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# **REVISED DRAFT**

## **Innovative Techniques and Integrated Approach in the USA**

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**MWH®**

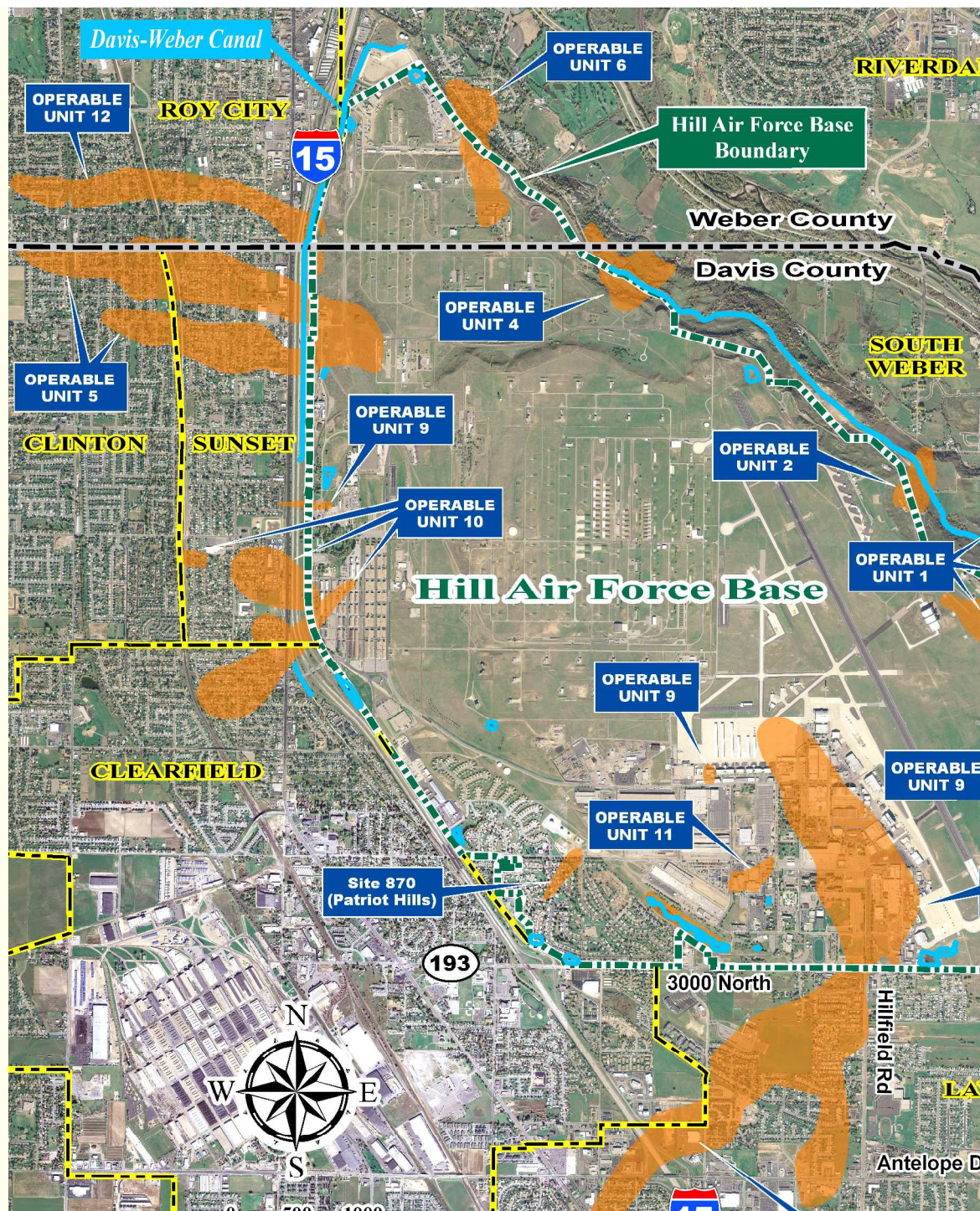
***BUILDING A BETTER WORLD***





## EXPLANATION

Groundwater contaminant concentration





# Environmental Investigation History

## Hill AFB, Utah, USA

- Began in 1987
- Originally 7 Operable Units (OUs)
- 13 OUs now identified
- TCE is primary contaminant of concern in groundwater at 8 OUs
- Most plumes extend off Base (some are >3 km)
- Residential Indoor Air Program
- Separate UST program for petroleum hydrocarbons

# Site Management Team

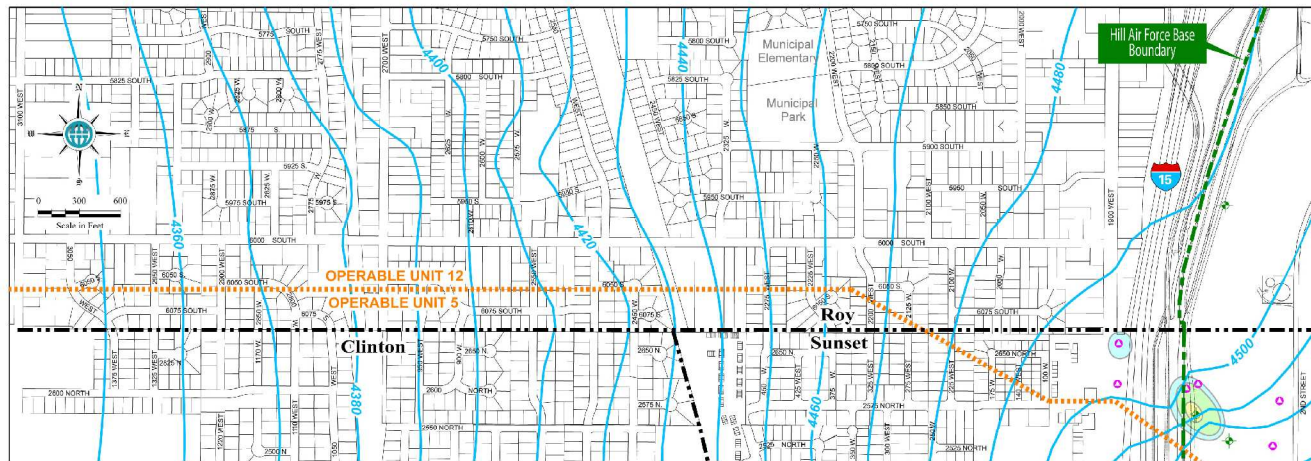
- United States Air Force -
  - Hill AFB Civil Engineering Environmental Restoration and the Air Force Center for Engineering and the Environment (AFCEE): (generally scientists and engineers – civilian employees of the U.S. Government)
- Environmental Consulting Firms
  - MWH, CH2M Hill, URS, Parsons, AEEC (primarily hydrogeologists, geologists, environmental engineers, chemists, database specialists, risk assessors, etc.)
- Subcontractors
  - Drilling and subsurface investigation companies, analytical laboratories, specialty remediation companies

# Other Stakeholders

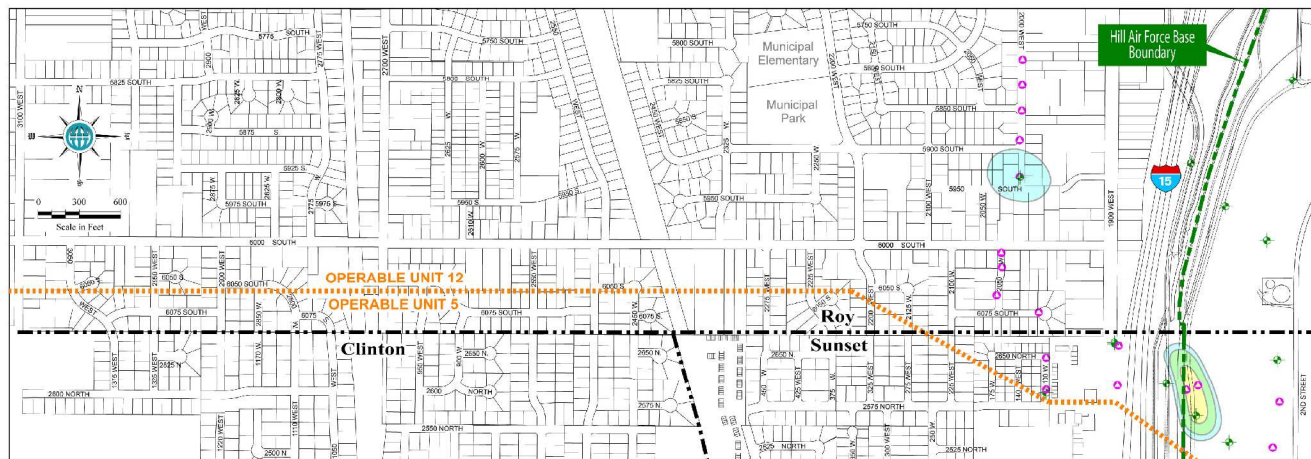
- Regulatory Agencies
  - U.S. Environmental Protection Agency
  - Utah Department of Environmental Quality
- Public and Restoration Advisory Board (RAB)
  - Landowners, Residents, Concerned Citizens and Citizen Groups
  - RAB, comprised of appointed citizens and representatives of surrounding municipalities. Provides structured citizen review of the restoration program.
- Municipalities and Public Utilities
  - Publicly-owned treatment facilities, water conservancy districts, etc.

# Innovative Techniques for Rapid Delineation of Large Groundwater Contaminant Plumes

**1998**



**1999**



# CPT Investigation Approach

- Lines of closely spaced (50-100 m apart) sampling locations along transects perpendicular to expected flow direction
- Transects 100-300 m apart (controlled by roadways)
- CPT and direct-push (Hydropunch) groundwater sampling performed at each location to identify geology, areal extent of contamination, and vertical extent of contamination (typically groundwater samples collected at 3 depths intervals)
- Transects typically extended until groundwater had contaminant concentrations of either ND or below regulatory limits (MCLs) (5 µg/l for TCE)

# OU 12 TCE Plume Delineation

- Cone penetration testing (CPT) was performed at 220 locations and over 600 direct-push groundwater samples were collected
- Over 115 monitoring wells installed to delineate and monitor the OU 12 plume







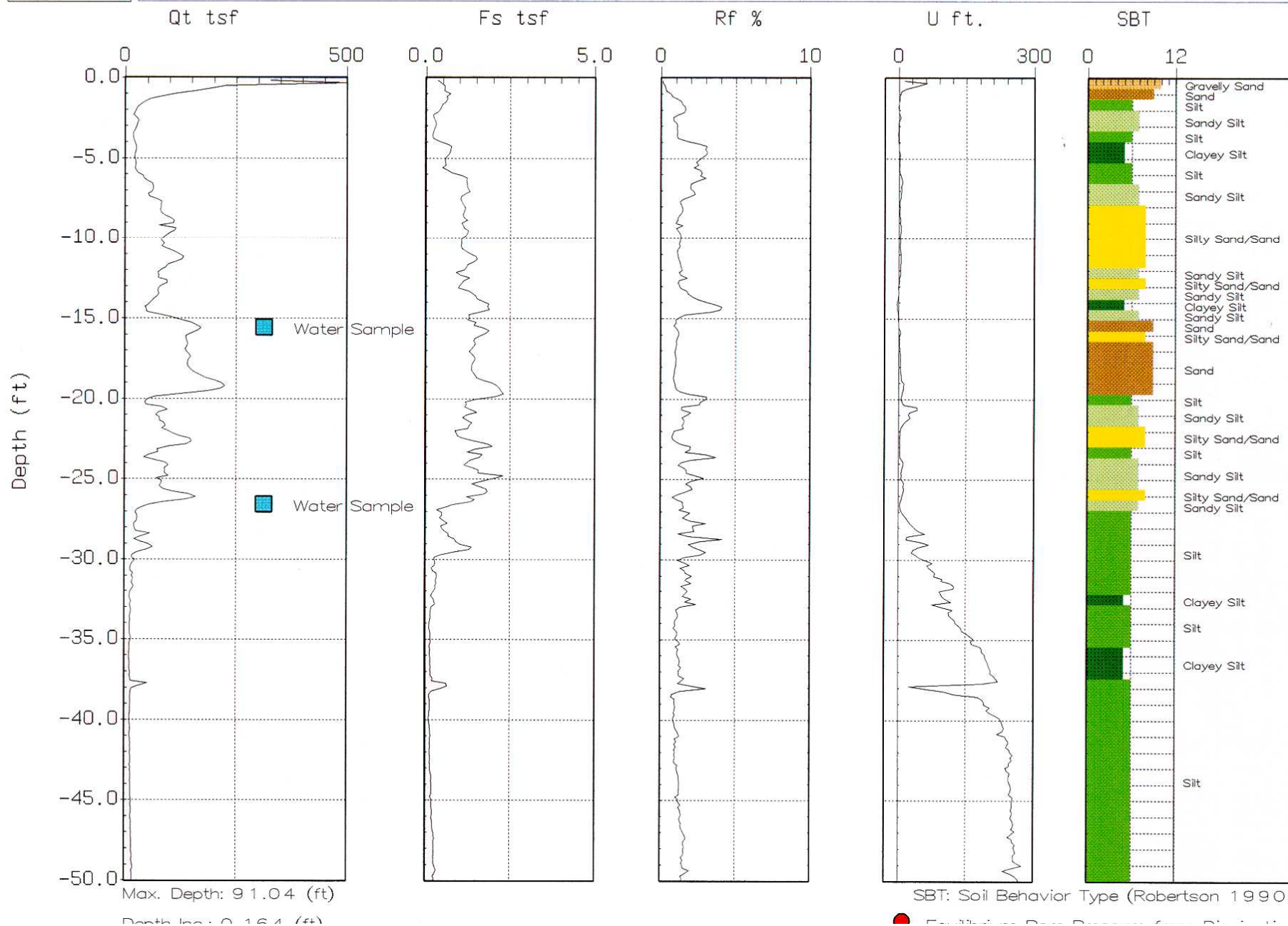
MWH Americas, Inc.

Hole No.: U5-2165

Location: OU-5

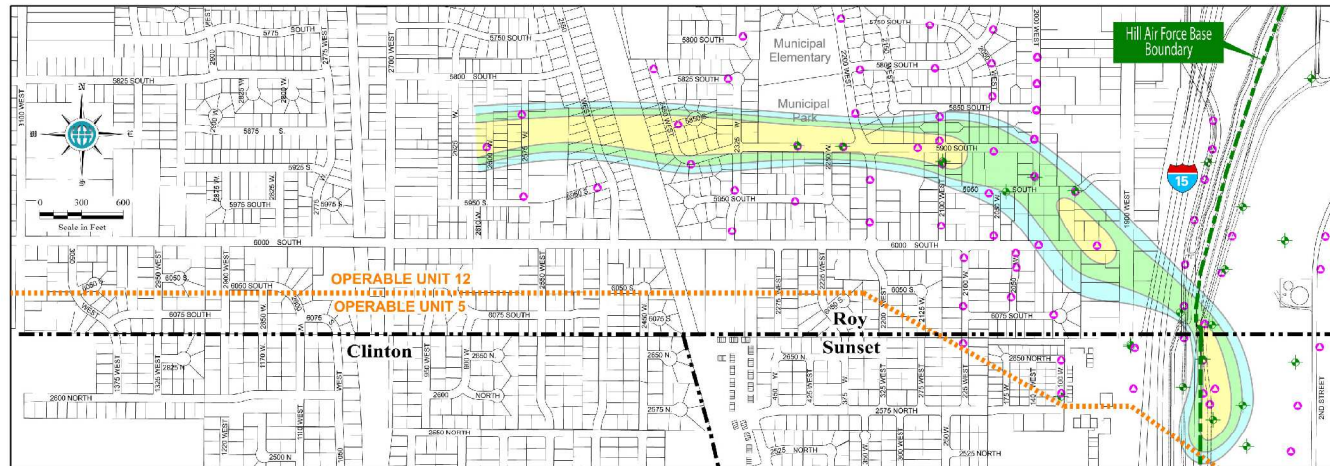
Cone: 20 TON A 112

Date: 12:05:01 12:53

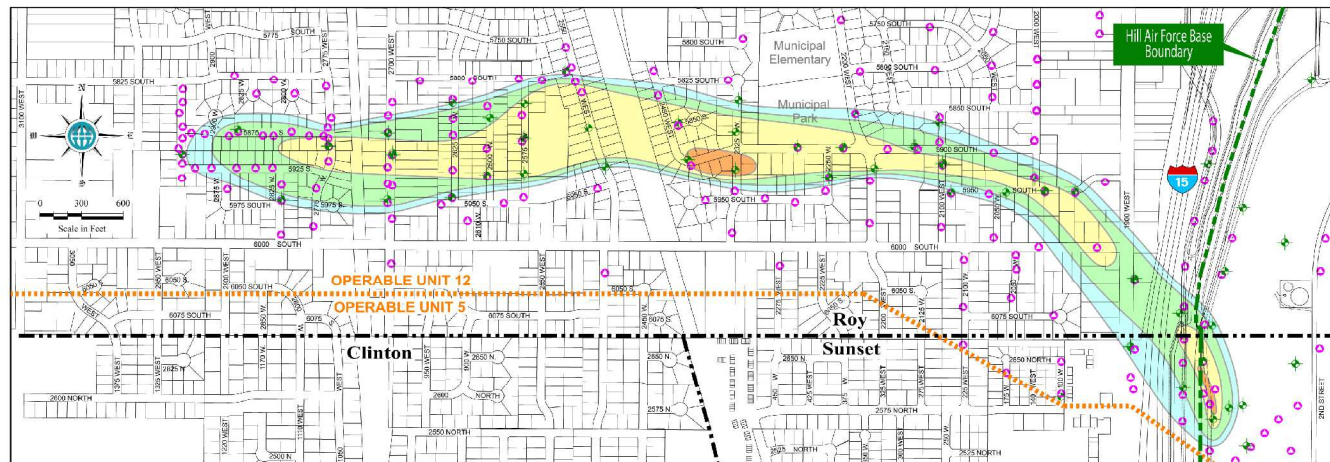


# Investigation Results

2000

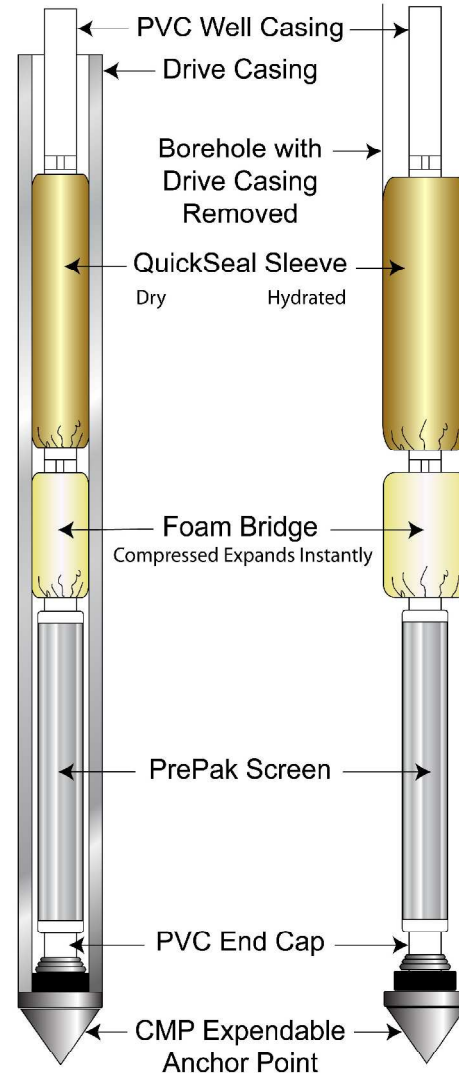


2001

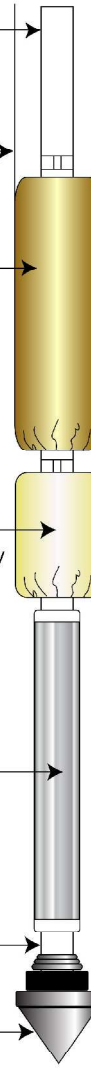


# Direct-Push Microwell

**DURING  
INSTALLATION  
(Left)**



**AFTER RETRACTING  
DRIVE CASING  
(Right)**



**DRIVE CASING**

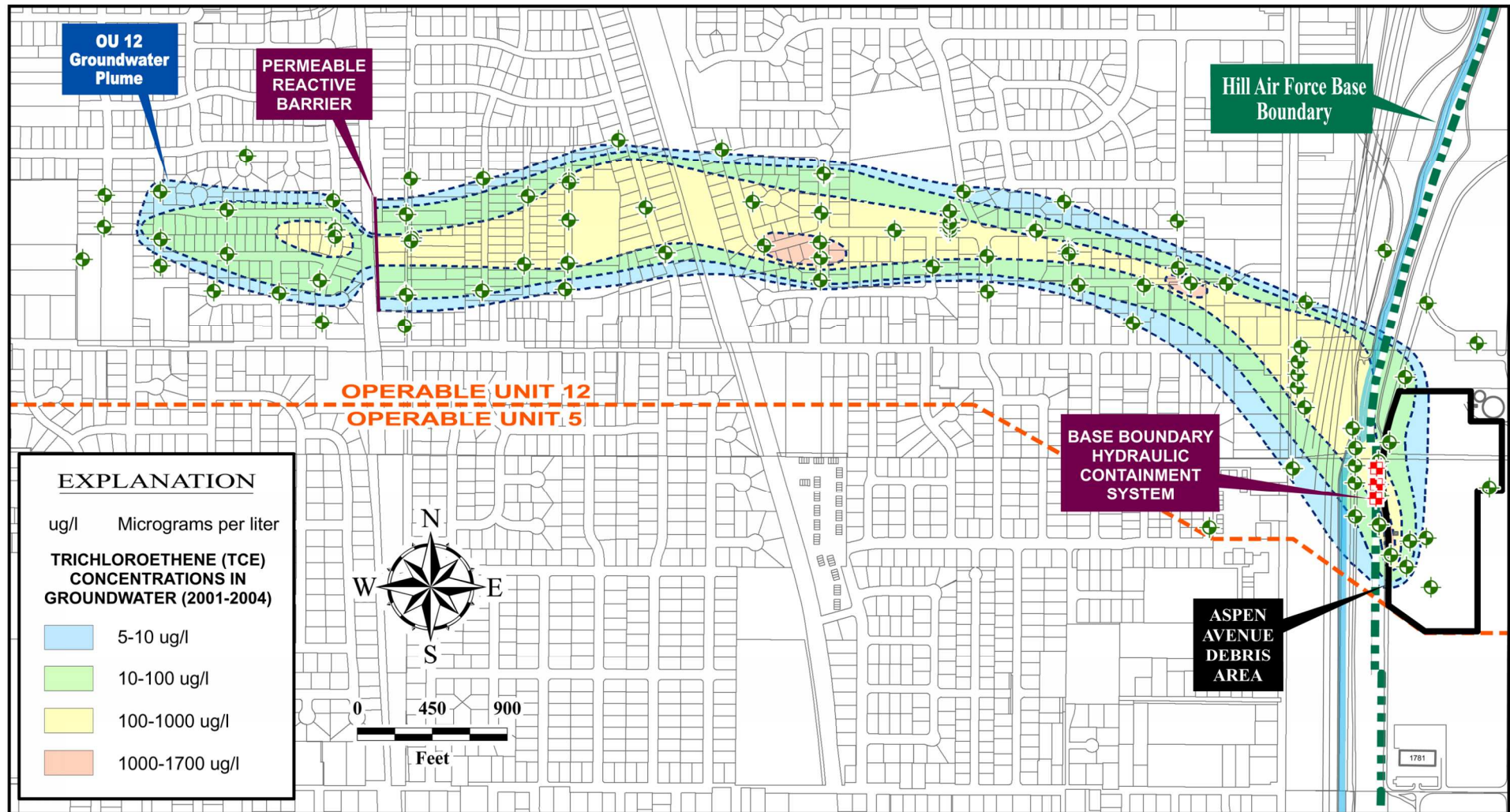


**SURFACE COMPLETION**



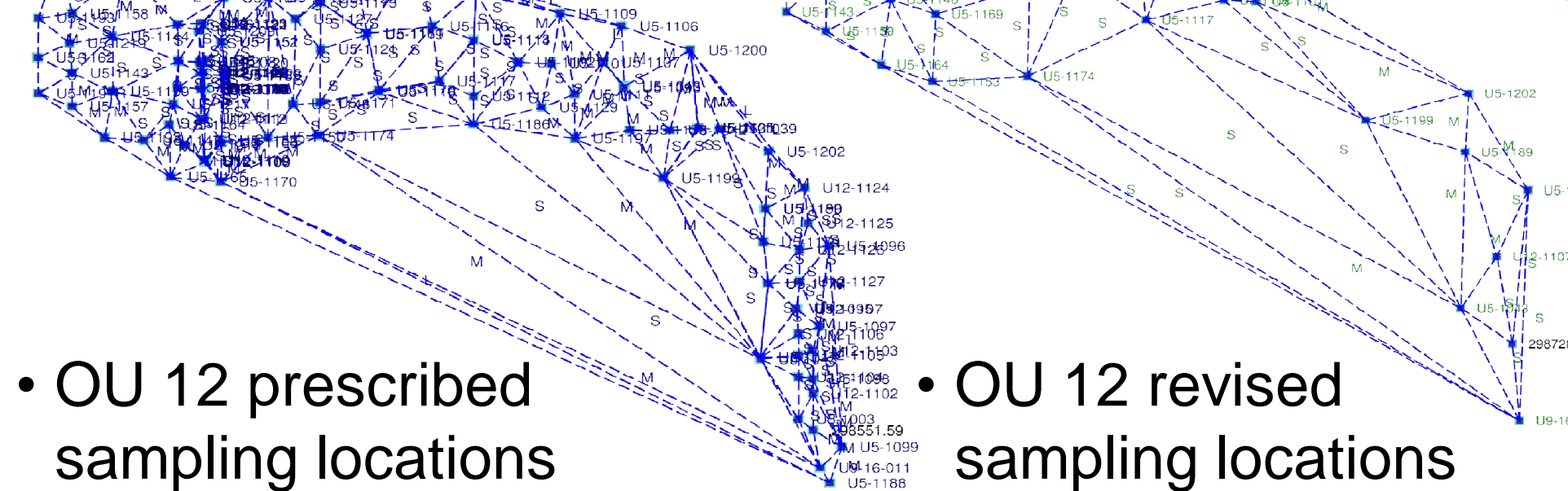


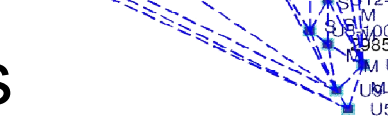
# OU 12 Monitoring Well Network





# Optimization of Monitoring Network with MAROS or GTS for Long-Term Monitoring



- OU 12 prescribed sampling locations
  - Not optimized – redundant locations and too frequent given historic site knowledge

The diagram shows a central point labeled 'OU 12' with several dashed lines radiating from it to various sampling locations. The locations are labeled with codes such as 'U5-1099', 'U5-1098', 'U5-1097', 'U5-1096', 'U5-1095', 'U5-1094', 'U5-1093', 'U5-1092', 'U5-1091', 'U5-1090', 'U5-1089', 'U5-1088', 'U5-1087', 'U5-1086', 'U5-1085', 'U5-1084', 'U5-1083', 'U5-1082', 'U5-1081', 'U5-1080', 'U5-1079', 'U5-1078', 'U5-1077', 'U5-1076', 'U5-1075', 'U5-1074', 'U5-1073', 'U5-1072', 'U5-1071', 'U5-1070', 'U5-1069', 'U5-1068', 'U5-1067', 'U5-1066', 'U5-1065', 'U5-1064', 'U5-1063', 'U5-1062', 'U5-1061', 'U5-1060', 'U5-1059', 'U5-1058', 'U5-1057', 'U5-1056', 'U5-1055', 'U5-1054', 'U5-1053', 'U5-1052', 'U5-1051', 'U5-1050', 'U5-1049', 'U5-1048', 'U5-1047', 'U5-1046', 'U5-1045', 'U5-1044', 'U5-1043', 'U5-1042', 'U5-1041', 'U5-1040', 'U5-1039', 'U5-1038', 'U5-1037', 'U5-1036', 'U5-1035', 'U5-1034', 'U5-1033', 'U5-1032', 'U5-1031', 'U5-1030', 'U5-1029', 'U5-1028', 'U5-1027', 'U5-1026', 'U5-1025', 'U5-1024', 'U5-1023', 'U5-1022', 'U5-1021', 'U5-1020', 'U5-1019', 'U5-1018', 'U5-1017', 'U5-1016', 'U5-1015', 'U5-1014', 'U5-1013', 'U5-1012', 'U5-1011', 'U5-1010', 'U5-1009', 'U5-1008', 'U5-1007', 'U5-1006', 'U5-1005', 'U5-1004', 'U5-1003', 'U5-1002', 'U5-1001', 'U5-1000', 'U5-999', 'U5-998', 'U5-997', 'U5-996', 'U5-995', 'U5-994', 'U5-993', 'U5-992', 'U5-991', 'U5-990', 'U5-989', 'U5-988', 'U5-987', 'U5-986', 'U5-985', 'U5-984', 'U5-983', 'U5-982', 'U5-981', 'U5-980', 'U5-979', 'U5-978', 'U5-977', 'U5-976', 'U5-975', 'U5-974', 'U5-973', 'U5-972', 'U5-971', 'U5-970', 'U5-969', 'U5-968', 'U5-967', 'U5-966', 'U5-965', 'U5-964', 'U5-963', 'U5-962', 'U5-961', 'U5-960', 'U5-959', 'U5-958', 'U5-957', 'U5-956', 'U5-955', 'U5-954', 'U5-953', 'U5-952', 'U5-951', 'U5-950', 'U5-949', 'U5-948', 'U5-947', 'U5-946', 'U5-945', 'U5-944', 'U5-943', 'U5-942', 'U5-941', 'U5-940', 'U5-939', 'U5-938', 'U5-937', 'U5-936', 'U5-935', 'U5-934', 'U5-933', 'U5-932', 'U5-931', 'U5-930', 'U5-929', 'U5-928', 'U5-927', 'U5-926', 'U5-925', 'U5-924', 'U5-923', 'U5-922', 'U5-921', 'U5-920', 'U5-919', 'U5-918', 'U5-917', 'U5-916', 'U5-915', 'U5-914', 'U5-913', 'U5-912', 'U5-911', 'U5-910', 'U5-909', 'U5-908', 'U5-907', 'U5-906', 'U5-905', 'U5-904', 'U5-903', 'U5-902', 'U5-901', 'U5-900', 'U5-899', 'U5-898', 'U5-897', 'U5-896', 'U5-895', 'U5-894', 'U5-893', 'U5-892', 'U5-891', 'U5-890', 'U5-889', 'U5-888', 'U5-887', 'U5-886', 'U5-885', 'U5-884', 'U5-883', 'U5-882', 'U5-881', 'U5-880', 'U5-879', 'U5-878', 'U5-877', 'U5-876', 'U5-875', 'U5-874', 'U5-873', 'U5-872', 'U5-871', 'U5-870', 'U5-869', 'U5-868', 'U5-867', 'U5-866', 'U5-865', 'U5-864', 'U5-863', 'U5-862', 'U5-861', 'U5-860', 'U5-859', 'U5-858', 'U5-857', 'U5-856', 'U5-855', 'U5-854', 'U5-853', 'U5-852', 'U5-851', 'U5-850', 'U5-849', 'U5-848', 'U5-847', 'U5-846', 'U5-845', 'U5-844', 'U5-843', 'U5-842', 'U5-841', 'U5-840', 'U5-839', 'U5-838', 'U5-837', 'U5-836', 'U5-835', 'U5-834', 'U5-833', 'U5-832', 'U5-831', 'U5-830', 'U5-829', 'U5-828', 'U5-827', 'U5-826', 'U5-825', 'U5-824', 'U5-823', 'U5-822', 'U5-821', 'U5-820', 'U5-819', 'U5-818', 'U5-817', 'U5-816', 'U5-815', 'U5-814', 'U5-813', 'U5-812', 'U5-811', 'U5-810', 'U5-809', 'U5-808', 'U5-807', 'U5-806', 'U5-805', 'U5-804', 'U5-803', 'U5-802', 'U5-801', 'U5-800', 'U5-799', 'U5-798', 'U5-797', 'U5-796', 'U5-795', 'U5-794', 'U5-793', 'U5-792', 'U5-791', 'U5-790', 'U5-789', 'U5-788', 'U5-787', 'U5-786', 'U5-785', 'U5-784', 'U5-783', 'U5-782', 'U5-781', 'U5-780', 'U5-779', 'U5-778', 'U5-777', 'U5-776', 'U5-775', 'U5-774', 'U5-773', 'U5-772', 'U5-771', 'U5-770', 'U5-769', 'U5-768', 'U5-767', 'U5-766', 'U5-765', 'U5-764', 'U5-763', 'U5-762', 'U5-761', 'U5-760', 'U5-759', 'U5-758', 'U5-757', 'U5-756', 'U5-755', 'U5-754', 'U5-753', 'U5-752', 'U5-751', 'U5-750', 'U5-749', 'U5-748', 'U5-747', 'U5-746', 'U5-745', 'U5-744', 'U5-743', 'U5-742', 'U5-741', 'U5-740', 'U5-739', 'U5-738', 'U5-737', 'U5-736', 'U5-735', 'U5-734', 'U5-733', 'U5-732', 'U5-731', 'U5-730', 'U5-729', 'U5-728', 'U5-727', 'U5-726', 'U5-725', 'U5-724', 'U5-723', 'U5-722', 'U5-721', 'U5-720', 'U5-719', 'U5-718', 'U5-717', 'U5-716', 'U5-715', 'U5-714', 'U5-713', 'U5-712', 'U5-711', 'U5-710', 'U5-709', 'U5-708', 'U5-707', 'U5-706', 'U5-705', 'U5-704', 'U5-703', 'U5-702', 'U5-701', 'U5-700', 'U5-699', 'U5-698', 'U5-697', 'U5-696', 'U5-695', 'U5-694', 'U5-693', 'U5-692', 'U5-691', 'U5-690', 'U5-689', 'U5-688', 'U5-687', 'U5-686', 'U5-685', 'U5-684', 'U5-683', 'U5-682', 'U5-681', 'U5-680', 'U5-679', 'U5-678', 'U5-677', 'U5-676', 'U5-675', 'U5-674', 'U5-673', 'U5-672', 'U5-671', 'U5-670', 'U5-669', 'U5-668', 'U5-667', 'U5-666', 'U5-665', 'U5-664', 'U5-663', 'U5-662', 'U5-661', 'U5-660', 'U5-659', 'U5-658', 'U5-657', 'U5-656', 'U5-655', 'U5-654', 'U5-653', 'U5-652', 'U5-651', 'U5-650', 'U5-649', 'U5-648', 'U5-647', 'U5-646', 'U5-645', 'U5-644', 'U5-643', 'U5-642', 'U5-641', 'U5-640', 'U5-639', 'U5-638', 'U5-637', 'U5-636', 'U5-635', 'U5-634', 'U5-633', 'U5-632', 'U5-631', 'U5-630', 'U5-629', 'U5-628', 'U5-627', 'U5-626', 'U5-625', 'U5-624', 'U5-623', 'U5-622', 'U5-621', 'U5-620', 'U5-619', 'U5-618', 'U5-617', 'U

# HydraSleeve for Long-Term Monitoring to Reduce Sampling Costs and Carbon Footprint

- Reduces sampling costs significantly
- Reduces IDW (99% decrease in purge water)
- Increases number of wells sampled per day
- Data are comparable, but VOC concentrations were biased low by ~ 3 ug/l on average



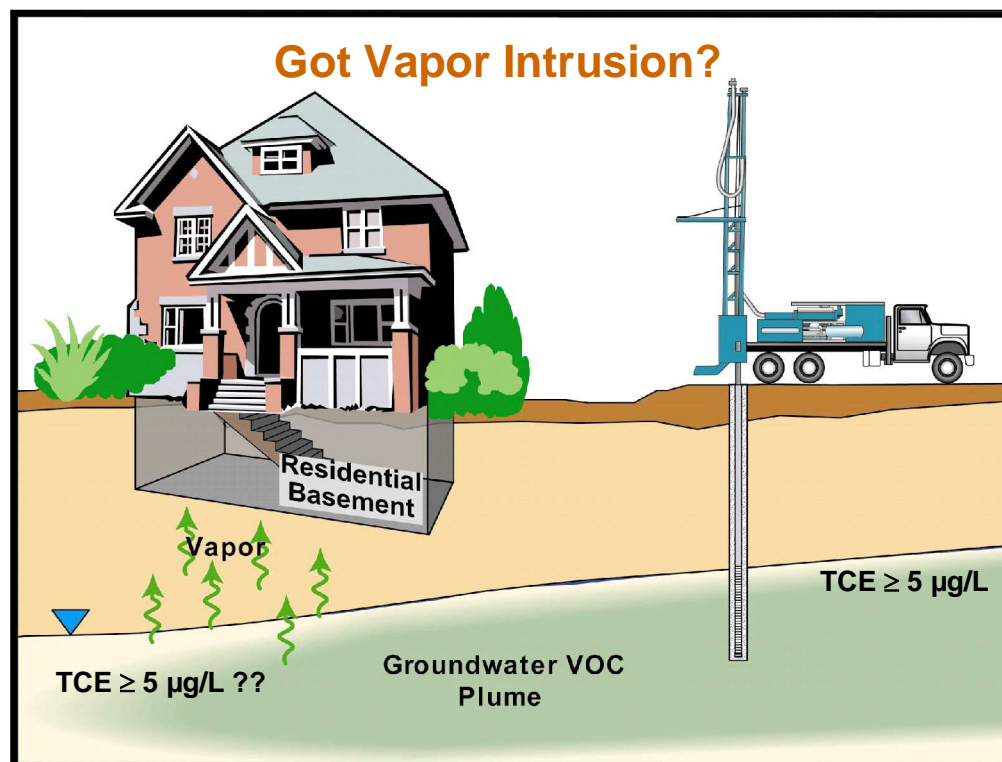
# Indoor Air Sampling Program

Since January 2001:

- ~1819 homes sampled
- ~7200 air samples collected
- 364 homes with detections

Vapor Removal Systems (VRS):

- 106 systems installed



# HAFB Indoor Air Program 2010 Status

- 2710 letters sent
- 633 agreed to sampling
- 630 homes sampled
- 710 samples collected
- 77 homes had detections
- 12 above action level
  - 9 - Tetrachloroethene (PCE)
  - 1 - Trichloroethene (TCE)
  - 1 - Carbon Tetrachloride (CTCL)
  - 1 - trans-Dichloroethene (tDCE)





# Stakeholders



**Hill AFB  
Environmental  
Restoration  
Project Manager**



**Hill AFB Community  
Involvement Team (CIT)**



**Residents**



**MWH Sampling Coordinator**



**MWH Air Sampling Team**



**Laboratory**



**MWH Database Manager**



**MWH Scientists**

# Community Relations

- **Public Meetings**

- present information and results
- provides forum to obtain public feedback

- **Contact potentially impacted residents to request sampling**

- use database to identify residents
- certified mailings to request sampling
- door to door solicitation of non-respondents
- schedule sampling event with residents



# Indoor Air Sampling Program Database Interface

## Residential Sampling Inventory Interface Master Form

Microsoft Access - [Contact Info Master Form]

Name: Jon Date: Location: 012-4000 Area: PAU21

Address: Petrusa Circle Pleasant City, UT 12246 Phone: 801-123-4567

Residence Information:

- Boysenets
- HVAC/Refrigeration
- Paints/Products
- Construction
- Weather/Equipment
- Activities

Year Built: 1992  
Year Moved In: 1998  
Approx Square Footage: 3000

Remarks: Home has full finished basement

## Residential Communications Interface

Microsoft Access - [Location filterable contacts with results]

Last Name: Jon Phone: 801-123-4567 Loc: 012-4000

First Name: Jon Address: Ruby Drive Green City, UT 12246

City: Green City State: UT Zip: 12246

Other: Resident prefers to be contacted via cell phone: 801-123-4568

Communications: jondoe@geosyncity.com

Date: 29-Mar-2005 11:45 Followup: Requested: Completed: 10

Medium: Phone Info: Date: Action Taken:

Notes: JM msg left with reminder of an sampling appt tomorrow. Laundry reminder and cell number also given.

9/22/2008 4:52:24 PM

Record: 11 of 2

Drop Off Date/Time: 25-May-2005 15:45 Read Action: SP51 Task: 1

Pick Up Date/Time: 26-May-2005 15:45

Sample Type (S, JPS etc): PS SAMPLED Duplicate: ☐ TOT1

OTHER NOTES: System shop. CO detector is 0. Resident prefers results sent to his name.

Action Alert: ☐ Sampling Team: 1

Record: 11 of 14

Loc ID	SAMP DATE	SAMP TIME	MA	ANAL	CO	CHEM	CO	RESULT	UNIT
01-0000	11/2/2004	N	AA	TO15	DCA11	0		PF6V	
01-0000	11/2/2004	N	AA	TO15	DCA12	0		PF6V	
01-0000	11/2/2004	N	AA	TO15	DCE11	0		PF6V	
01-0000	11/2/2004	N	AA	TO15	DCE12	0.17		PF6V	
01-0000	11/2/2004	N	AA	TO15	DCE13	0		PF6V	
01-0000	11/2/2004	N	AA	TO15	DCE14	0		PF6V	
01-0000	11/2/2004	N	AA	TO15	DCE15	0		PF6V	
01-0000	11/2/2004	N	AA	TO15	DCE16	0		PF6V	
01-0000	11/2/2004	N	AA	TO15	DCE17	0		PF6V	
01-0000	11/2/2004	N	AA	TO15	DCE18	0		PF6V	
01-0000	11/2/2004	N	AA	TO15	DCE19	0		PF6V	
01-0000	11/2/2004	N	AA	TO15	DCE20	0		PF6V	
01-0000	11/2/2004	N	AA	TO15	DCE21	0		PF6V	
01-0000	11/2/2004	N	AA	TO15	DCE22	0		PF6V	
01-0000	11/2/2004	N	AA	TO15	DCE23	0		PF6V	
01-0000	11/2/2004	N	AA	TO15	DCE24	0		PF6V	
01-0000	11/2/2004	N	AA	TO15	DCE25	0		PF6V	
01-0000	11/2/2004	N	AA	TO15	DCE26	0		PF6V	
01-0000	11/2/2004	N	AA	TO15	DCE27	0		PF6V	
01-0000	11/2/2004	N	AA	TO15	DCE28	0		PF6V	
01-0000	11/2/2004	N	AA	TO15	DCE29	0		PF6V	
01-0000	11/2/2004	N	AA	TO15	DCE30	0		PF6V	

## Household Chemical Products Linked to Resident Record Subform

Microsoft Access - [Products Linkform]

Room Type: Three New Room

Add New Product

Category	Manufacturer	Product Name	Class Code	Part Num	Location	Room Type
Cleaners/Disinfectants/Deodorizers/Pest	Braxton	Copper Spray - 1 Quat H	1	NONE	Groundlev	Orange
Adhesives/Glue/Epoxy Glue	Pennacer	AC coolant of refrigerant I	1	NONE	Groundlev	Orange
Refrigerants/Coolants	AC coolant of refrigerant I	1	NONE	Groundlev	Orange	
Adhesives/Glue/Epoxy Glue	Quakly Seal II	Contact Adhesive	1	MTL101	Groundlev	Sealing
Pest/Weed Control	Ortho	Roach, Ant & Spider Killer	1	NONE	Groundlev	Storage
Paints/Adhesives/Glue	Asp	Kerose	1	NONE	Represent	Living
Paints/Glue/Putty/Sealant	Chase Product	Champion Spray-On Paint C	1	MTL101	Groundlev	Orange
Caustic/Pest/Putty/Sealant	DOW Corning	Silicone sealant	1	PC03	Groundlev	Orange

## Sampling Event Subform

Microsoft Access - [Sample Inventory Information]

Drop Off Date/Time: 3/7/2005 7:50:30 AM Units: 25

Pick Up Date/Time: 3/10/2005 7:45:30 AM Units: 1

Location: Basement

Room Type: Storage

Integration System been running continuously since last test: ☐ ☒ Tracking

Calorimeter/monitor detector operational: ☐ ☒ Tracking

Green Star Certification OK: ☐ ☒ Tracking

Sample Results: Resident did laundry with bleach during test.

Weather for test duration:

Cloud Cover	OPENED	CLOSED	UNITS
Cloud Cover	5	20	%
Temperature	37	44	°F
Humidity	20	20	%
Wind Speed	5	5	MPH
Barometric Pressure	30.22	30.22	IN HG

Remarks on Weather: Saw pressure system to north during night, but cleared before sample pick-up time.

Sample Equipment:

Identification Number	Type
00020	Flow Controller
00079	Flow Controller
00020	Flow Controller

Equipment Remarks: New pressure gauge from lab was used for initial measurement.

## Household Chemical Products Database Subform

Microsoft Access - [Product Lookup]

Category: Cleaners/Disinfectants/Deodorizers/Pest

Manufacturer: Braxton

Name: Copper Spray - 1 Quat H

Part Num: NONE

MSDS Web Address: http://www.braxton.com/MSDS/CopperSpray-1QuatH.pdf

Add Chemical List To File:

Category: Adhesives/Glue/Epoxy Glue

Manufacturer: Pennacer

Name: AC coolant of refrigerant I

Part Num: NONE

MSDS Web Address: http://www.pennacer.com/MSDS/ACCoolant.pdf

Add Chemical List To File:

Category: Paints/Adhesives/Glue

Manufacturer: Asp

Name: Kerose

Part Num: NONE

MSDS Web Address: http://www.asp.com/MSDS/Kerose.pdf

Add Chemical List To File:

## Home Construction Inventory Subform

Microsoft Access - [Construction Linkform]

CONSTRUCTION: 10

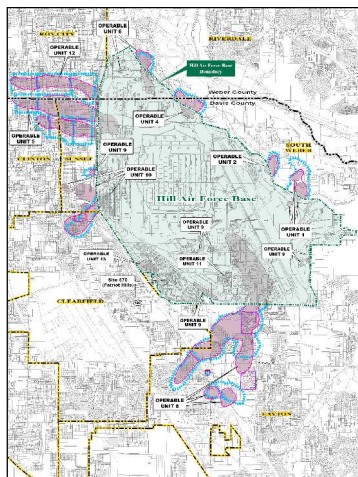
CONSTRUCTION	ACTIVE DATE	INACTIVE DATE	REMARKS
Brick, Aluminum	15-Jul-1995	25-Aug-1995	
Brick, Vinyl	21-Aug-1995		
Brick, Attached	15-Jul-1995		
Foundation Driv	15-Jul-1995		
Driv	02-May-1996		Driv info filed upon discovery of water intrusion during spring snow melt.



HILL AIR FORCE BASE  
BASEWIDE  
INDOOR AIR SAMPLING  
DATABASE INTERFACE  
FIGURE 5-1

# Multiple Lines of Evidence:

## Approach for Determining the Presence or Absence of Vapor Intrusion in a Residence



The indoor air sampling program includes homes located above the known or suspected extent of groundwater contamination.



Indoor air samples are collected in dedicated SUMMA<sup>®</sup> canisters



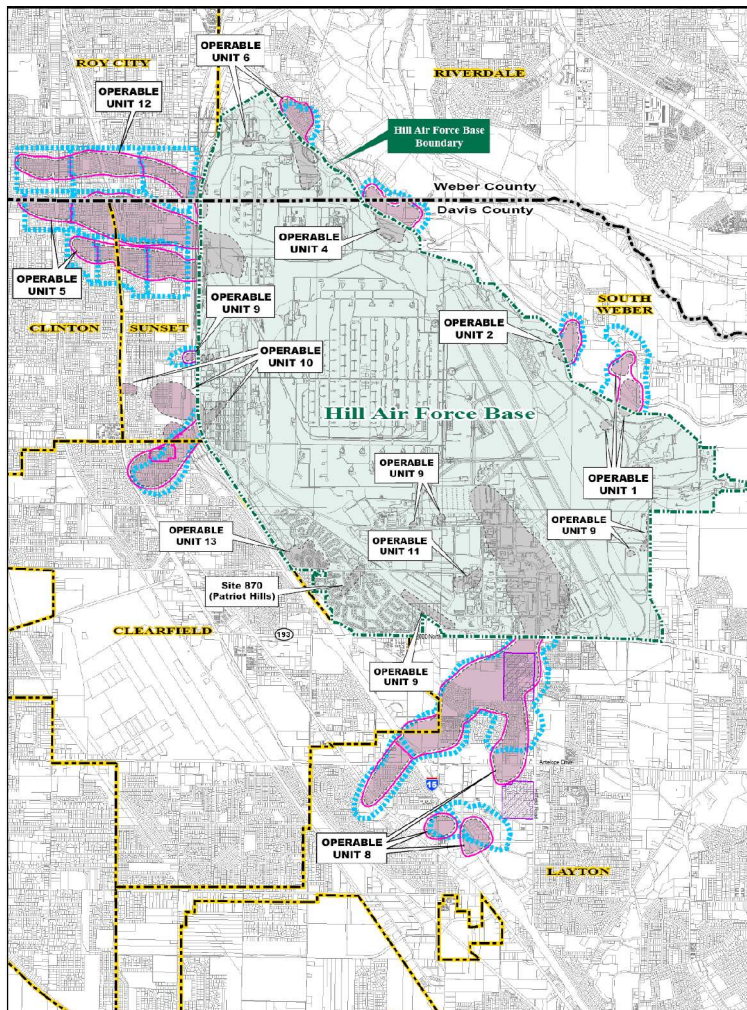
Identification of household products or activities that could potentially interfere with air sample results.



The INFICON HAPSITE<sup>®</sup> portable GC/MS is utilized in the identification of interior contaminant sources.



# Groundwater Contamination and Potential Vapor Intrusion Risk



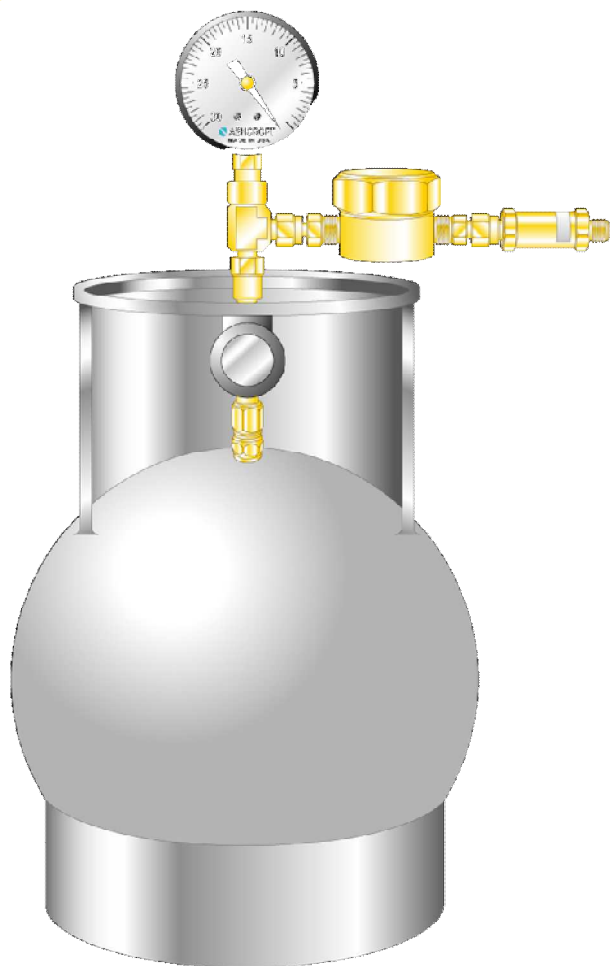
- Contaminants from groundwater have the potential to volatilize, migrate through the overlying vadose zone, and create a potential vapor intrusion risk.
- Groundwater investigations define contaminants of concern and the areal extent of the groundwater plume.
- Residences contacted for inclusion in the indoor air sampling program are based on their location with respect to groundwater contamination.
- Groundwater data can be used in conjunction with indoor air sampling data to calculate attenuation factors.

# Interior Sources of Indoor Air Contaminants

- A detailed chemical inventory of all residences is performed prior to initiating indoor air sampling.
- 292 common household products have been identified as containing contaminants of concern (COC) that could potentially interfere with indoor air sample results.
- Homeowner activities including the use of COC containing products or dry cleaning storage, can potentially impact air sample results.



# SUMMA<sup>®</sup> Canister Sampling



- Indoor air samples are collected in stainless steel 6-liter SUMMA<sup>®</sup> canisters equipped with a 24-hour flow-rate controller.
- SUMMA<sup>®</sup> canisters are placed in the lowest livable room of the residence.
- Indoor air samples are analyzed by U.S. EPA Method TO15 for target contaminants.
- Dedicated SUMMA<sup>®</sup> canisters are batch certified clean by the laboratory.

# INFICON HAPSITE® Portable GC/MS

- The use of the HAPSITE® allows for the real-time identification and removal of interior sources, which may not have ingredients listed, have an incomplete ingredients list, or are activities, such as dry cleaning or taxidermy.
- Interior sources have been identified and removed from 24 of the 26 homes investigated using the HAPSITE®
- The Hapsite is not intended to generate lab certifiable results, but rather to be used as a screening tool in the multiple lines of evidence approach for determining the presence or absence of VI in a residence..





# Mitigation Action Levels (MALs) / Screening Levels

TABLE 7-1

COMPARISON OF 2004 AND 2009 MITIGATION ACTION LEVELS  
BASEWIDE RESIDENTIAL INDOOR AIR SAMPLING PROGRAM  
HILL AIR FORCE BASE, UTAH  
(Page 1 of 1)

	2004 MAL ( $\mu\text{g}/\text{m}^3$ )	2009 MAL/ Screening Level ( $\mu\text{g}/\text{m}^3$ )	2004 MAL (ppbv)	2009 MAL/ Screening Level (ppbv)
Carbon Tetrachloride	1.6	1.6	0.26	0.26
Chloroform <sup>(a)</sup>	NA	8.3	NA	1.7
1,1-Dichloroethane	500	15	120	3.8
1,2-Dichloroethane <sup>(b)</sup>	0.94	NA	0.23	NA
1,1-Dichloroethene	200	209	50	53
cis-1,2-Dichloroethene	35	63	8.8	16
trans-1,2-Dichloroethene	70	63	18	16
Tetrachloroethene	8.1	4.1	1.2	0.61
1,1,1-Trichloroethane <sup>(b)</sup>	2200	NA	400	NA
Trichloroethene	2.3	12	0.43	2.3
Vinyl Chloride	2.8	2.8	1.1	1.1

NA Not applicable; no criteria initially developed for this compound

MAL Mitigation Action Level

$\mu\text{g}/\text{m}^3$  micrograms per cubic meter

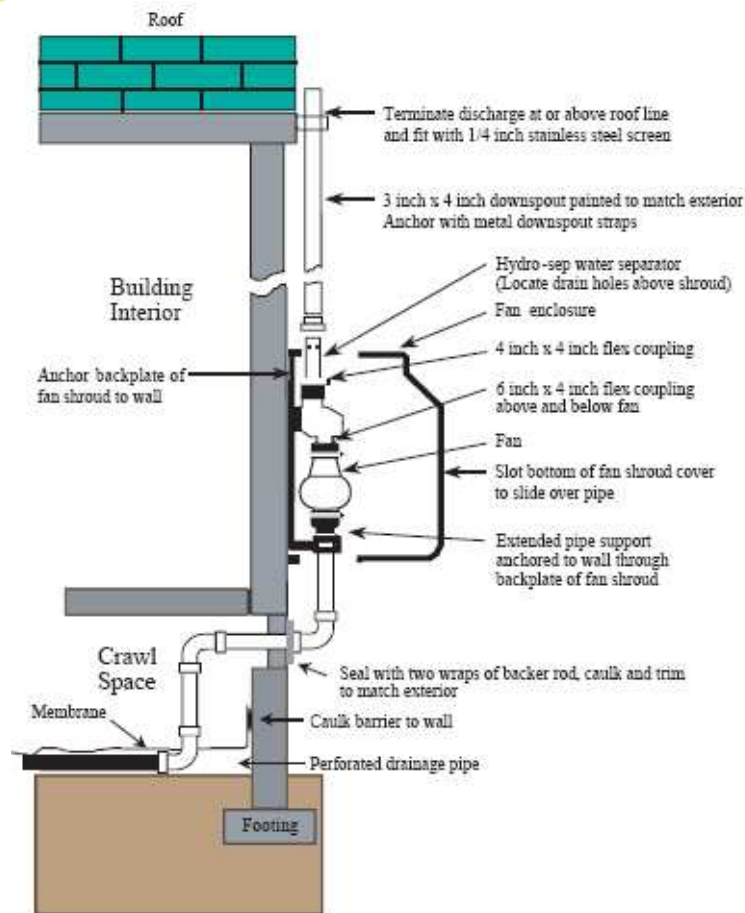
ppbv parts per billion by volume

<sup>(a)</sup> Chloroform screening level is a proposed risk-based action level.

<sup>(b)</sup> This analyte has been removed from the sampling program.

- The methodology for determining if vapor intrusion is a concern in a residence involves the application of MALs.
- The MALs for the indoor air program were established based on COCs identified in underlying impacted groundwater.
- The MALs are risk-based.
- If COCs are detected in indoor air samples at concentrations exceeding the MALs a VRS system is recommended to the resident.

# Vapor Removal System (VRS)



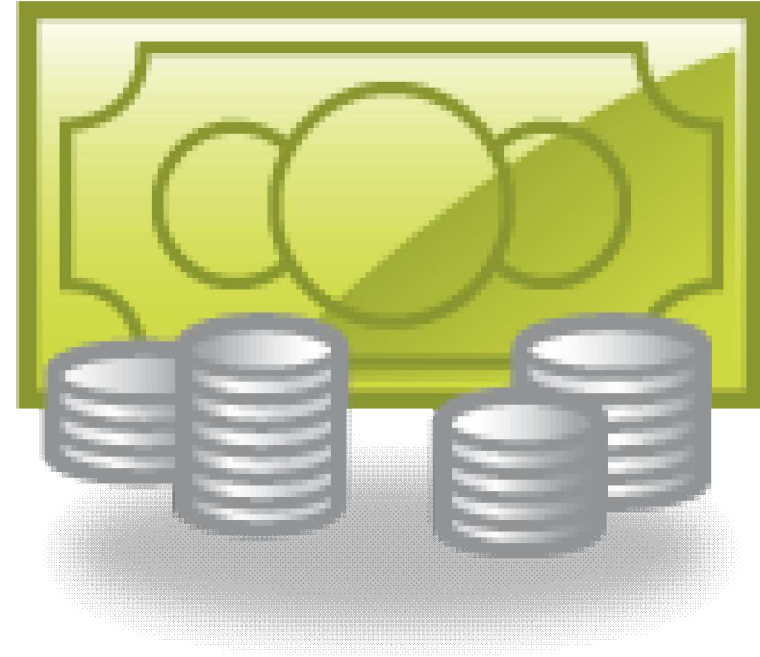
SOURCE:  
Specifications for Soil Gas Reduction Systems  
July 19, 2002 by Doug Kladder

- VRSs are installed to mitigate COCs present in indoor air as a result of confirmed vapor intrusion.
- Primarily VRSs operate continuously, create negative pressure in the soil or fill material underlying the structures foundation, and do not negatively impact the use or aesthetics of the structure.
- 106 VRSs have been installed to date.
- Indoor air sampling continues on an annual basis to verify effective VRS operation.



# Indoor Air Program Costs

- Current MWH air sampling contract ~1M Euros over 18 month period and assumes the collection of ~ 1000 air samples.
- VRS installation costs:  
~ 1500 Euros per system
- Cost per indoor air sample is ~1000 Euros. This cost per sample includes:
  - Laboratory analysis
  - Data validation
  - Monthly and annual data reporting
  - Sample collection
  - Project management
  - Sample coordination / scheduling
  - Public meetings



# Questions?

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