGAS.MXD MCLAY1 12/10/2009

SS029

SD001

FT005

WP017

SS030

SB709x29
1010

SB710x29
26.4

SB711x29
51.6J

SB712x29
159

SB713x29
150

SB714x29
16.9

SB715x29
187

SB716x29
5420

SB717x29
24.1FD

SB718x29
2270

SB719x29
776

SB720x29
607

SB721x29
53.1

SB722x29
476

SB723x29
25.4

PERIMETER ROAD

CARSON ROAD

PERIMETER ROAD

5

100

5

5

5

385

385

1148

KEY MAP

LEGEND

- SHALLOW SOIL GAS SAMPLING LOCATION
- MONITORING WELL
- ACTIVE EXTRACTION WELL
- INACTIVE EXTRACTION WELL
- 5 APPROXIMATE 2Q08 TCE ISOCONCENTRATION CONTOUR (µg/L)
- GROUNDWATER EXTRACTION SYSTEM PIPING
- WATER LINE FIRE/MAIN/RAW WATER/ SERVICE/SIPHON/SPRINKLER (DASHED WHERE ABANDONED)
- WASTEWATER FM/MAIN/OVERFLOW/ SERVICE/SLUDGE (DASHED WHERE ABANDONED)
- GAS MAIN/SERVICE/VENT (DASHED WHERE ABANDONED)
- FUEL LINES (DASHED WHERE ABANDONED)
- ELECTRICAL LINES (DASHED WHERE ABANDONED)
- FM/MAIN/SERVICE (DASHED WHERE ABANDONED)
- ERP SITE BOUNDARY
- BASE BOUNDARY
- BUILDINGS
- SURFACE WATER
- WETLANDS

SOIL GAS SAMPLE LOCATION — EW563X39
TCE (ppbv) — 18,800 J
FLAG

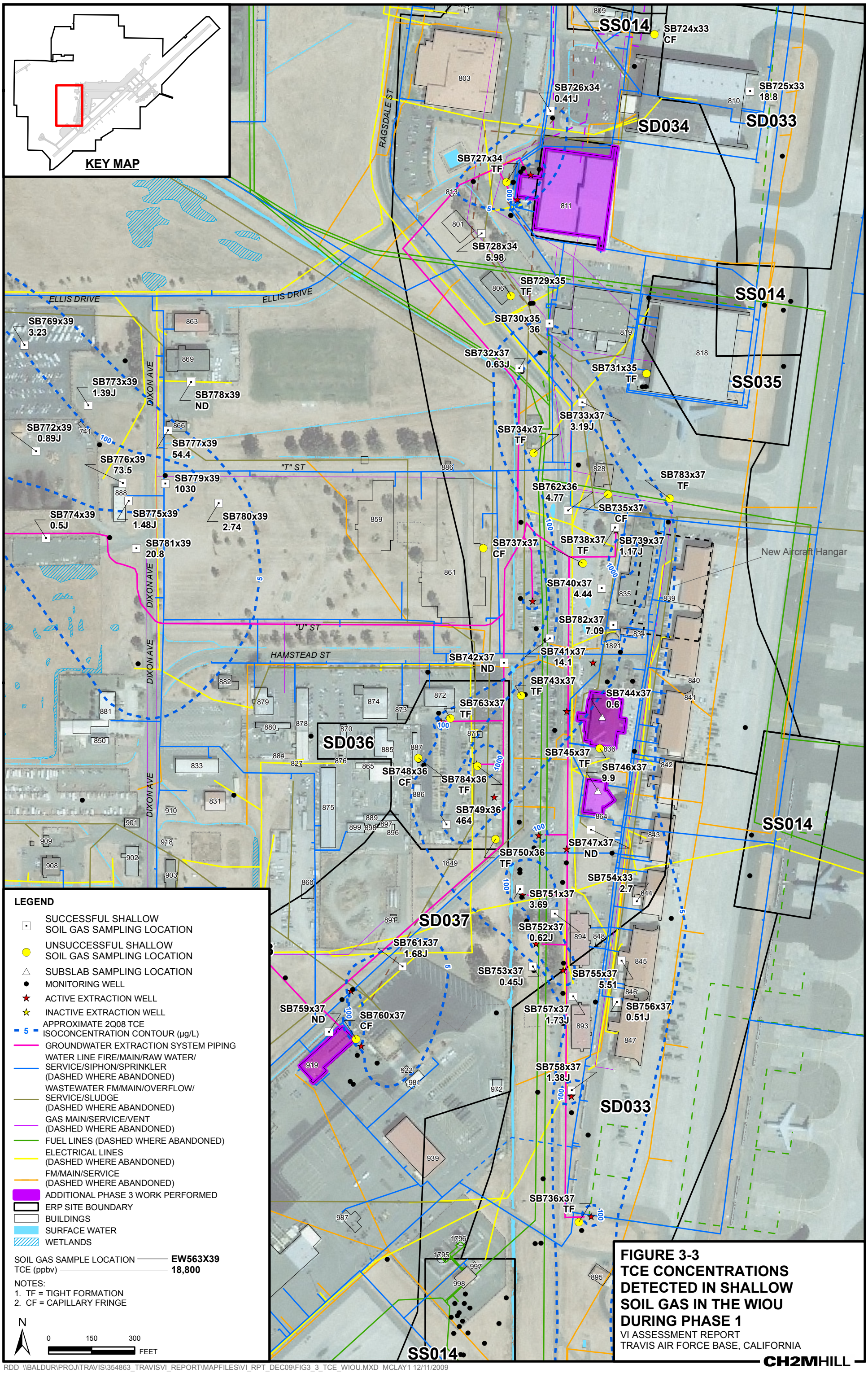
N

0 200 400
FEET

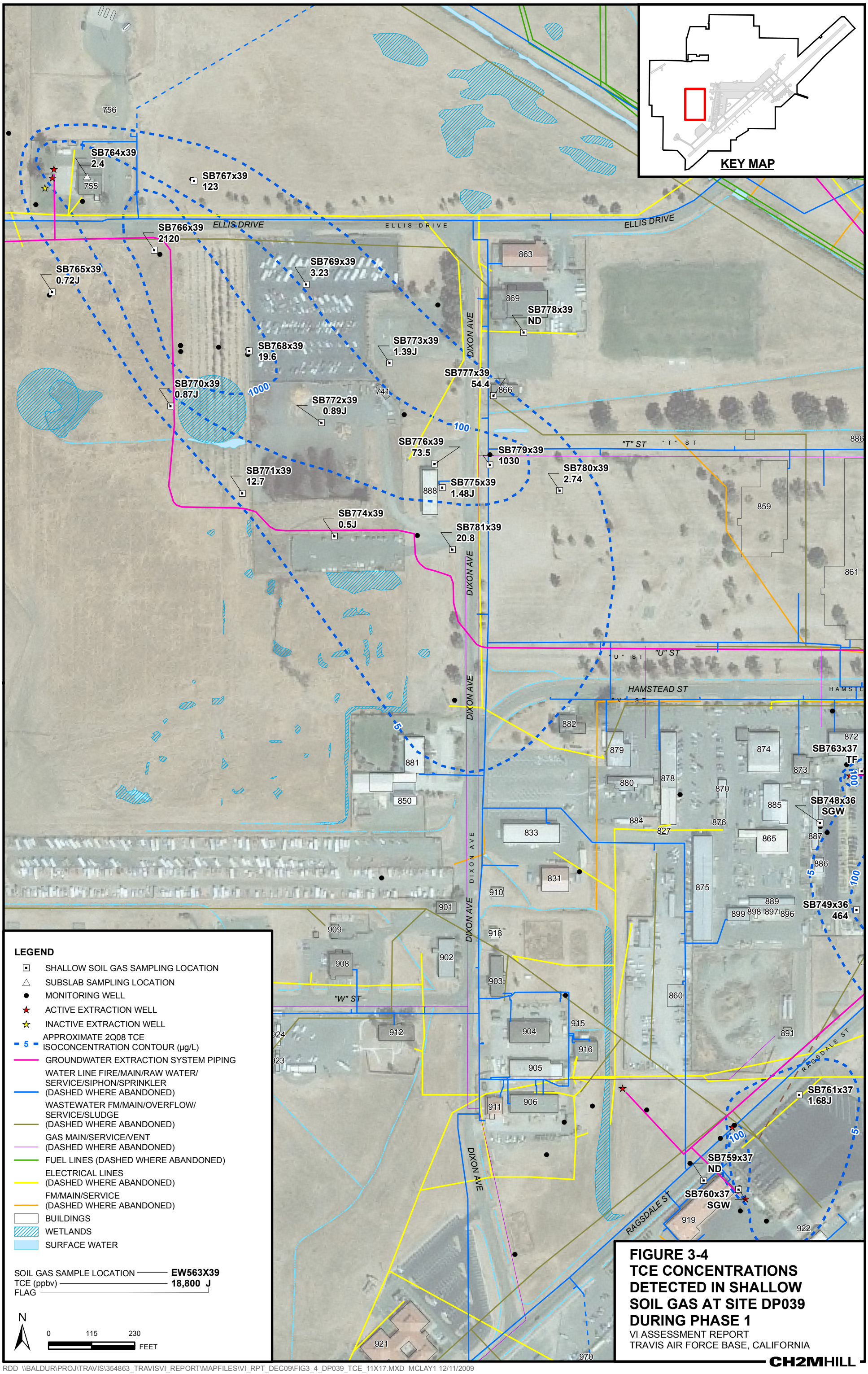
FIGURE 3-2
TCE CONCENTRATIONS DETECTED IN SHALLOW SOIL GAS AT SITE SS029 DURING PHASE 1
VI ASSESSMENT REPORT
TRAVIS AIR FORCE BASE, CALIFORNIA

CH2MHILL

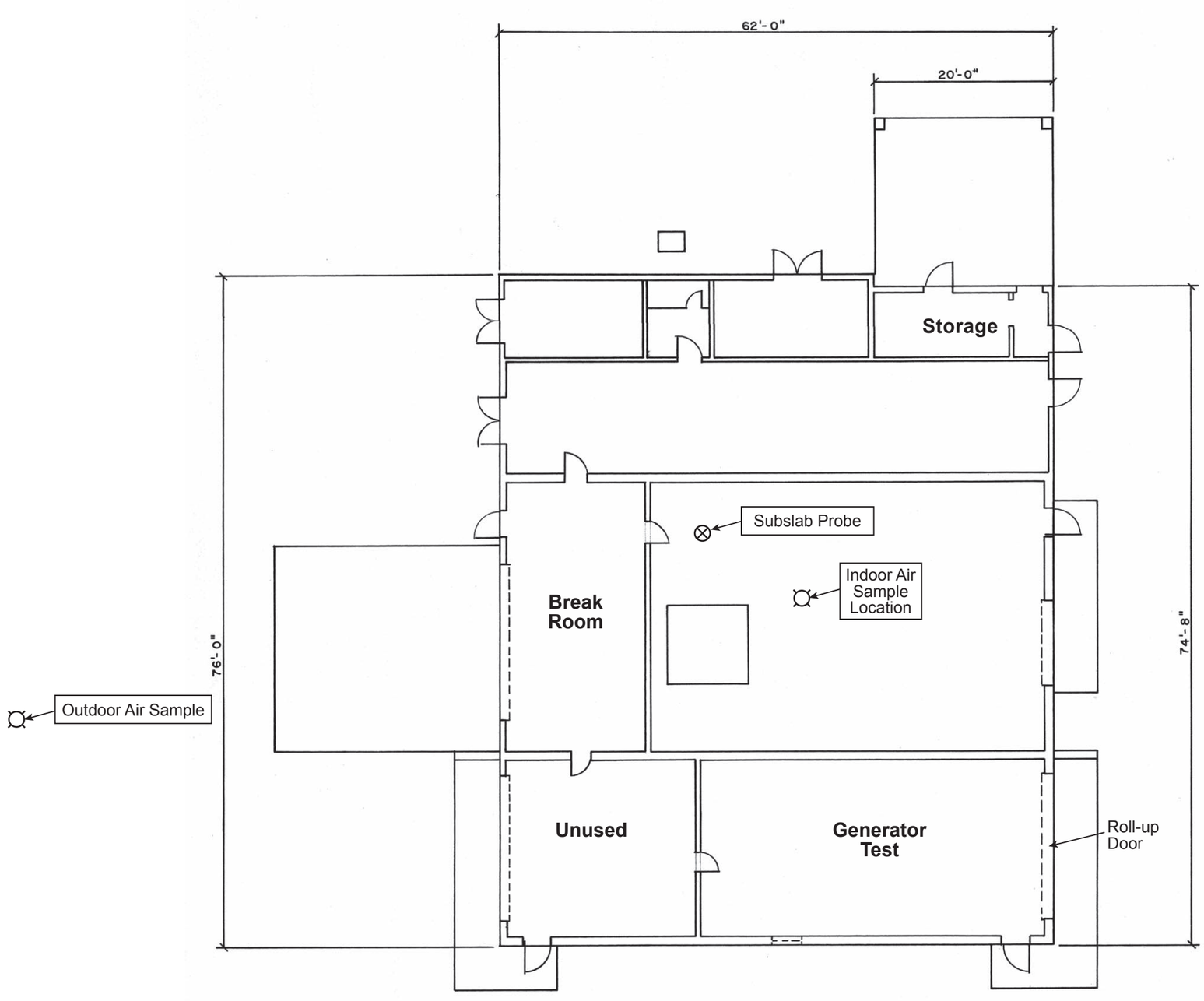
RDD \\BALDUR\PROJ\TRAVIS\354863_TRAVISVI_REPORT\MAPFILES\VI_RPT_DEC09\FIG3_2_SS029_TCE_SOILGAS.MXD MCLAY1 12/10/2009



RDD \\BALDUR\PROJ\TRAVIS\354863_TRAVISVI_REPORT\MAPFILES\VI_RPT_DEC09\FIG3_3_TCE_WIOU.MXD MCLAY1 12/11/2009



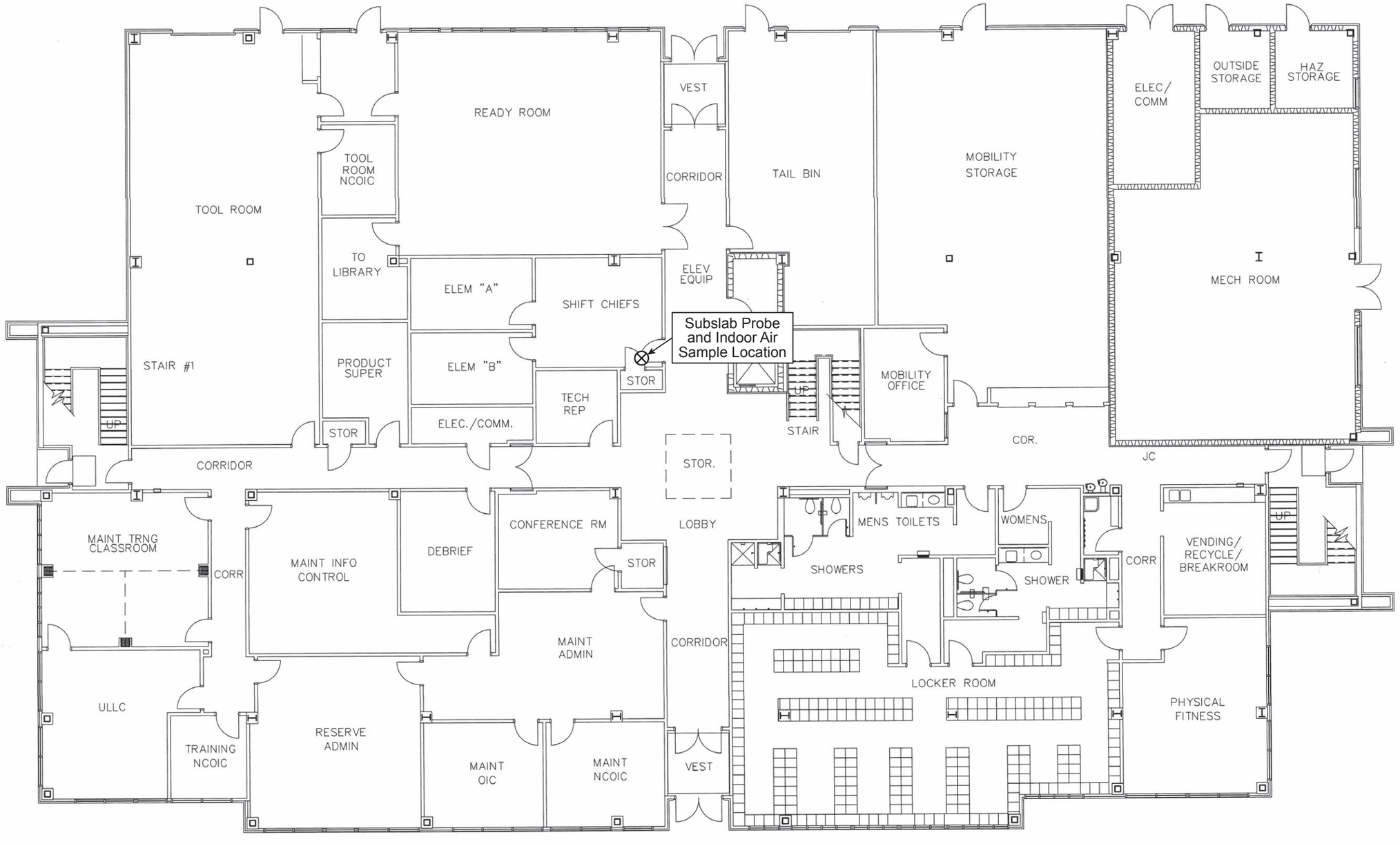
RDD \\BALDUR\PROJ\TRAVIS\354863_TRAVISVI_REPORT\MAPFILES\VI_RPT_DEC09\FIG3_4_DP039_TCE_11X17.MXD MCLAY1 12/11/2009



LEGEND

- Air Sample Location
- Subslab Probe

FIGURE 3-5
FACILITY 755 PHASE 1
SAMPLING LOCATIONS
VI ASSESSMENT REPORT
TRAVIS AIR FORCE BASE, CALIFORNIA



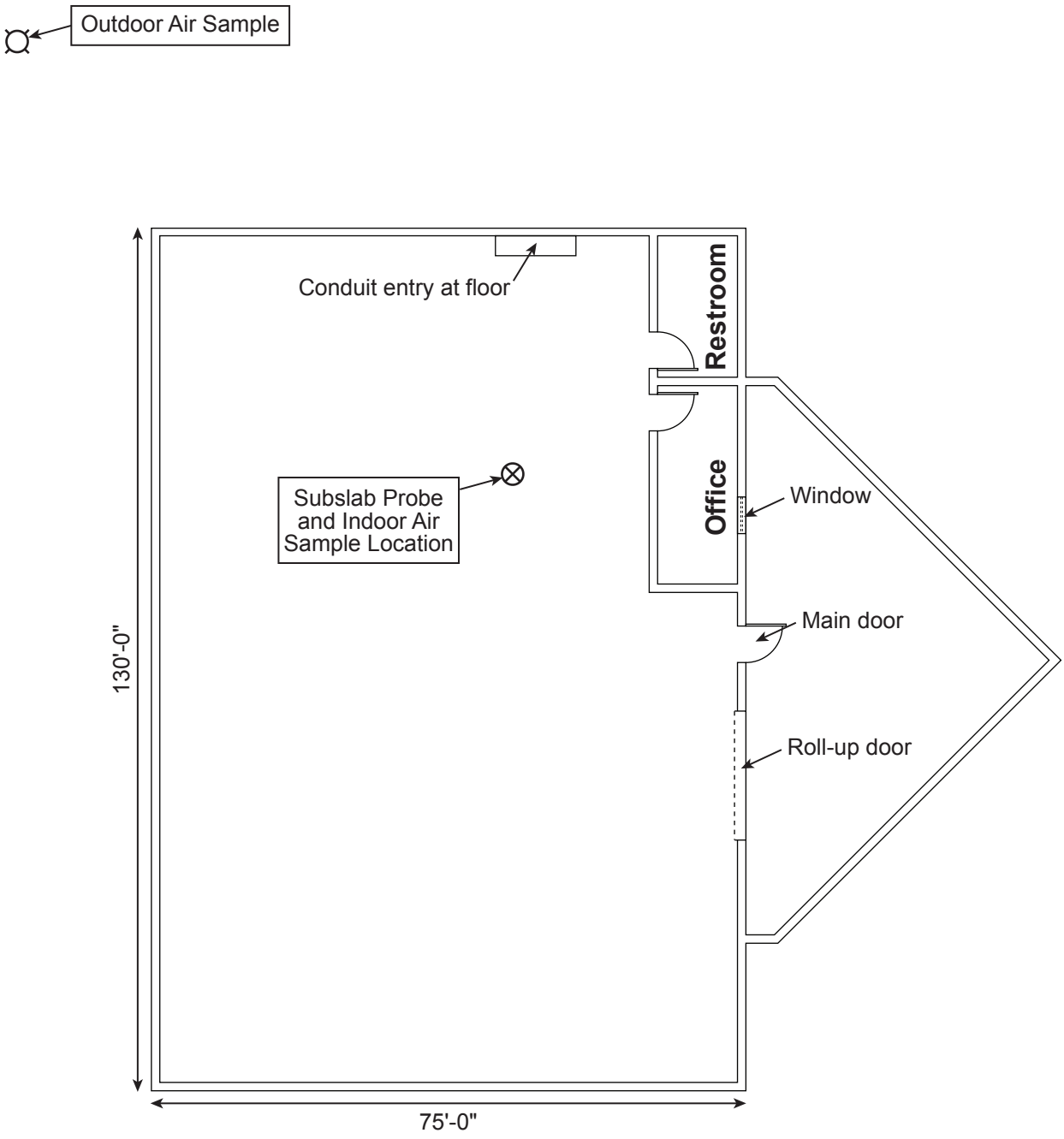
LEGEND

- Air Sample Location
- Subslab Probe

FIGURE 3-6
FACILITY 836 PHASE 1
SAMPLING LOCATIONS
VI ASSESSMENT REPORT
TRAVIS AIR FORCE BASE, CALIFORNIA

CH2MHILL

ES120709023903SAC Figure_3-6.ai 03.22.2010 tdaus



LEGEND

- Outdoor Air Sample Location
- Subslab Probe and Indoor Air Sample Location

N

FIGURE 3-7
FACILITY 864 PHASE 1
SAMPLING LOCATIONS
VI ASSESSMENT REPORT
TRAVIS AIR FORCE BASE, CALIFORNIA

CH2MHILL

ES120709023903SAC Figure_3-7.ai 12.10.09 tdaus

SECTION 4

Phase 3 Field Investigation Activities

The Phase 3 VI assessment field activities were performed at Travis AFB from May 21 through July 9, 2009. Indoor air and/or subslab samples were collected at the following facilities during Phase 3: Facilities 16, 18, 811, 836, 864, and 919. The Phase 3 sampling was expanded based on a meeting held between Travis AFB and EPA on March 30, 2009. EPA requested collection of several additional indoor air samples. The budgetary constraints of the current project prohibited collection of all of the additional samples requested by EPA. To support the further evaluation of VI at Travis AFB, EPA performed some of the Phase 3 sampling and analyses. EPA also collected split samples; although it should be noted that for the split sample collected at the floor in Facility 18, each canister had an independent piece of Teflon tubing extending to the drain (the tubing did not enter the drain at the same location). The EPA Split Sample Report and a discussion of the EPA split sampling evaluation are provided as Appendix F.

Building surveys at each building included for Phase 3 indoor air and/or subslab sampling were performed prior to Phase 3 sample collection. The building survey results are provided in Appendix C.

Prior to collection of Phase 3 samples, pressure differential measurements were made at all four buildings that had subslab probes installed during Phase 3 (Facilities 16, 18, 811, and 919). The purpose of the pressure differential measurements was to assess pressure differences between the vadose zone and the buildings that may increase or decrease the likelihood of VI. The results of the pressure differential measurements are provided in Appendix D.

Phase 3 subslab soil vapor, indoor air, and outdoor air samples were collected from each facility in accordance with the Work Plan (CH2M HILL, 2008). Details of the field activities are provided in the following subsections.

4.1 Utility Clearance

Dig permits were obtained from Travis AFB for all Phase 3 subslab sampling locations prior to beginning intrusive work. Subtronics Corporation performed a utility clearance at all boring locations. The Subtronics Corporation technician was accompanied by CH2M HILL personnel to ensure that all locations were cleared. Underground Services Alert (USA) was notified 3 weeks prior to beginning work.

4.2 Subslab, Indoor Air, and Outdoor Air Sampling

4.2.1 Subslab and Indoor Air Sampling Locations

Subslab soil vapor, indoor air, and outdoor air samples were collected by CH2M HILL at Facilities 16, 18, 811, and 919 over a 24-hour period between July 8 and 9, 2009. EPA

collected indoor air and outdoor air samples at Facilities 836 and 864 over the same 24-hour time period. EPA also collected split samples at selected locations at Facilities 16, 18, 811, and 919. The sampling period was changed from an 8-hour sampling period in Phase 1 to a 24-hour sampling period in Phase 3. Activities performed during the day versus the night are not expected to bias the results if the sample is collected over a 24-hour period rather than an 8-hour period unless the occupants are using volatile COCs during business hours. In this case, the 24-hour sampling period would be more likely to be representative of VI because it would be less biased by indoor air sources.

Facilities 16, 18, 811, and 919 were sampled during Phase 3 because these buildings overlie or are in close proximity to groundwater plumes, and during Phase 1, no soil gas data could be collected adjacent to these buildings. Facilities 836 and 864 had been sampled during Phase 1 to support the development of a site-specific industrial attenuation factor (indoor air, subslab, and outdoor air samples were collected at these facilities). Both of these buildings overlie the WIOU groundwater plume. No VOCs were detected in these buildings at concentrations exceeding the industrial RBCs. However, EPA requested that additional samples be collected at these buildings to investigate potential preferential pathways that might increase vapor intrusion at these and other industrial buildings at Travis AFB and to support an evaluation of future VI risk.

A total of 18 VI investigation samples were collected by CH2M HILL in 6-L evacuated stainless steel Summa™ canisters certified and provided by the analytical laboratory, ASL, located in Corvallis, Oregon:

- Eleven indoor air samples (including two field duplicates)
- Five subslab soil vapor samples
- Two outdoor air samples

The locations of these concurrent subslab soil vapor, indoor air, and outdoor air samples collected at Facilities 16, 18, 811, and 919 by CH2M HILL are illustrated on Figures 4-1 through 4-4. Indoor air field duplicates were collected at Facilities 18 and 919. EPA collected split samples at Facilities 16, 18 and 919, also identified on Figures 4-1, 4-2, and 4-4.

Indoor air samples were collected by EPA at Facilities 836 and 864, and one outdoor air sample was collected between these facilities. Locations of these samples are illustrated on Figures 4-5 and 4-6. As previously mentioned, EPA also collected split samples at Facilities 16, 18, and 919 (Figures 4-1, 4-2, and 4-4).

A total of 11 VI investigation samples were collected by EPA in 6-L evacuated stainless steel Summa™ canisters certified and provided by EPA laboratory:

- Nine indoor air samples (including one field duplicate and 3 split samples)
- One subslab soil vapor sample (split sample)
- One outdoor air sample

The location and purpose of each Phase 3 sampling location is described below.

Facility 16

Facility 16 is a former maintenance shop located at Site SS016. Facility 16 is now used for storage and is not routinely occupied (Figure 4-1). The HVAC system is currently not operational. With the exception of the restrooms, all of the floor drains have been blocked (either spot welded or covered with solid plaques). The blocked floor drains are not expected to be air tight. It was reported during the building survey that the reason the floor drains were sealed was that historically water has come into the facility through the drains. Groundwater in this area is approximately 10 feet bgs, with seasonal variation of 1 to 2 feet, so it is not clear what the source of the water was (groundwater, sanitary sewer, or surface drainage problems). The southern side of the building overlies a portion of the Site SS016 VOC groundwater plume that exceeds groundwater screening levels. No soil gas samples were collected at this site during Phase 1 because of the location of the site on the flightline. The Phase 3 sampling at this facility consisted of the following (all sampling locations for this facility are depicted on Figure 4-1):

- One subslab soil gas sample location. The sample location is in the portion of the building closest to the area of the groundwater plume where TCE concentrations exceed 100 µg/L. The purpose of this data point is to evaluate subslab concentrations near the groundwater plume.
- One outdoor air sample to represent background air quality. This sample location is north of Facility 18 and is used to represent background for both Facilities 16 and 18. This sample location is located upgradient of and cross-wind to the groundwater plume (shown on Figure 4-2).
- Three indoor air sample locations:

    1. Main hangar breathing zone, in the portion of the building overlying the groundwater plume (paired with subslab sampling location). The objectives are to evaluate potential VI into a representative area overlying the highest groundwater VOC concentrations and where workers would potentially be exposed and evaluate attenuation through the slab.
    2. Within the utility vault (service pit) on the southern side of the main hangar (near the groundwater plume). The objective is to evaluate indoor air concentrations in a location where preferential vapor transport into the building may exist. The air concentrations measured in this vault are not representative or appropriate for use in estimating potential risk for indoor workers because workers do not enter the vault.
    3. Within the main hangar/open storage area breathing zone, near the utility vault. The objective is to evaluate what effect air mixing has on indoor air concentrations in the event elevated VOC concentrations are detected within the vault.

Facility 18

Facility 18 is a former degreasing facility located at Site SS016 and is currently used as a storage area (Figure 4-2). This facility is unoccupied except for brief periods when supplies are being moved in and out of storage. The HVAC system is currently not operational. The southern side of the building overlies a portion of the Site SS016 VOC groundwater plume that exceeds groundwater screening levels. No soil gas samples were collected at this site

during Phase 1 because of the location of the site on the flightline. The Phase 3 sampling at this facility consisted of the following (all sampling locations for this facility are depicted on Figure 4-2):

- One subslab soil gas sample location. The purpose of this sampling location is to evaluate subslab concentrations in the portion of the building overlying the highest concentrations of the groundwater VOC plume.
- Three indoor air sample locations:
    1. Office breathing zone. This location is near the groundwater plume and paired with a subslab sampling location. The objectives are to evaluate potential VI into a representative area (e.g., office) where workers would potentially be exposed and evaluate attenuation through the slab.
    2. Shower drain at floor level. The shower drain may represent a preferential pathway and the shower is located in a portion of the building that overlies the groundwater VOC plume. The objective is to evaluate indoor air concentrations in a location where preferential vapor transport into the building may exist. The air concentrations measured at the shower drain in this room are not representative or appropriate for use in estimating potential chronic risk for indoor workers because the sample was not collected in the breathing zone and because of the shorter relative time spent in the shower versus office areas.
    3. Center of tank room (open storage area) breathing zone. The objective is to evaluate what effect air mixing has on indoor air concentrations.

Facility 811

Facility 811 is located in the WIOU and is an aircraft hangar used for washing aircraft (Figure 4-3). Sliding doors span the east side of the building and remain open while aircraft are being washed. A portion of the western side of this building overlies a plume of floating product (Stoddard solvent). There is also a small area of VOC contamination exceeding screening levels co-mingled with the Stoddard solvent plume. Stoddard solvent continues to be used to wash airplanes down in this building. During Phase 1, a shallow soil gas sample was attempted above the Stoddard solvent plume, but collection of that sample was unsuccessful because the lithology was too impermeable. Indoor air samples were not collected at this building during Phase 3 because of the open nature of the hangar and the fact that large quantities of Stoddard solvent continue to be regularly used in the building. Receptors within the building are monitored under the base industrial hygiene program.

The Phase 3 sampling at this facility consisted of one subslab sample collected above the Stoddard solvent floating product plume. The soil vapor sample was analyzed for VOCs and the volatile fraction of Stoddard solvent. The data were collected to evaluate future scenarios.

Facility 919

Facility 919 is a vehicle maintenance shop located in the WIOU (Figure 4-4). The HVAC system consists of wall units. A small area of VOC groundwater contamination exceeding screening levels abuts the northern side of this facility. Two soil gas samples were planned

for this building during Phase 1 sampling. One was successfully collected, and soil gas concentrations were below industrial SSG RBCs. However, the sample at the second location, near the highest groundwater VOC concentrations, was not successful because of water entering the sampling tubing, indicating the sample depth was within the capillary fringe. The Phase 3 sampling at this facility consisted of the following (all sampling locations for this facility are depicted on Figure 4-4):

- Two subslab soil gas sample locations on the northern side of the building (closest to the VOC groundwater plume). Building foundations at Travis AFB typically consist of a high permeability gravel layer overlain by a concrete slab, and thus large variations in subslab concentrations are not expected. However, data from these two locations will be used to evaluate spatial variability in subslab VOC concentrations and to evaluate subslab concentrations in the portion of the building closest to the groundwater VOC plume.
- One outdoor air sample to represent background air quality. The outdoor air sample was placed upwind of the building and the VOC groundwater plume.
- Three indoor air sample locations:
    1. Office breathing zone (paired with the subslab sampling location). The objectives are to evaluate potential VI into a representative area (e.g., office) where workers would potentially be exposed and evaluate attenuation through the slab.
    2. Mechanical room breathing zone. While utilities appear to enter above grade on the exterior walls of the facility, perforations in the floor of the mechanical room were present. The objective is to evaluate indoor air concentrations in a location where preferential vapor transport into the building may exist. The air concentrations measured in this room are not representative or appropriate for use in estimating potential chronic risk for indoor workers because of the shorter relative time spent in the mechanical room versus office areas.
    3. Restroom breathing zone. Open floor drains and water pipes are present in the restroom. The objective is to evaluate indoor air concentrations where a preferential pathway to indoor air may exist. The air concentrations measured in this room are not representative or appropriate for use in estimating potential chronic risk for indoor workers because of the shorter relative time spent in the restroom versus office areas.

Note that the sample locations were focused on the portion of the building closest to the groundwater plume. No indoor air samples are proposed in the vehicle service area because (1) it would be difficult to distinguish between chemicals used in the building and those originating from VI, (2) this area has large doors that are open during working hours to allow vehicle entry, and (3) this area is further away from the groundwater plume than the area of the building that was sampled.

Facility 836

Facility 836 is the Squadron Operations Administration building, which is occupied 24 hours a day, 7 days a week (24/7) (Figure 4-5). The HVAC system also runs 24/7. The entire building overlies a groundwater VOC plume. A paired indoor air/subslab sample

was collected in the Shift Chiefs office during Phase 1 sampling. Indoor air samples were also collected by EPA in the restroom during Phase 1. VOC concentrations in samples collected during Phase 1 did not exceed industrial screening levels. VOC concentrations detected indoors were similar to those detected outdoors. The primary site COCs (TCE and PCE) were not detected in samples collected in the restroom. Data collected during Phase 1 do not indicate significant VI risk at this building and do not indicate that preferential pathways are an issue. However, to address concerns raised by EPA that the potential for preferential pathways had not been adequately addressed at this building, the Phase 3 sampling at this facility consisted of the following:

- One outdoor air sample to represent background air quality. This sample was located between Facilities 836 and 864 and was used to represent background for both facilities. Because of the location of Facilities 836 and 864 above the groundwater plume, the considerable size of the groundwater plume, and the prevailing wind direction at Travis AFB (west to east) any outdoor air location near these buildings is downwind of the groundwater plume. However, data from this outdoor location will be used in conjunction with the data from outdoor locations at Facilities 919 and between Facilities 16 and 18 to evaluate background concentrations.
- Three indoor air sample locations (shown on Figure 4-5).
    1. Resample Shift Chiefs office breathing zone. The objectives are to evaluate potential VI into a representative area (e.g., office) where workers will potentially be exposed and evaluate attenuation through the slab. This will also provide data to estimate temporal variability because this room has previously been sampled.
    2. Breakroom floor drain at floor level. Floor drain and water pipes are present in this room. The sample was collected at the floor drain near the vending machine in the breakroom. The objective is to evaluate indoor air concentrations where a preferential pathway to indoor air may exist. Samples previously placed in the restroom area did not have TCE detections, suggesting a high air turnover rate. The breakroom, which also overlies the VOC groundwater plume, is not expected to have as high of an air turnover rate as the restroom.
    3. Mechanical room floor drain at floor level. Utilities enter through the floor of the mechanical room. The sample was collected at a drain in the floor. The objective is to evaluate indoor air concentrations in a location where preferential vapor transport into the building may exist. The air concentrations measured in this room are not representative or appropriate for use in estimating potential chronic risk for indoor workers because the sample was not collected in the breathing zone and because of the shorter relative time spent in the mechanical room versus office areas.

Facility 864

Facility 864 is a maintenance shop currently used for storage (Figure 4-6). The facility is typically unoccupied and does not have an operational HVAC system. The entire building overlies a VOC groundwater plume. A paired indoor air/subslab sample was collected in the main storage area during Phase 1 sampling. VOC concentrations in samples collected during Phase 1 did not exceed industrial screening levels. VOC concentrations detected indoors were similar to those detected outdoors. Data collected during Phase 1 do not

indicate significant VI risk at this building and do not indicate that preferential pathways are an issue. However, to address concerns raised by EPA that the potential for preferential pathways had not been adequately addressed at this building, the Phase 3 sampling at this facility consisted of the following:

- Three indoor air sample locations (shown on Figure 4-6):

    1. Main storage area breathing zone. The objectives are to evaluate potential VI into a representative area where workers will potentially be exposed. This will also provide data to estimate temporal variability because this room has previously been sampled. The sample results will also be used to evaluate what effect air mixing has on indoor air concentrations if the second sampling location (near conduit entry) has relatively high VOC concentrations.

    2. Near the electrical conduit entry in the main storage area (breathing zone). The objective is to evaluate indoor air concentrations where a preferential pathway to indoor air may exist. The air concentrations measured near this conduit are not representative or appropriate for use in estimating potential chronic risk for indoor workers because the sample is a preferential pathway location and does not reflect the effect of air mixing.

    3. Restroom shower drain at floor level. Open floor drains and water pipes are present. The objective is to evaluate indoor air concentrations in a location where preferential vapor transport into the building may exist. The air concentrations measured in this room are not representative or appropriate for use in estimating potential risk for indoor workers because the sample was not collected in the breathing zone and because of the shorter relative time spent in the restroom versus office areas.

4.2.2 Subslab, Indoor, and Outdoor Air Sampling Procedures

Subslab soil vapor samples were collected in accordance with the Work Plan (CH2M HILL, 2008). Subslab probes were installed in the facility foundation near the highest concentrations of the groundwater plumes. The locations were cleared for utilities through the dig permit process and by the utility locator subcontractor Subtronics prior to installation. The sampling procedure included a helium leak check immediately before sample collection to ensure the probe was installed correctly.

Subslab samples were collected over a 24-hour period in 6-L Summa™ canisters. The Summa™ canisters were equipped with flow controllers (calibrated by the analytical laboratory) to allow for time-weighted sample collection over the 24-hour period. The samples were analyzed by TO-14 low-level scan. The target analyte list included, but was not limited to, the chlorinated and non-chlorinated VOCs detected in groundwater at Travis AFB (CH2M HILL, 2008).

Indoor air and outdoor air samples were collected in accordance with the Work Plan (CH2M HILL, 2008). Indoor air samples were collected over a 24-hour period in 6-L Summa™ canisters equipped with flow controllers calibrated by the laboratory.

4.3 Differential Pressure Measurements

The potential for VI is often directly related to the operation of the building HVAC system, which may pressurize or depressurize the building and decrease or increase the likelihood of VI from the vadose zone. Travis AFB also has very strong winds, which can create pressure differences between the vadose zone and the building. Therefore, differential pressure, barometric pressure, and temperature measurements were collected in June 2009 at Facilities 16, 18, 811, and 919 for periods of 2 to 4 days prior to the collection of subslab soil vapor and indoor air samples. The differential pressure measurements were performed using an Omniguard 4 differential pressure monitor with data logger and barometric pressure data logger in accordance with the Work Plan (CH2M HILL, 2008). The Omniguard 4 differential pressure monitor was connected to a subslab probe. Helium leak checks were performed on the subslab probes prior to the pressure differential measurements, to ensure the probes were correctly installed. The differential pressure measurements and data evaluation are provided in Appendix D.

Unused Storage Rooms
Open Storage
MAIN HANGAR
offices on second floor only
Main Hangar 2 (Breathing Zone)
Subslab 1
Main Hangar 1 (Breathing Zone)
Utility Vault (Split Sample with EPA)

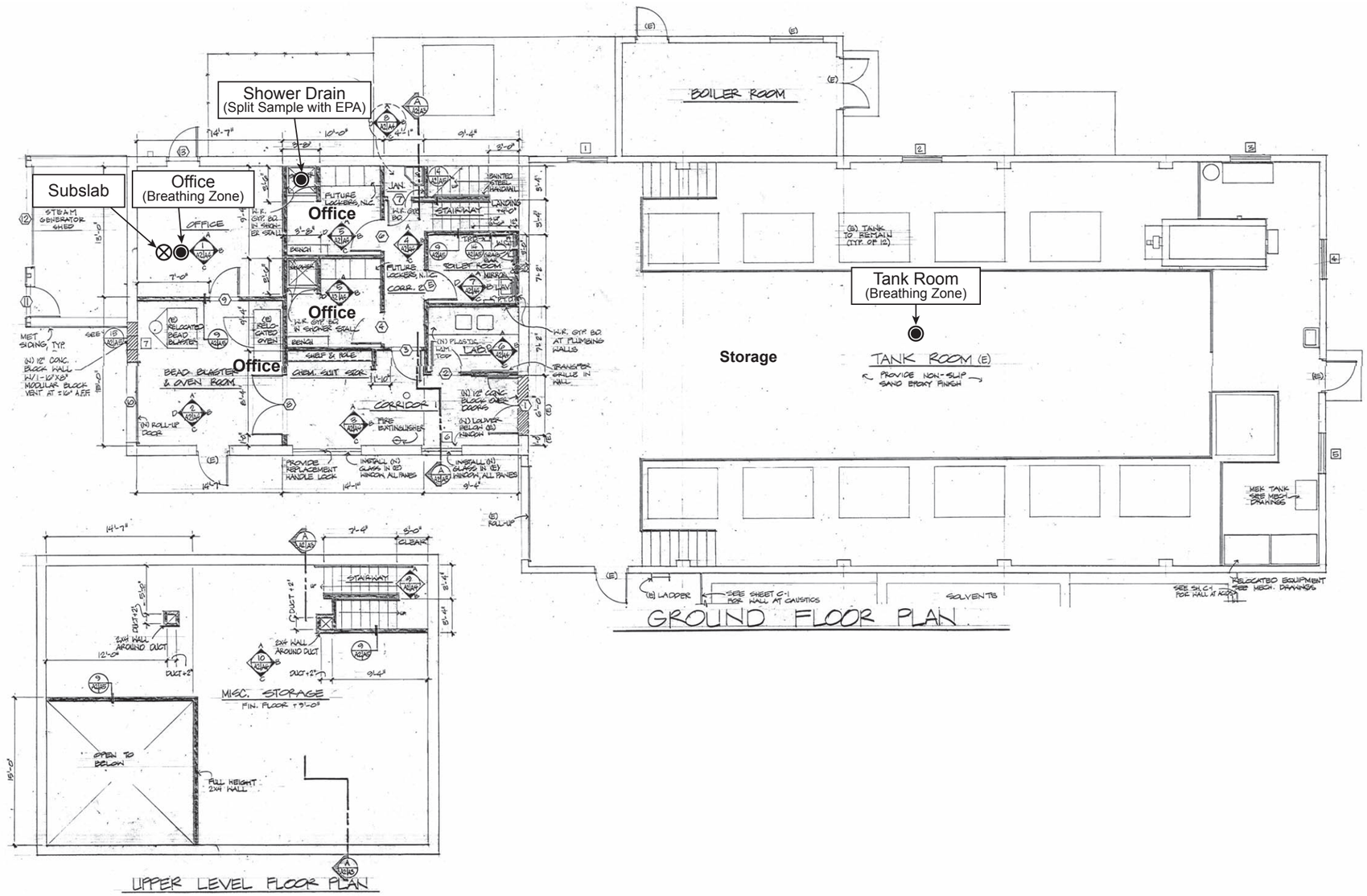
LEGEND

- Indoor Air Sample Location
- Subslab Probe

FIGURE 4-1
FACILITY 16 PHASE 3
SAMPLING LOCATIONS
VI ASSESSMENT REPORT
TRAVIS AIR FORCE BASE, CALIFORNIA

CH2MHILL

ES120709023903SAC Figure_4-1.ai 12.10.09 tdaus



LEGEND

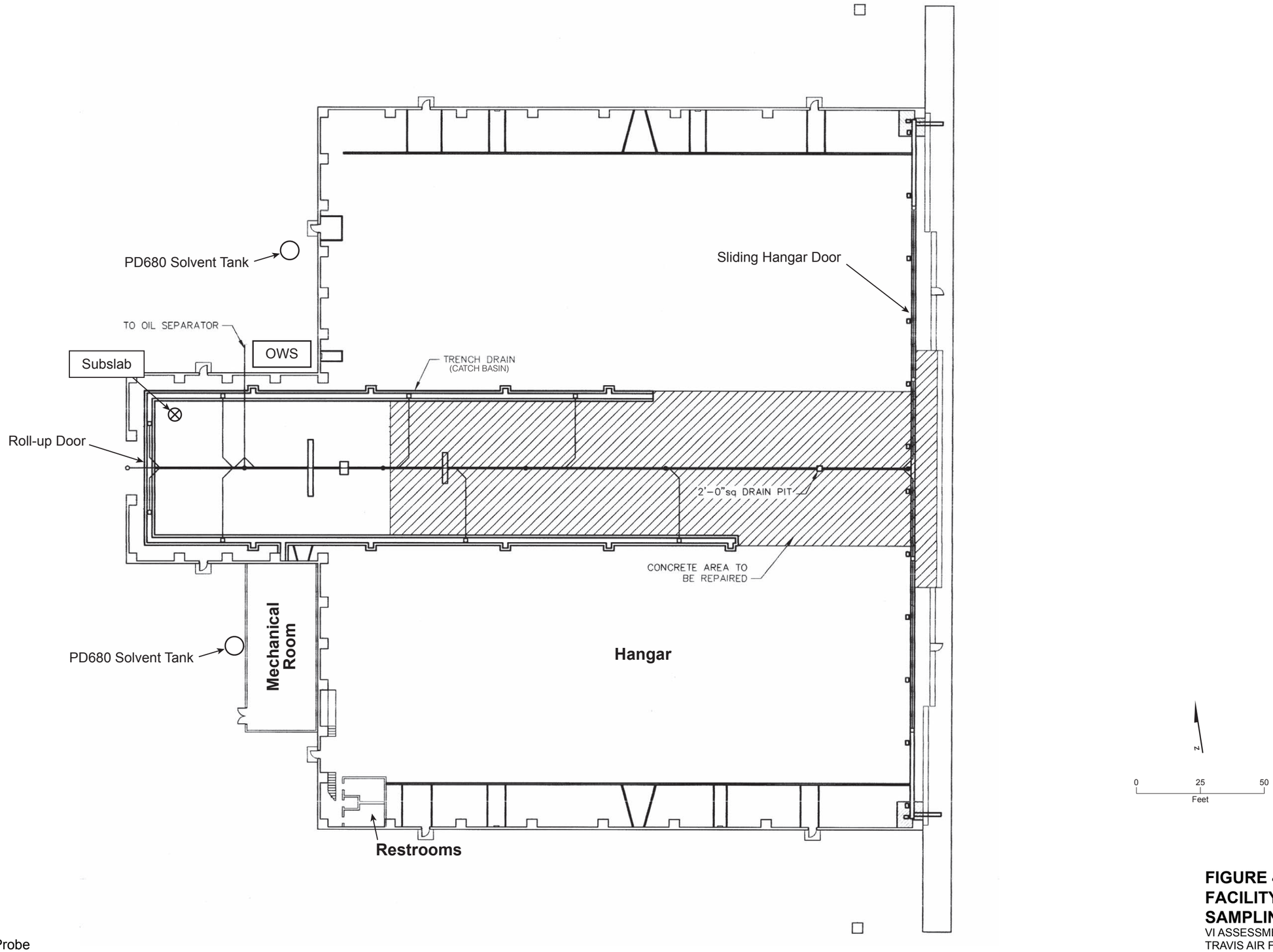
- Indoor Air Sample Location
- Outdoor Air Sample Location
- Subslab Probe

N

FIGURE 4-2
FACILITY 18 PHASE 3
SAMPLING LOCATIONS
VI ASSESSMENT REPORT
TRAVIS AIR FORCE BASE, CALIFORNIA

CH2MHILL

ES120709023903SAC Figure_4-2.ai 12.10.09 tdaus



LEGEND

⊗ Subslab Probe

FIGURE 4-3
FACILITY 811 PHASE 3
SAMPLING LOCATIONS
VI ASSESSMENT REPORT
TRAVIS AIR FORCE BASE, CALIFORNIA

CH2MHILL

ES120709023903SAC Figure_4-3.ai 12.10.09 tdaus

Outdoor Air Sample

Subslab 2

Restroom
(Breathing Zone)

Mechanical Room
(Breathing Zone)

Subslab 1
(Split Sample with EPA)

Office
(Breathing Zone)
(Split Sample with EPA)

Oil/Water Separator

Break Room

Office

BAY "1"

BAY "2"

BAY "3"

BAY "4"

W. LATRINE

M. LATRINE

JAN. CLOSET

HALL

MECHANICAL E.M.

PARTS & TOOLS

OFFICE

Office

MTL. THRES.

E.W.C.

WH.

V.A.T.

MARBLE THRES.

MTL. STRIP

BASE FLOOR IN THIS AREA TO MATCH ADJ. F.F. ELEV.

NOTE: SLOPE FLOOR TO DRAIN

F.A. CONTROL PANEL

AUTO-EXHAUST OUTLETS TO DUCT SYSTEM BELOW TYP. OF 8

TWIN POST ELECTRIC HYDRAULIC LIFT "ADDITIVE BID ITEM"

4'x10' TRANSLUCENT SKYLIGHT PANEL (VARY SIZE TO FIT METAL ROOF PANEL DIMENSIONS) TYP. OF 8, CENTERED ON STRUC BAYS

SLOPE FLOOR TOWARD DRAIN (SEE FOUNDATION PLAN)

10'x15' OVERHEAD DOORS TYP. OF 4

TRENCH DRAIN W/ GRATING RIM@ EL. 39.11 (SEE DET. '1' SHT A-3 & STRUCTURAL DWGS.)

SLOPE

6" O.D. x 48" H. STEEL GUARD POST - TYP OF 3. SEE DET.

95'-0"

80'-0"

FLOOR PLAN

NOTES

- INDICATES 1-HR. FIRE RESISTIVE WALL ASSEMBLY CONSISTING OF 5/8" TYPE 'X' GYP. BD. EACH SIDE OVER STL. STUDS - PROVIDE FIBREGLASS SOUND INSUL. WHERE NOTED.
- INDICATES GYP. BD. EA. SIDE OVER STEEL STUDS W/ FIBREGLASS SOUND INSULATION.
- INDICATES 1/2" GYP. BD. ONE SIDE OVER STEEL STUDS.
- INDICATES GYP. BD. BOTH SIDES OVER STEEL STUDS.
- INDICATES PRE-ENGINEERED METAL BLDG. WALLS, PROVIDE GYP. BD. WHERE NOTED.

LEGEND

- Indoor Air Sample Location
- Outdoor Air Sample Location
- Subslab Probe

GRAPHIC SCALE

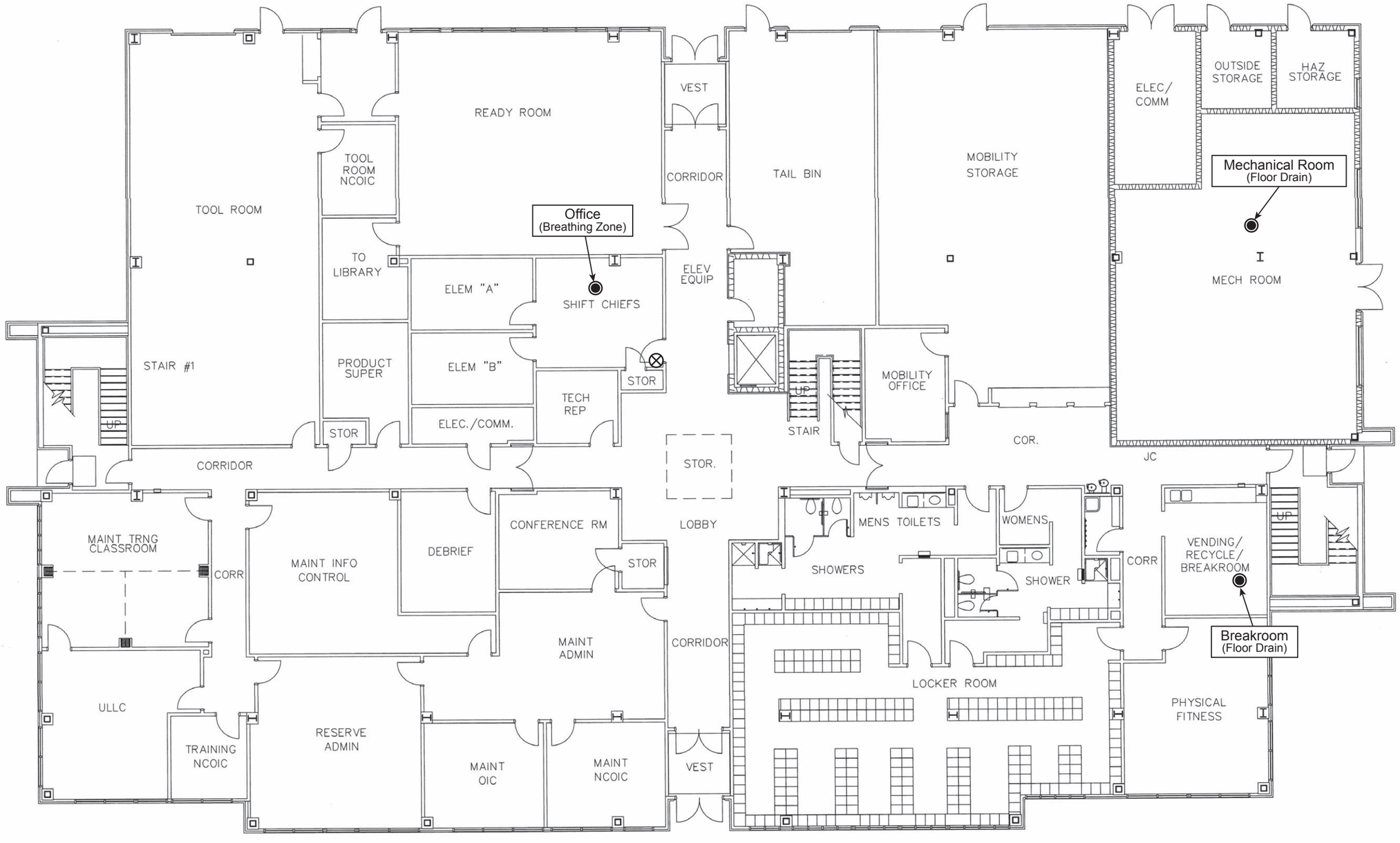
0 1' 2' 3' 4' 8' 12'

1/4" = 1'-0"

FIGURE 4-4
FACILITY 919 PHASE 3
SAMPLING LOCATIONS
VI ASSESSMENT REPORT
TRAVIS AIR FORCE BASE, CALIFORNIA

CH2MHILL

ES120709023903SAC Figure_4-4.ai 12.10.09 tdaus



LEGEND

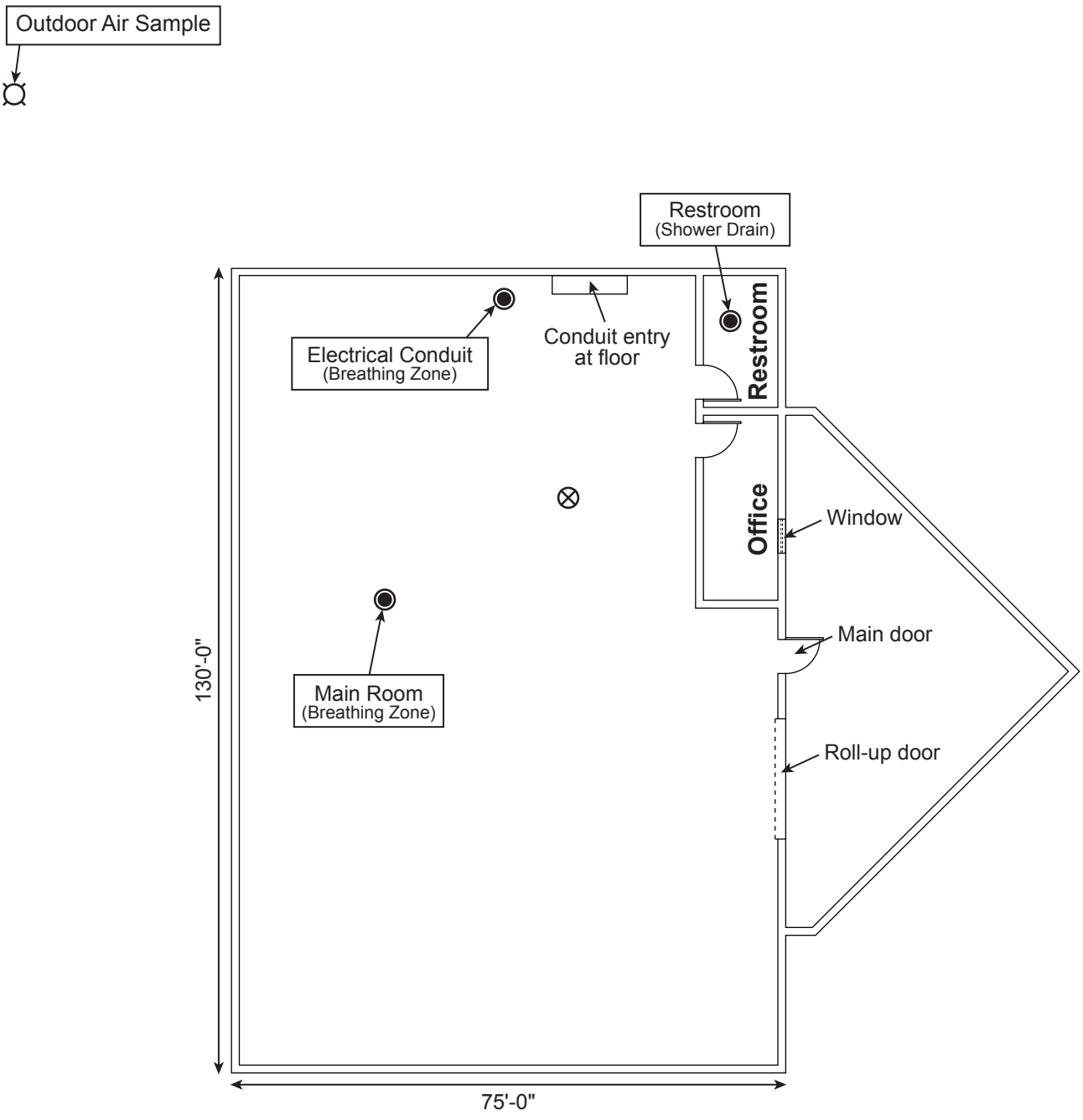
- ◉ Indoor Air Sample Location
- ⊗ Subslab Probe (Phase 1)

z

FIGURE 4-5
FACILITY 836 PHASE 3
SAMPLING LOCATIONS
VI ASSESSMENT REPORT
TRAVIS AIR FORCE BASE, CALIFORNIA

CH2MHILL

ES120709023903SAC Figure_4-5.ai 12.10.09 tdaus



LEGEND

- Indoor Air Sample Location
- Outdoor Air Sample Location
- Subslab Probe (Phase 1)

N

FIGURE 4-6
FACILITY 864 PHASE 3
SAMPLING LOCATIONS
VI ASSESSMENT REPORT
TRAVIS AIR FORCE BASE, CALIFORNIA

CH2MHILL

ES120709023903SAC Figure_3-7.ai 12.10.09 tdaus