NAVFAC OER2 Optimization Case Studies

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OER2 Webinar Series

- **Why Attend?**
  - Obtain and hear about the latest DOD and DON's policies/guidance, tools, technologies and practices to improve the ERP's efficiency
  - Promote innovation and share lessons learned
  - FEEDBACK to the ERP Leadership
- **Who Should Attend?**
  - ERP Community Members: RPMs, RTMs, Contractors, and other remediation practitioners who support and execute the ERP
  - Voluntary participation
- **Schedule and Registration:**
  - Offered quarterly
  - Registration link for each topic (announced via ER T2 email)
- **Topics and Presenters:**
  - ERP community members to submit topics (non-marketing and DON ERP-relevant) to POCs (Nathan Delong at nathan.a.delong2.civ@us.navy.mil or EXWC_T2@navy.mil)
  - Selected topic will be assigned Champion to work with presenter

NSF-INDIAN HEAD LANDFILL LTM OPTIMIZATION

Joseph Rail
NAVFAC WASH

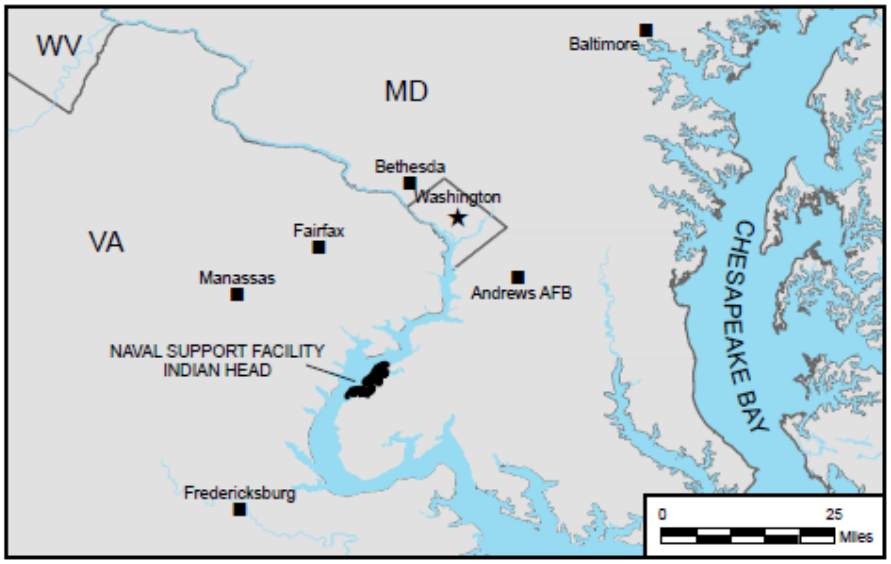
NSF-Indian Head Landfill LTM Optimization

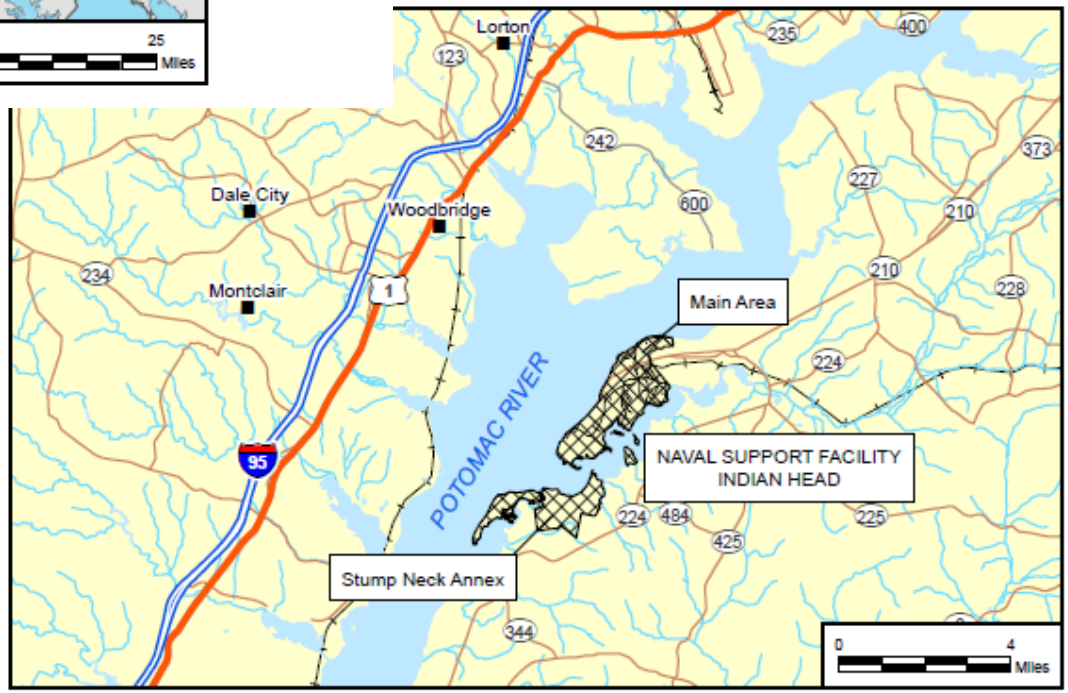
- Recent LTM optimization efforts have been implemented at Naval Support Facility, Indian Head, MD for three landfill sites (Sites 11, 21, and 36.)
- Sites 11, 21, and 36 are closed landfills that were sampled semi-annually for VOCs, total and dissolved metals, and general chemistry - following COMAR regulations.
- ROD Remedies-
  - Site 11 & 21- Protective soil cover, Institutional Controls (ICs), and groundwater monitoring
  - Site 36- Land use controls (LUCs), maintenance of existing soil & vegetative cover, and long-term monitoring of shallow groundwater
- Post-Closure Monitoring began in 2014 (9 years ago.)

NSF-Indian Head Landfill LTM Optimization

- **Sites 11 and 21:**
  - **VOCs are consistently non-detect or trace levels.**
    - Reduce VOC sampling frequency to *1x per 5-Year Review period*
  - **Iron and manganese are consistently detected above criteria in most of the wells.**
    - While continuing to sample for iron and manganese, recommend reducing metals list and eliminating dissolved metals analysis.
    - Reduce metal sampling frequency from semi-annual to *biennial*
- **Site 36:**
  - **VOCs are consistently detected at low concentrations.**
    - Reduce VOC sampling frequency from semi-annual to *biennial*
  - **Several metals consistently detected above criteria. Re-visit the metals list for analysis.**
    - Reduce metal sampling frequency semi-annual to *annual*

Naval Support Facility, Indian Head, MD Location





Site 11- Caffee Road Landfill

- **7MWs - Semi-annual sample frequency**
  - **IS11MW04, IS11MW06, IS11MW07, IS11MW08, IS11MW09, IS11MW10, and IS11MW11**
- **No groundwater COCs per the ROD (2009)**

Site 11- Caffee Road Landfill

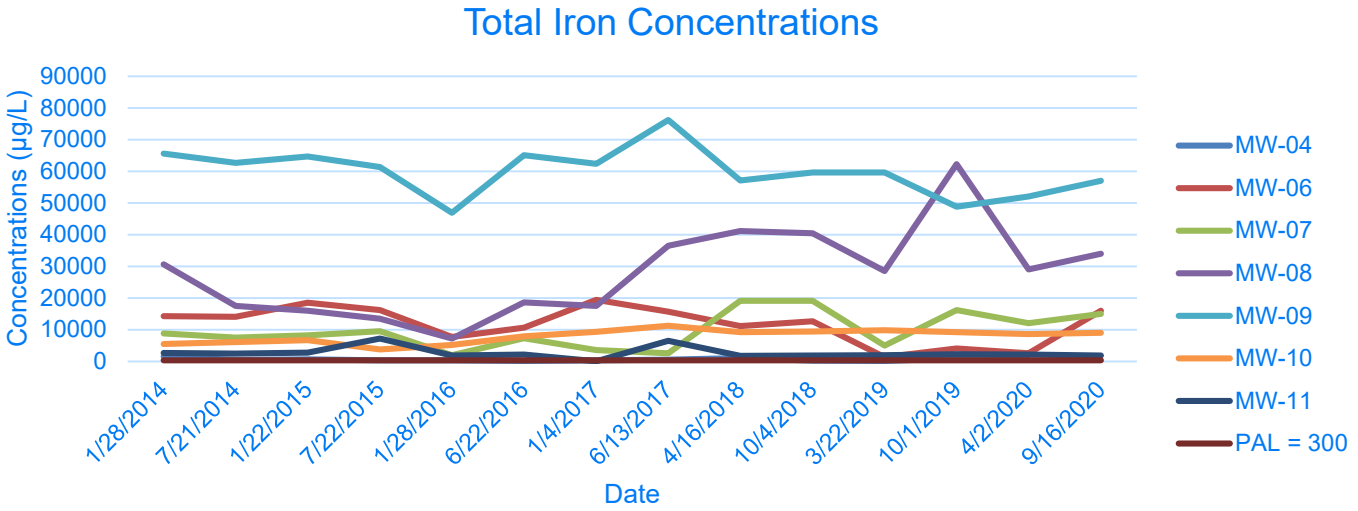
18 rounds of sampling have been conducted in 8 years (2014-2022).

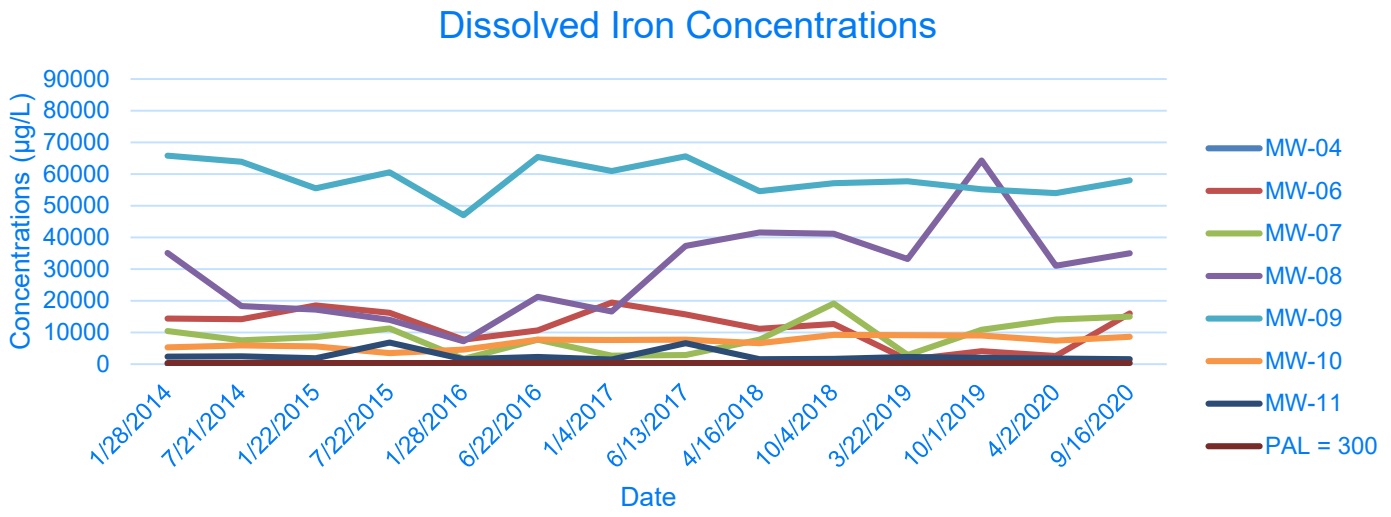
- **VOCs**
  - **Minimal VOC detections, all at orders of magnitude below screening levels.**
  - **Most of the detections occurred prior to 2016**
  - **No MCL exceedances in any round**

- **Metals**
  - **In all wells, total and dissolved iron and manganese have exceeded the screening criteria in most rounds.**
  - **Arsenic, barium, cobalt, and lead have been detected above criteria.**
  - **Total and dissolved analysis typically closely match.**

Site 11- Total vs. Dissolved Metals

There is a close correlation between total and dissolved metals. Iron shown as an example.

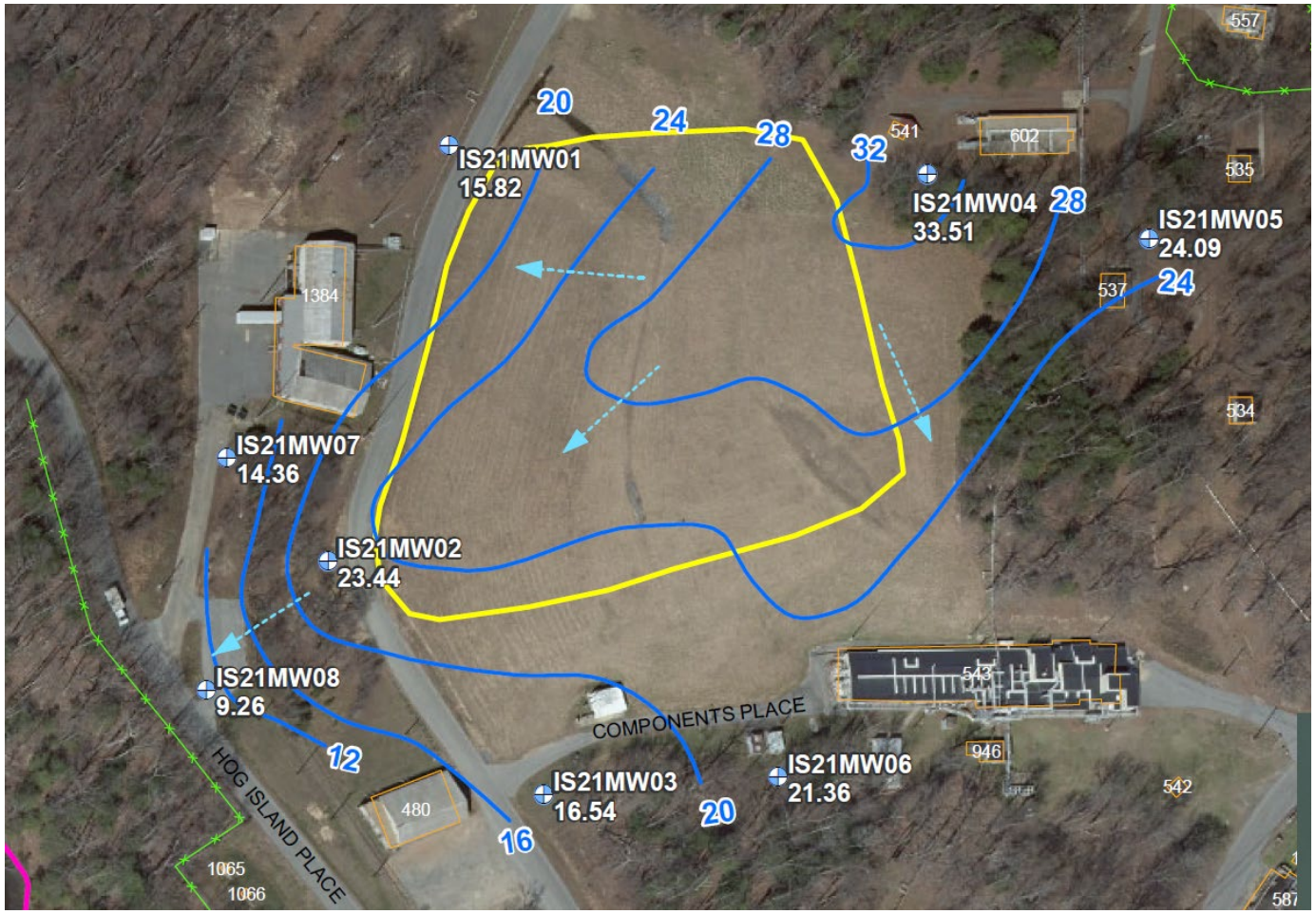




Site 11- Proposed Optimization

- Reduce VOC sampling frequency to once per 5-Year Review period
  - Vast majority of VOCs are non-detect. The few detections are well below criteria.
- Reduce metals sampling frequency from semi-annual to biennial.
  - Allows for two or more sample events to supplement each Five-Year Review period
- Reduce the metals list to the 6 that have had exceedances of criteria (vs. 22 sampled now).
  - Arsenic, barium, cobalt, iron, lead, and manganese.
- Eliminate dissolved metals. Total and dissolved metals are closely correlated.

Site 21-Bronson Road Landfill



- **8MWs - Semi-annual sample frequency**
  IS21MW01, IS21MW02, IS21MW03, IS21MW04, IS21MW05, IS21MW06, IS21MW07, and IS21MW08
- **Groundwater COC Manganese (ROD 2011)**

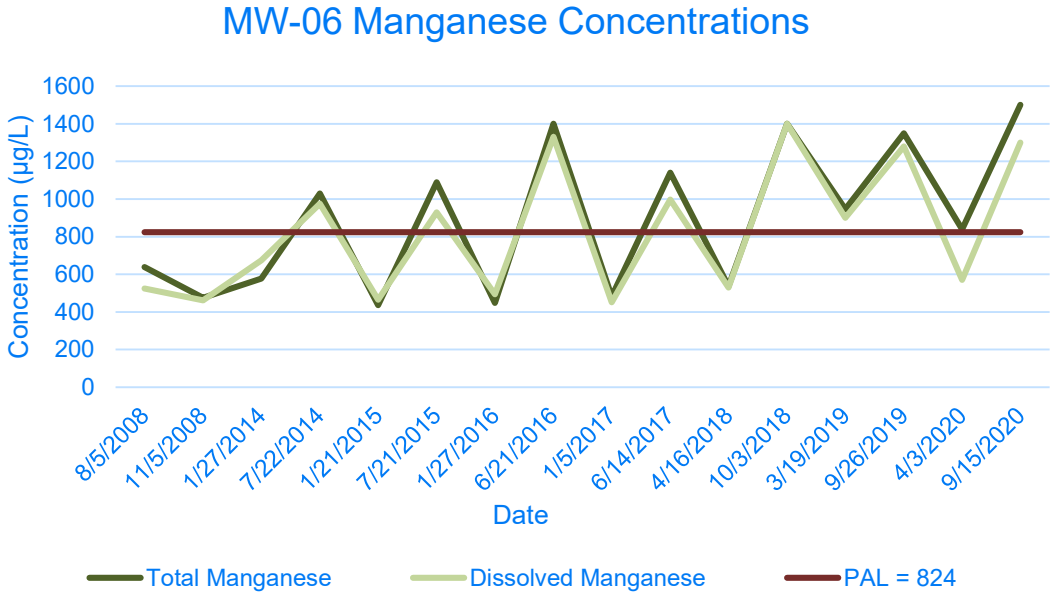
Site 21-Bronson Road Landfill

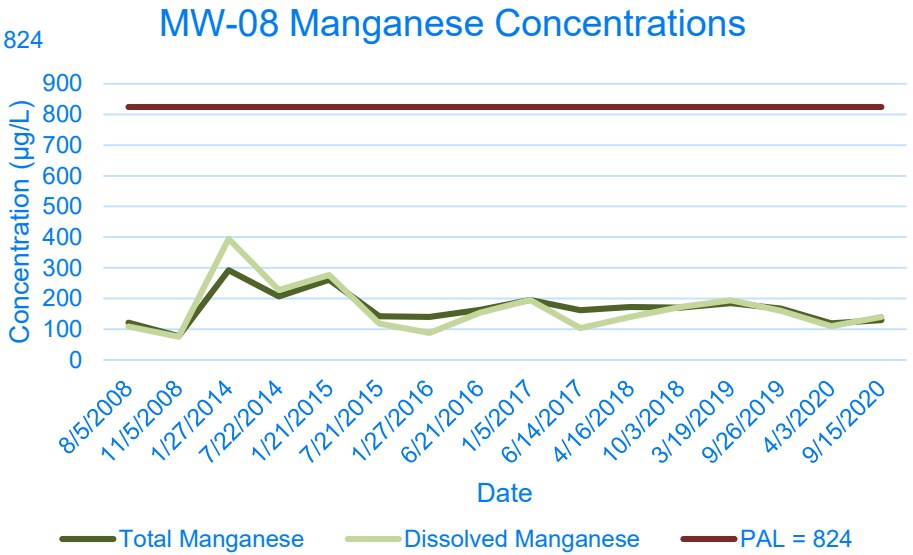
18 rounds of sampling have been conducted in 8 years (2014-2022).

- **VOCs**
  - **Low level VOC detections, all at orders of magnitude below screening levels.**
  - **No MCL exceedances in any round**
  - **Aside from trace levels of chloroform, 5 of the 8 wells sampled (MW-1, MW-3, MW-4, MW-5, and MW-8) have all been non-detect for VOCs since 2015 or 2016 (Rounds 5 or 6).**
- **Metals**
  - **5 of the 8 wells except MW-1, MW-4 & MW-5 (2 up gradient wells) have common exceedances of iron and manganese.**
    - **Occasional exceedances of cobalt.**

Site 21-Bronson Road Landfill-Metals

Total and dissolved analysis typically closely match. Manganese shown as an example.

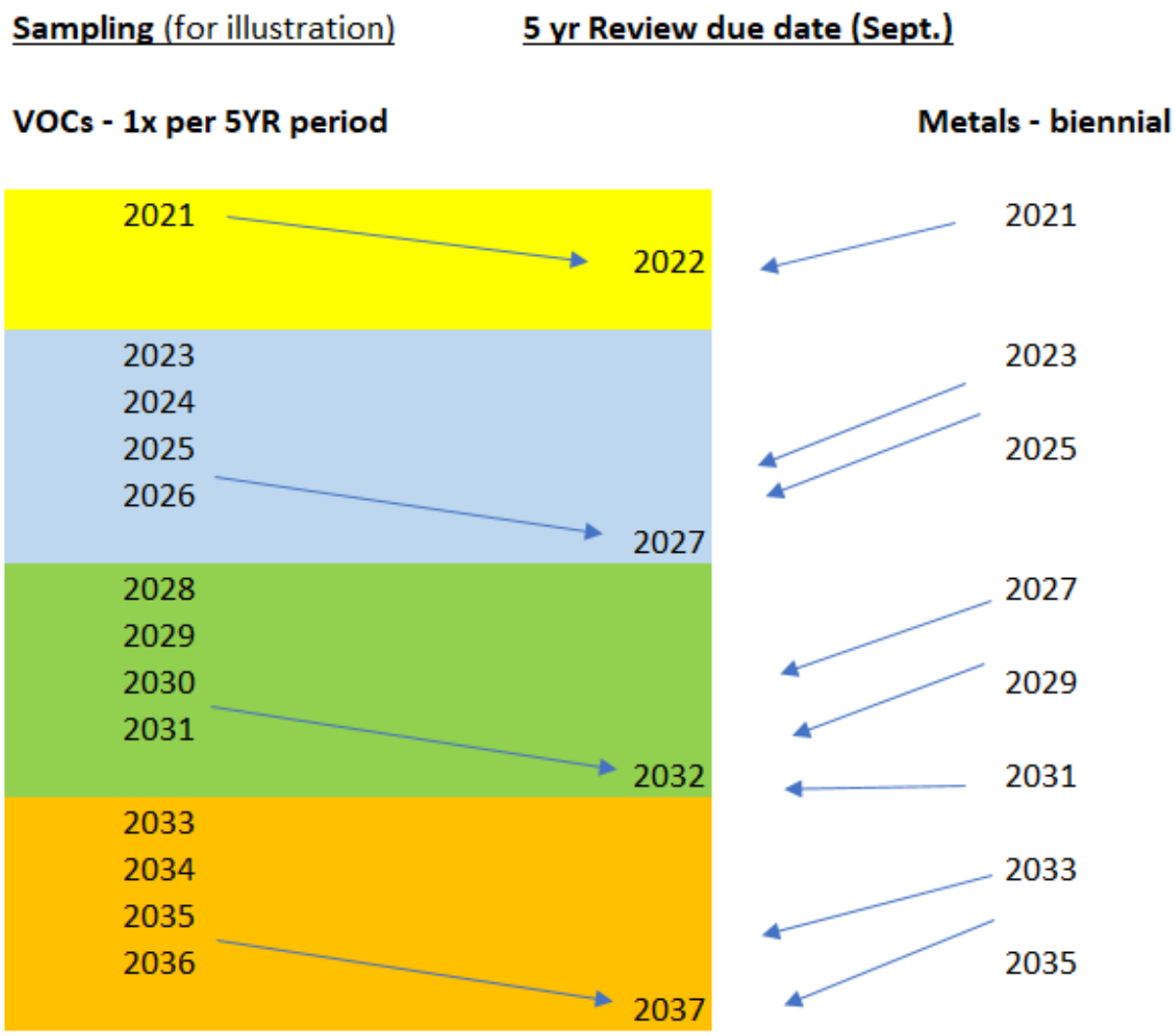




Site 21- Proposed Optimization

- Reduce VOC sampling frequency to once per 5-Year Review period
  - VOC detections are at very low levels and typically infrequent.
- Eliminate VOC analysis for MW-4 or MW-5 (up gradient wells with similar historical data).
- Reduce metals sampling frequency from semi-annual to biennial
  - Allows for two or more sample events to supplement each Five-Year Review period
- Reduce the metals list to only the 3 analytes that have had current or historical exceedances of criteria
  - Iron, manganese, and cobalt
- Eliminate dissolved metals. Total and dissolved metals are closely correlated.

Sampling Frequency for Sites 11 & 21



Site 36-Closed Landfill

- **1 MW, 4 pore water sampling points - Semi-annual sample frequency**
  IS36MW03, IS36PW01, IS36PW02, IS36PW03, and IS36PW04
  - **Groundwater COCs (ROD 2011): Arsenic, iron, manganese**

Site 36-Closed Landfill

17 rounds of sampling have been conducted in 8 years (2014-2022).

- **VOCs**
  - **Minimal low level VOC detections, all detections were orders of magnitude lower than criteria.**
  - **No MCL exceedances in any round**
- **Metals**
  - **Consistent exceedances of iron and manganese (total and dissolved) at all 4 porewater sampling points**
  - **Frequent exceedances of arsenic, cobalt, lead, and/or zinc (total and dissolved) at all 4 porewater sampling points**
  - **Total metals concentrations tend to be higher values than dissolved**
    - **Turbidity is high in the porewater wells.**

Site 36-Proposed Optimization

- Reduce VOC sampling frequency from semi-annual to biennial.
  - VOCs consistently below screening criteria.
- Reduce metals sampling frequency from semi-annual to annual.
  - Several metals consistently exceed screening criteria.
- Reduce constituent list to the 14 metals that have had current or historical exceedances
  - Antimony, arsenic, barium, beryllium, cadmium, cobalt, copper, iron, lead, manganese, mercury, nickel, vanadium, zinc
  - Continue total and dissolved analysis

Landfill LTM Optimization Summary

General Conclusions:

- Vast majority of VOCs are non-detect and the limited detections are below screening criteria.
- Metals concentrations are generally stable and do not exhibit increasing or decreasing trends.
- Numerous metals that were analyzed for have been consistently below the screening criteria.
- Total and dissolved metals results are consistently correlated.

Regulator Concurrence

- MDE agreed to evaluate optimization potential (biannual landfill monitoring typically required for 5 years or a full Five Year Review cycle before they'll consider reduction.)
- Based on a trend analysis (no increasing or decreasing trends) and multi-year data, regulators were amenable to reductions in LTM frequency and analyte list.

Landfill LTM Optimization Summary

Goals achieved

- Team acceptance and resolution of optimization recommendations for Indian Head Sites 11, 21, and 36.
- Determined a path forward for upcoming LTM events and for discussion in the current Five-Year Review.

Cost Avoidance

- Site 11 & 21- $42K annually ($52K pre-optimization, $10K post-optimization)
- Site 36- $24K annually ($42K pre-optimization, $18K post-optimization)

Deliverables

- Optimization Tech Memo finalized in April 2022.

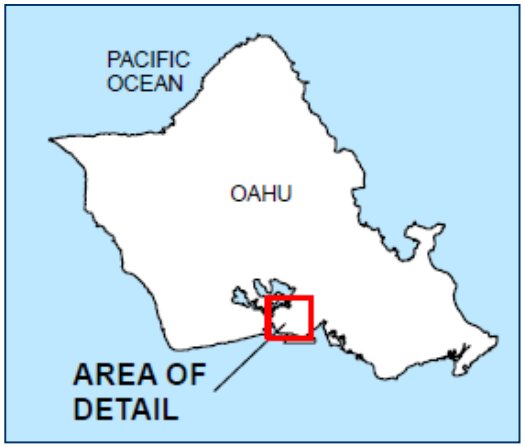
Lessons Learned

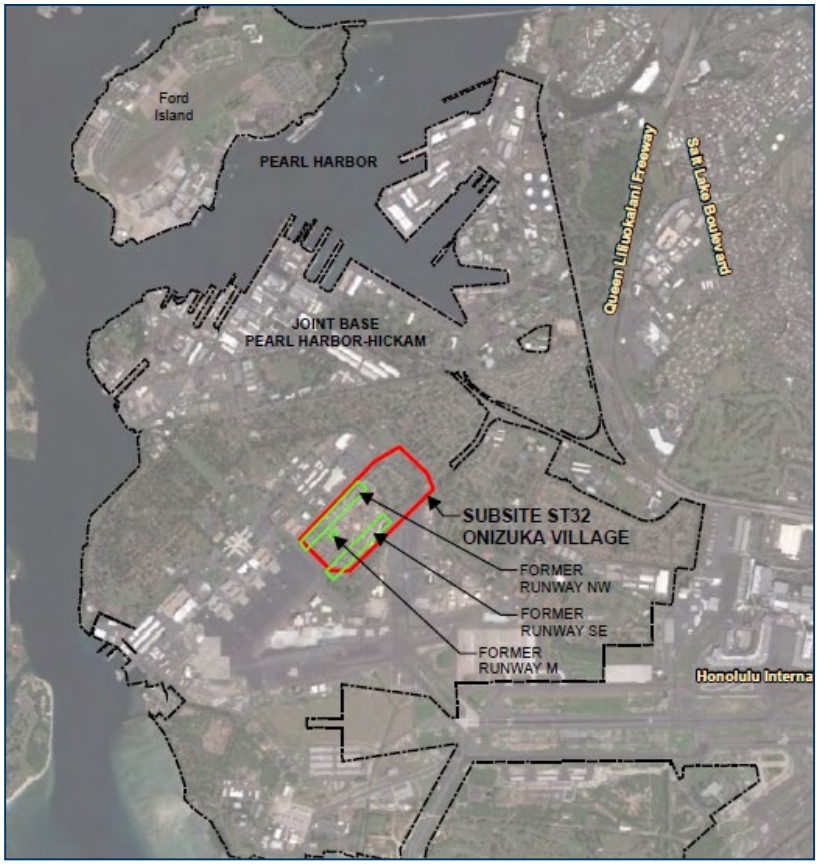
- Actively engaging regulators with potential optimization efforts early in a LTM program can pay off later on (i.e. Upfront agreement on when and how LTM data will be reviewed.)
- Batching similar sites together helps in managing the overall LTM program for an installation (scheduling base access, sampling frequency, and reporting.)

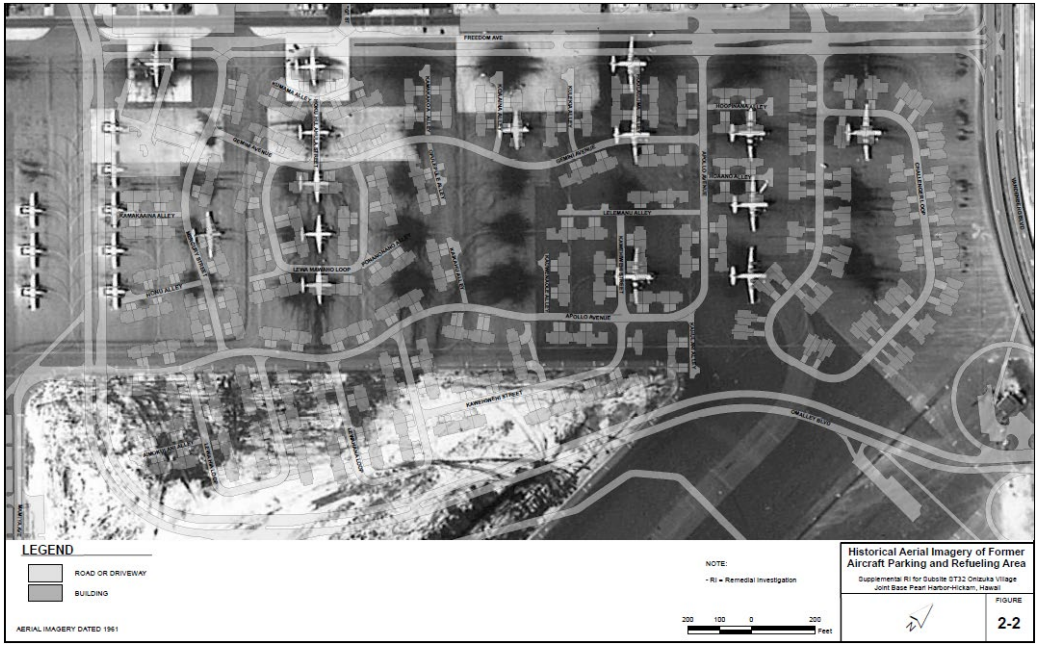
ONIZUKA VILLAGE TREATABILITY STUDY OPTIMIZATION

Jocelyn Tamashiro
NAVFAC PAC

Onizuka Village Treatability Study Optimization







Site Description

- 80 acres – 304 privatized homes, multiplex units
- Commercial/industrial facilities (BX, Commissary, flightline) to West, South and East; Residential area to North
- Storm drain and other utility conduits exist throughout the area
- Pesticide impacted soil wrapped and buried beneath/around homes
- Nearest surface water body is Pearl Harbor ~3 miles Southwest
- Groundwater depth 9 to 11 ft bgs, non-potable, flows Southwest
- COPCs:
  - -TPH-g, benzene & methane in soil gas at 4 to 6 ft bgs
  - -TPH-g in soil at 4.5 to 9.5 ft bgs
- Soil Gas
  - – No risks associated with current land use (VI was not identified in subslab locations)
  - ** Conducted subslab soil vapor sampling under 28 units
  - ** Polyethylene vapor barrier under houses

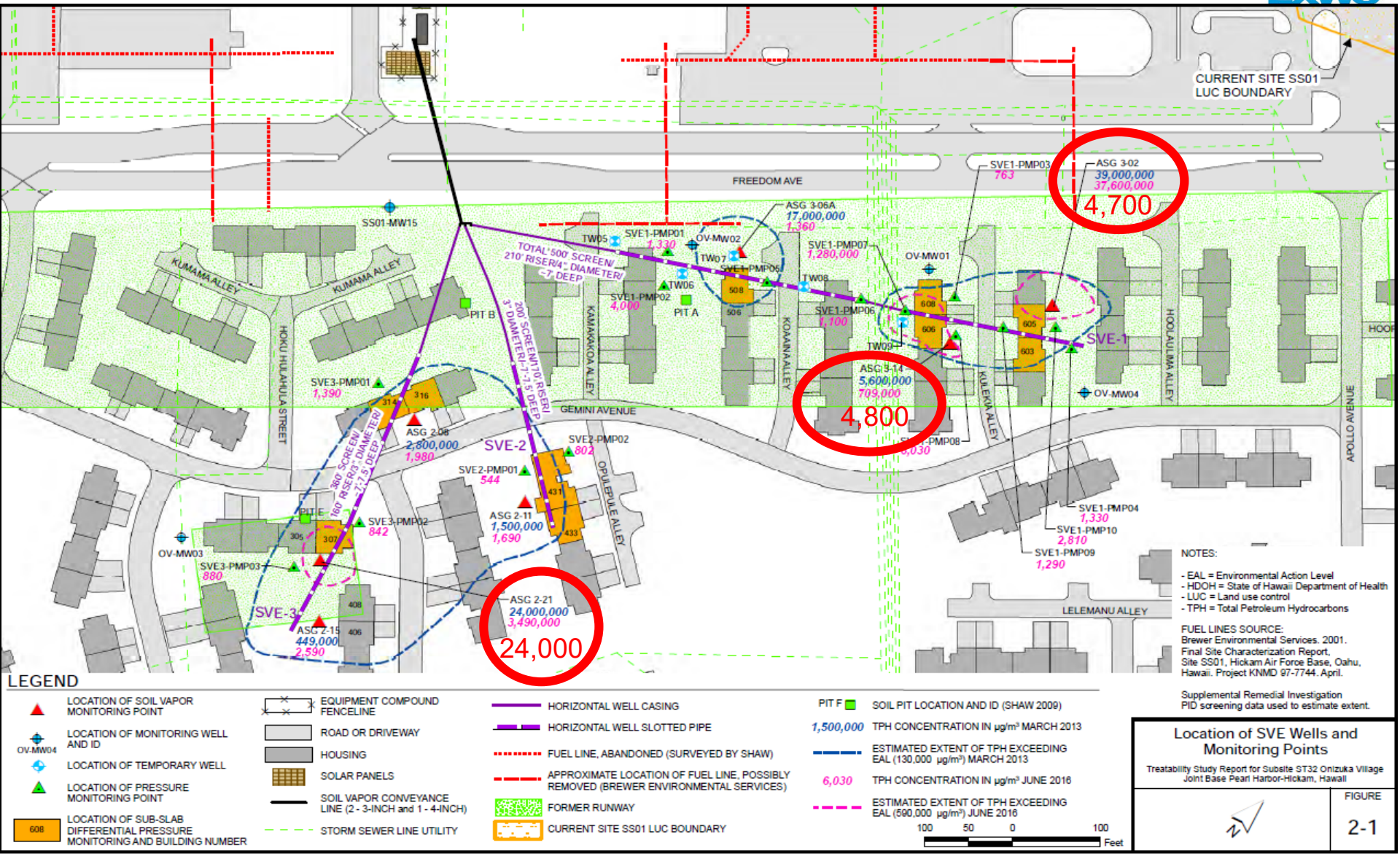
Remedial Action Objectives

- RAO 1: Protect future human receptors by preventing potential exposure to contaminants in shallow soil vapor via intrusion into indoor or ambient air that would result in the following:
  - A cumulative excess cancer risk higher than $1x10^{-4}$ for hypothetical future residents
  - A total noncancer HI higher than 1 for hypothetical future residents

- RAO 2: Prevent or mitigate, to the extent practical, the potential migration of unacceptable concentrations of TPH in soil vapor under current residential buildings

Contaminant of Concern	Remediation Goal, ug/m^3
Total C6-C10 gasoline range hydrocarbons	600,000

SVE System

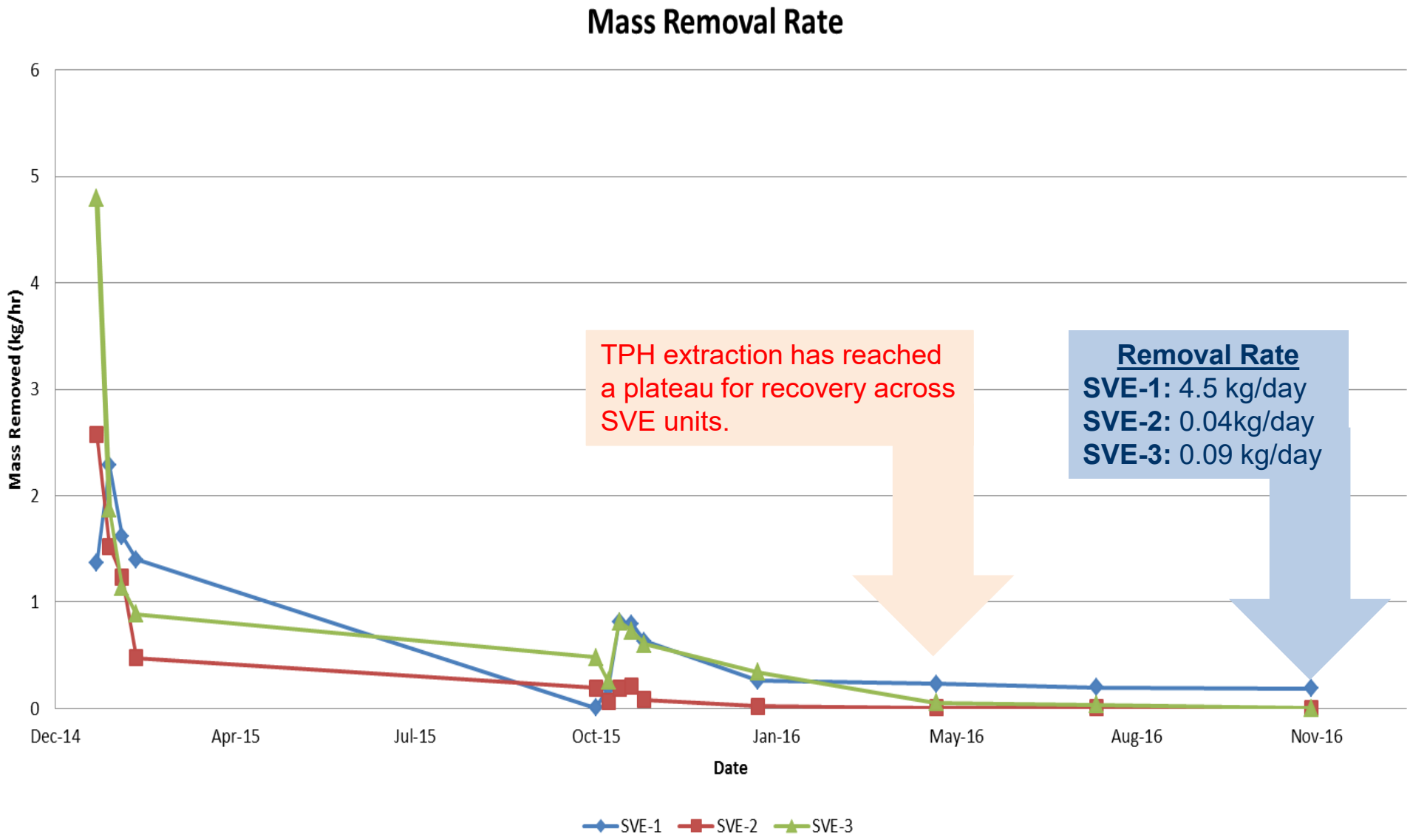

CURRENT SITE SS01
LUC BOUNDARY
FREEDOM AVE
GEMINI AVENUE
LELEMANU ALLEY
KUMAMA ALLEY
HOKU HULAHULA STREET
KAMAKAKOA ALLEY
KOAANA ALLEY
KULEKA ALLEY
HOOLAULIMA ALLEY
APOLLO AVENUE
OPULEPULE ALLEY
SS01-MW15
OV-MW01
OV-MW02
OV-MW03
OV-MW04
PIT A
PIT B
PIT E
SVE-1
SVE-2
SVE-3
SVE1-PMP01 1,330
SVE1-PMP02 4,000
SVE1-PMP03 763
SVE1-PMP04 1,330
SVE1-PMP06 1,100
SVE1-PMP07 1,280,000
SVE1-PMP09 1,290
SVE1-PMP10 2,810
SVE2-PMP01 544
SVE2-PMP02 802
SVE3-PMP01 1,390
SVE3-PMP02 842
SVE3-PMP03 880
ASG 2-08 2,800,000 1,980
ASG 2-11 1,500,000 1,690
ASG 2-15 449,000 2,590
ASG 2-21 24,000,000 3,490,000
ASG 3-02 39,000,000 37,600,000
ASG 3-06A 17,000,000 1,360
ASG 3-14 5,600,000 709,000
4,700
4,800
24,000
TOTAL 500' SCREEN 210' RISER 4" DIAMETER ~7' DEEP
200' SCREEN 170' RISER 3" DIAMETER ~7.5' DEEP
360' SCREEN 160' RISER 3" DIAMETER ~7.5' DEEP
NOTES:
- EAL = Environmental Action Level
- HDOH = State of Hawaii Department of Health
- LUC = Land use control
- TPH = Total Petroleum Hydrocarbons
FUEL LINES SOURCE:
Brewer Environmental Services. 2001. Final Site Characterization Report, Site SS01, Hickam Air Force Base, Oahu, Hawaii. Project KNMD 97-7744. April.
Supplemental Remedial Investigation PID screening data used to estimate extent.
LEGEND
LOCATION OF SOIL VAPOR MONITORING POINT
LOCATION OF MONITORING WELL AND ID
LOCATION OF TEMPORARY WELL
LOCATION OF PRESSURE MONITORING POINT
LOCATION OF SUB-SLAB DIFFERENTIAL PRESSURE MONITORING AND BUILDING NUMBER
EQUIPMENT COMPOUND FENCELINE
ROAD OR DRIVEWAY
HOUSING
SOLAR PANELS
SOIL VAPOR CONVEYANCE LINE (2 - 3-INCH and 1 - 4-INCH)
STORM SEWER LINE UTILITY
HORIZONTAL WELL CASING
HORIZONTAL WELL SLOTTED PIPE
FUEL LINE, ABANDONED (SURVEYED BY SHAW)
APPROXIMATE LOCATION OF FUEL LINE, POSSIBLY REMOVED (BREWER ENVIRONMENTAL SERVICES)
FORMER RUNWAY
CURRENT SITE SS01 LUC BOUNDARY
PIT F SOIL PIT LOCATION AND ID (SHAW 2009)
1,500,000 TPH CONCENTRATION IN µg/m³ MARCH 2013
ESTIMATED EXTENT OF TPH EXCEEDING EAL (130,000 µg/m³) MARCH 2013
6,030 TPH CONCENTRATION IN µg/m³ JUNE 2016
ESTIMATED EXTENT OF TPH EXCEEDING EAL (590,000 µg/m³) JUNE 2016
100 50 0 100 Feet
Location of SVE Wells and Monitoring Points
Treatability Study Report for Subsite ST32 Onizuka Village Joint Base Pearl Harbor-Hickam, Hawaii
FIGURE 2-1

ZERO Exceedances – May 2019 Sampling (Sub-slab/ Hot Spots)

Concentration of TPH-GRO in Soil Vapor "Hot Spots", ug/m3

	ASG2-08	ASG2-11	ASG2-15	ASG2-21	ASG3-02	ASG3-06/06A	ASG3-14
August 2017	1,040	4,770	1,010	665,000	30,900,000	368	1,090,000
May 2018	4,400 J	3,200 J	2,700 J	110,000	16,000,000	2,500 J	150,000
January 2019	3,300 J	4,900 U	4,800 U	89,000	590,000	1,800 J	4,800 J
May 2019	4,500 U	5,000 U	4,600 U	24,000 J	4,700 U	4,600 U	4,800 U

TPH Extraction Trends

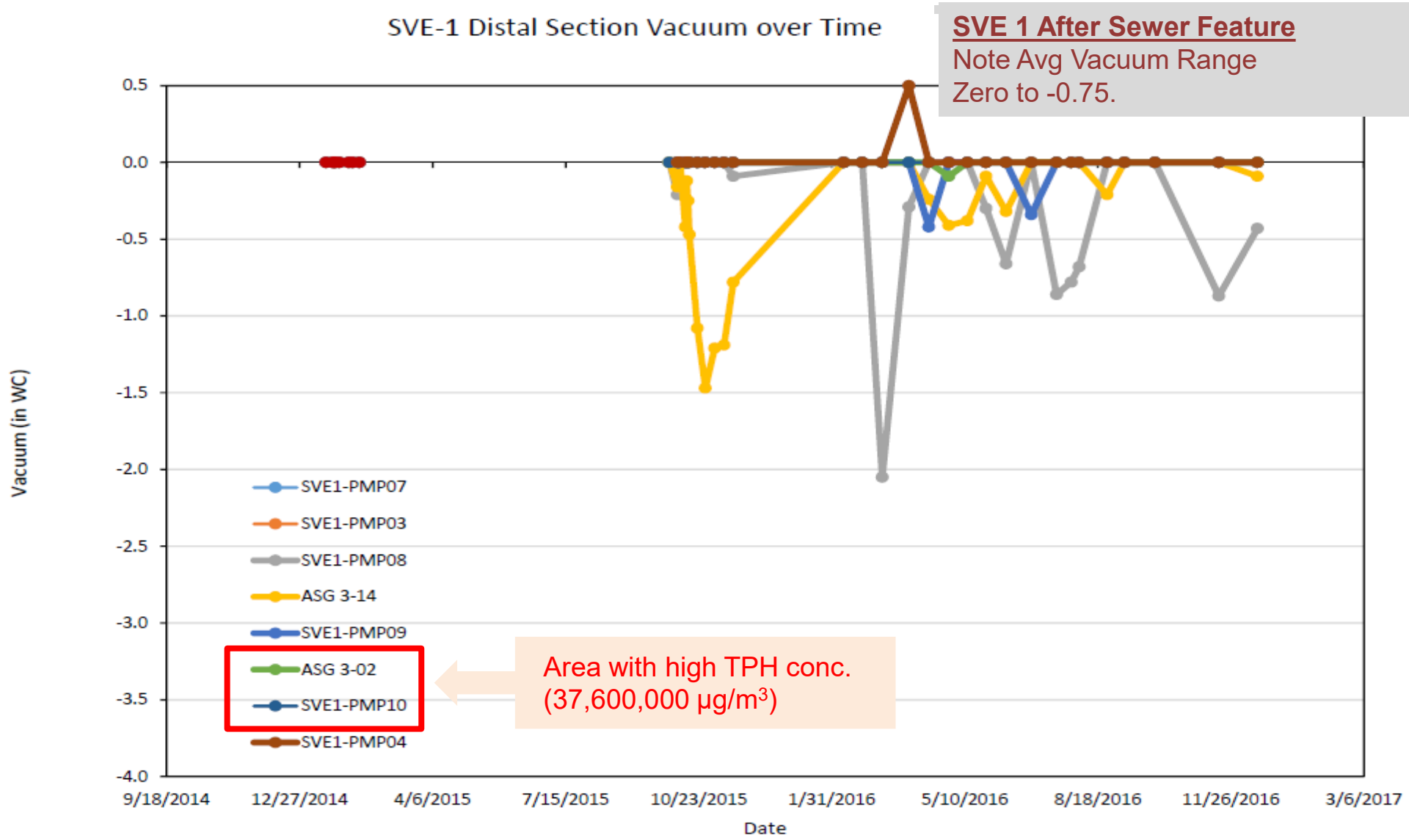


Mass Removal Summary 2015 -2016

Note MNA is greater than SVE removal at all locations.

	Period	Cumulative Days of Operation	Cumulative Hours[1]	Inlet Concentration (µg/m^3)	Flow[2] (cfm)	Volumetric Flow Rate (m^3/min)	Estimated Mass Removed (kg)	Cumulative from biodegradation[3] (kg)
SVE-1	1-12-15 to 1-19-15	7	31.5	3,100,000	260	7.28	43	
	1-20-15 to 1-26-15	7	31.5	5,200,000	260	7.28	72	
	1-27-15 to 2-2-15	7	31.5	3,700,000	260	7.28	51	
	2-3-15 to 2-10-15	7	31.5	3,200,000	260	7.28	44	
	9-15-15 to 10-23-15	53	238.5	11,000	259	7.25	1.1	
	10-24-15 to 10-30-15	7	31.5	440,000	262	7.34	6.1	
	10-31-15 to 11-5-15	6	27	1,800,000	264	7.39	22	
	11-6-15 to 11-12-15	7	31.5	1,800,000	260	7.28	25	
	11-13-15 to 11-19-15	7	31.5	1,500,000	253	7.08	20	
	11-20-15 to 1-21-16	51	229.5	600,000	260	7.28	60	
	1-22-16 to 4-29-16	99	445.5	530,000	262	7.34	104	
	4-30-16 to 7-27-16	88	396	450,000	259	7.25	78	
	7-28-16 to 11-23-16	119	535.5	430,000	260	7.28	101	
				Cumulative SVE-1 TPH Mass Removed			625	1089
SVE-2	1-12-15 to 1-19-15	7	31.5	5,900,000	260	7.28	81	
	1-20-15 to 1-26-15	7	31.5	3,500,000	260	7.28	48	
	1-27-15 to 2-2-15	7	31.5	2,800,000	260	7.28	39	
	2-3-15 to 2-10-15	7	31.5	1,100,000	260	7.28	15	
	9-15-15 to 10-23-15	53	238.5	440,000	260	7.28	46	
	10-24-15 to 10-30-15	7	31.5	150,000	260	7.28	2.1	
	10-31-15 to 11-5-15	6	27	430,000	260	7.28	5.1	
	11-6-15 to 11-12-15	7	31.5	470,000	260	7.28	6.5	
	11-13-15 to 11-19-15	7	31.5	190,000	260	7.28	2.6	
	11-20-15 to 1-21-16	51	229.5	45,000	270	7.56	4.7	
	1-22-16 to 4-29-16	99	445.5	15,000	260	7.28	3	
	4-30-16 to 7-27-16	88	396	20,000	260	7.28	3	
	7-28-16 to 11-23-16	119	535.5	3,700	260	7.28	1	
				Cumulative SVE-2 TPH Mass Removed			257	1,639
SVE-3	1-12-15 to 1-19-15	7	31.5	11,000,000	260	7.28	151	
	1-20-15 to 1-26-15	7	31.5	4,300,000	260	7.28	59	
	1-27-15 to 2-2-15	7	31.5	2,600,000	260	7.28	36	
	2-3-15 to 2-10-15	7	31.5	2,000,000	260	7.28	28	
	9-15-15 to 10-23-15	53	238.5	1,100,000	260	7.28	115	
	10-24-15 to 10-30-15	7	31.5	580,000	260	7.28	8.0	
	10-31-15 to 11-5-15	6	27	1,900,000	260	7.28	22	
	11-6-15 to 11-12-15	7	31.5	1,700,000	260	7.28	23	
	11-13-15 to 11-19-15	7	31.5	1,400,000	260	7.28	19	
	11-20-15 to 1-21-16	51	229.5	750,000	270	7.56	78	
	1-22-16 to 4-29-16	99	445.5	130,000	260	7.28	25	
	4-30-16 to 7-27-16	88	396	75,000	260	7.28	13	
	7-28-16 to 11-23-16	119	535.5	10,000	232	6.50	2	
				Cumulative SVE-3 TPH Mass Removed			580	531
				Estimated Total System TPH Mass Removed			1,462	2,170

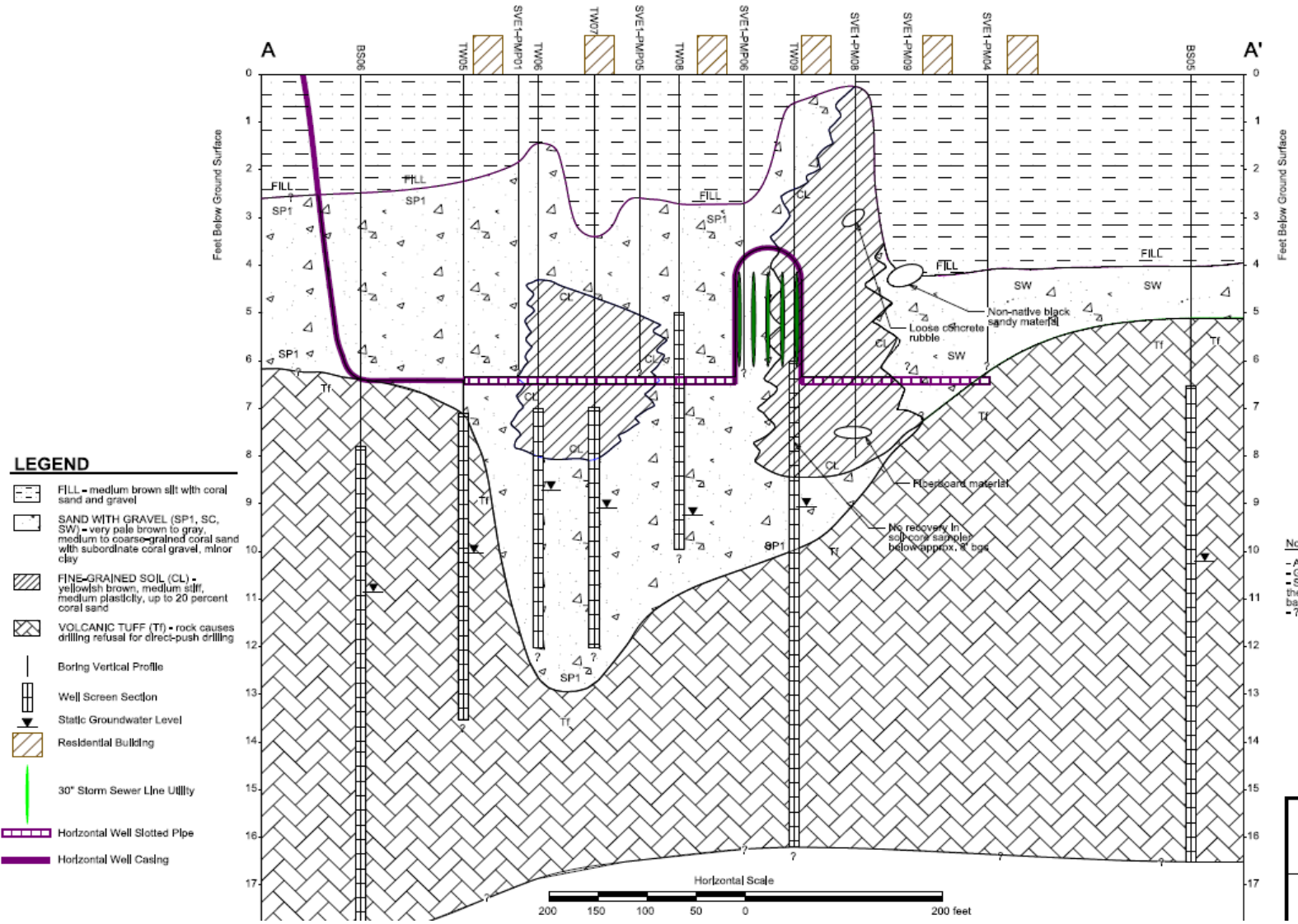
SVE 1 Vacuum Measurements



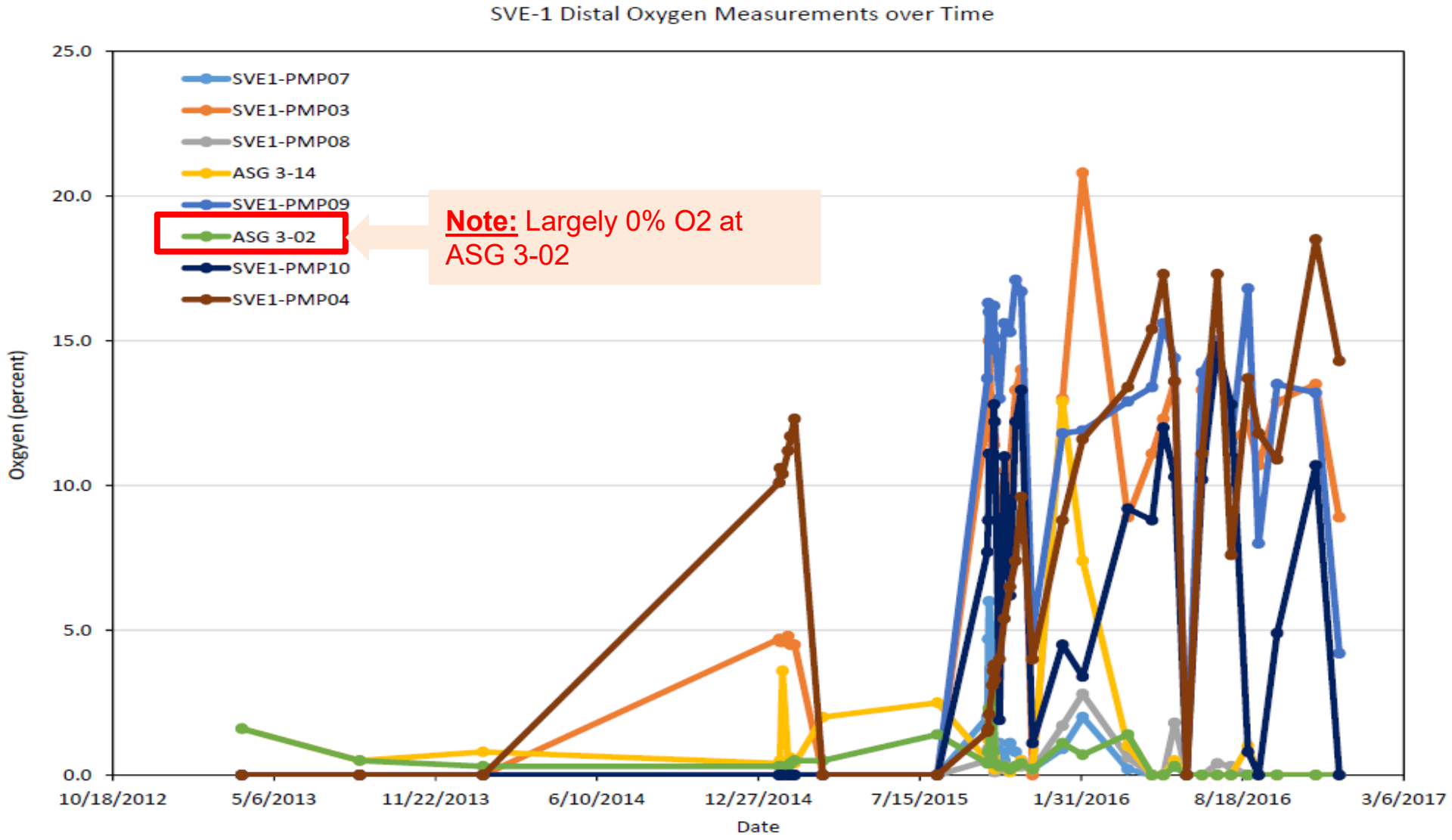
SVE 1 After Sewer Feature
Note Avg Vacuum Range
Zero to -0.75.

Area with high TPH conc.
(37,600,000 µg/m^3)

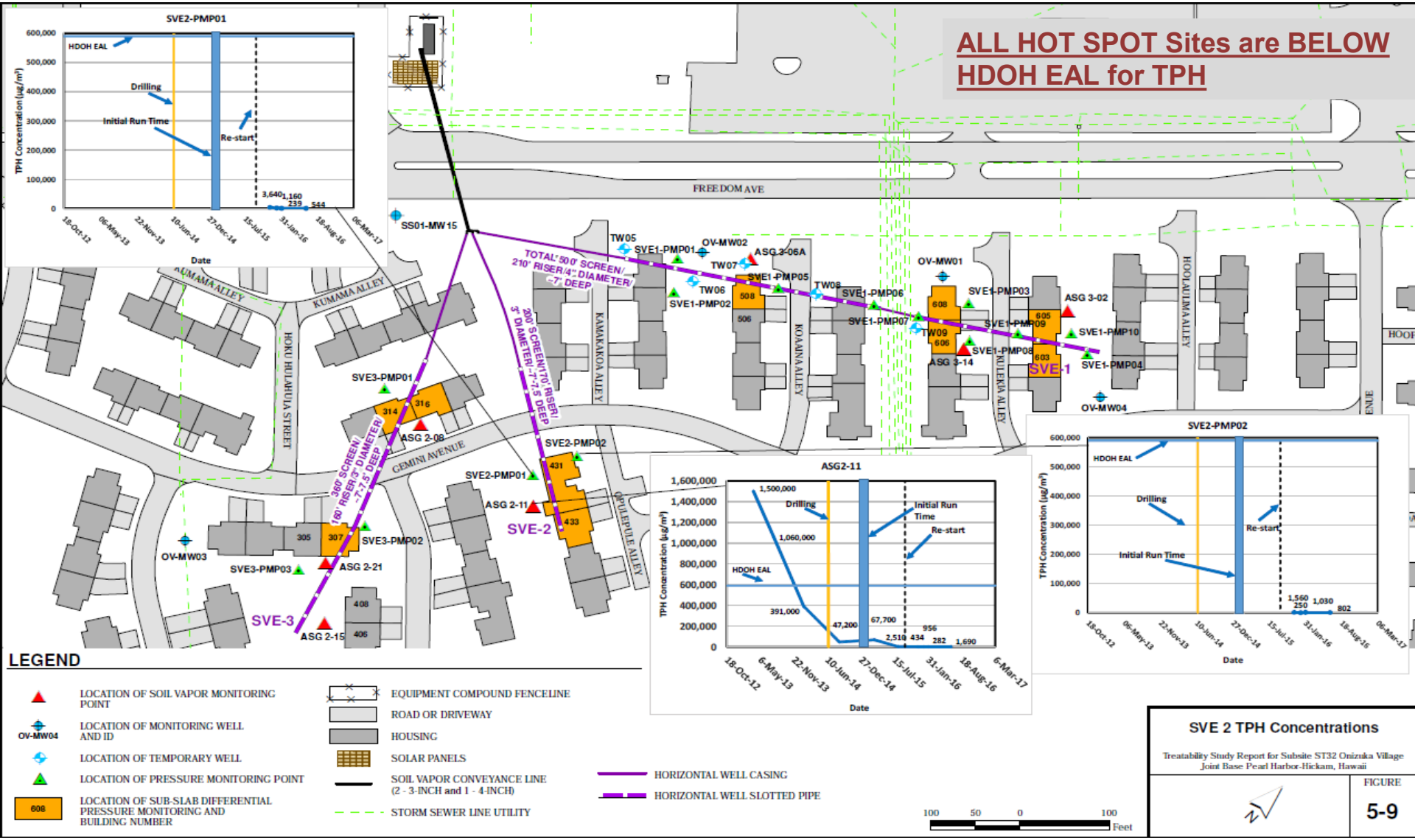
Cross-Section SVE 1



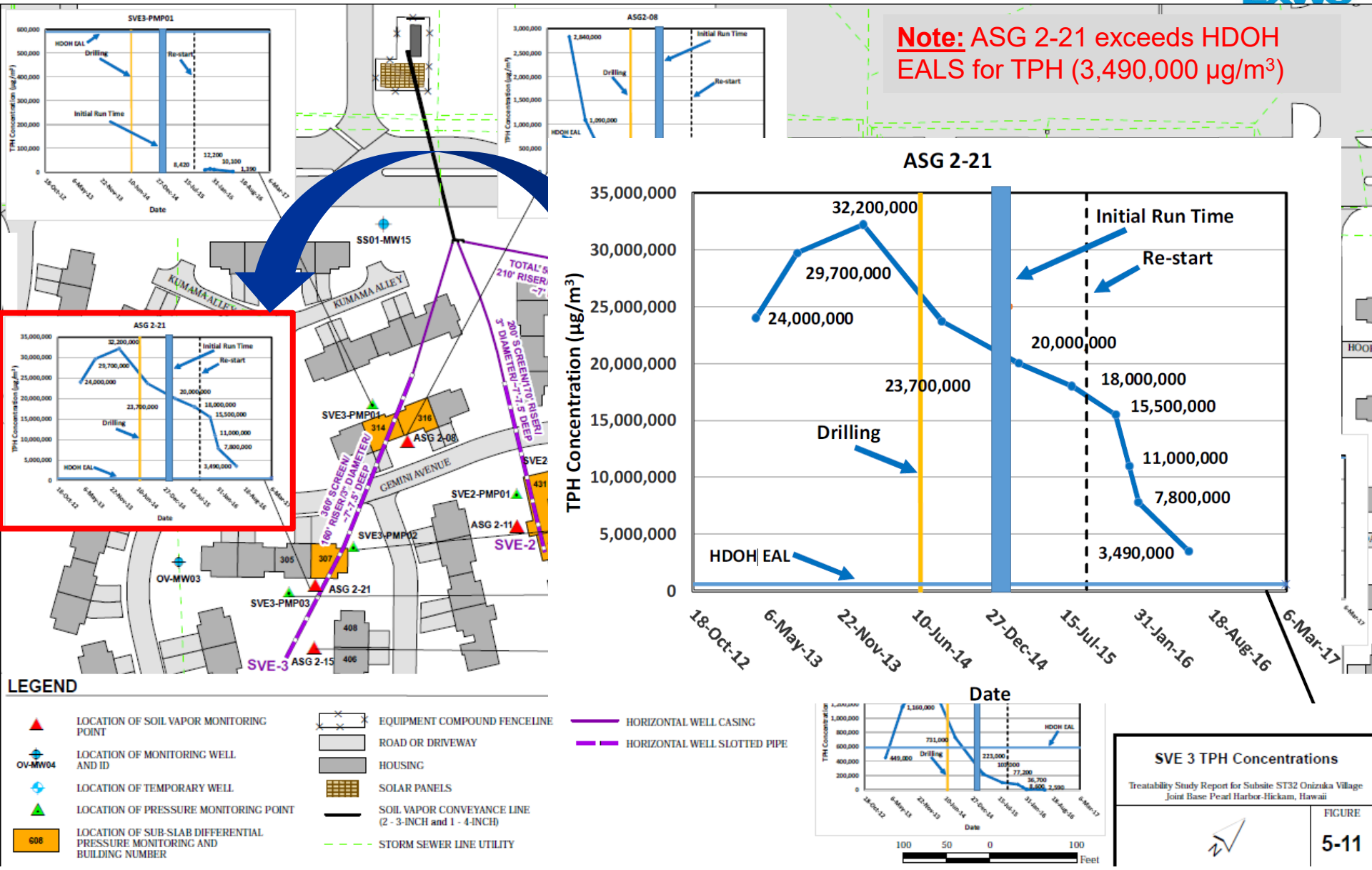
SVE 1 O2 Measurements



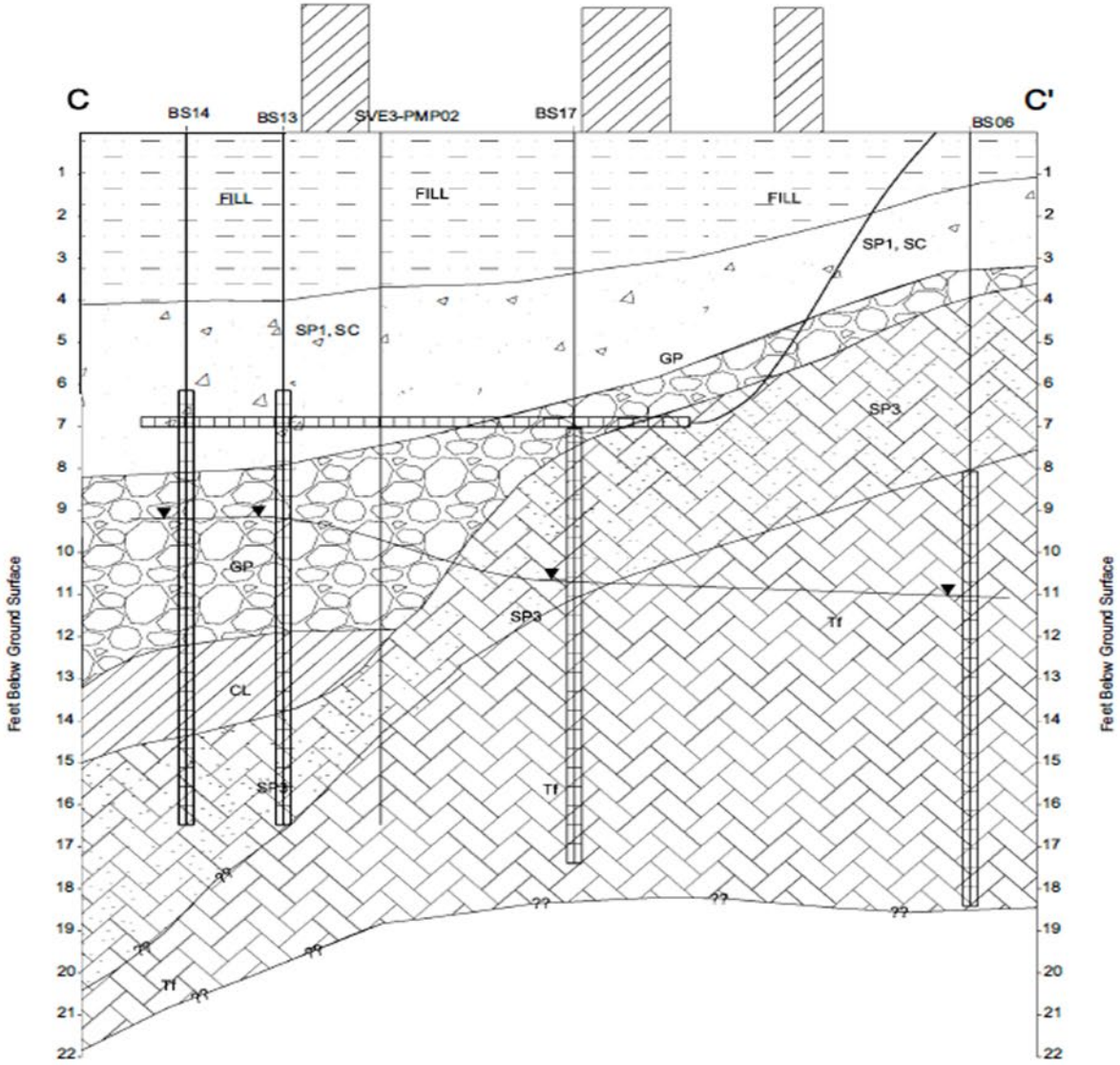
SVE 2 TPH Trends



SVE 3 TPH Trends



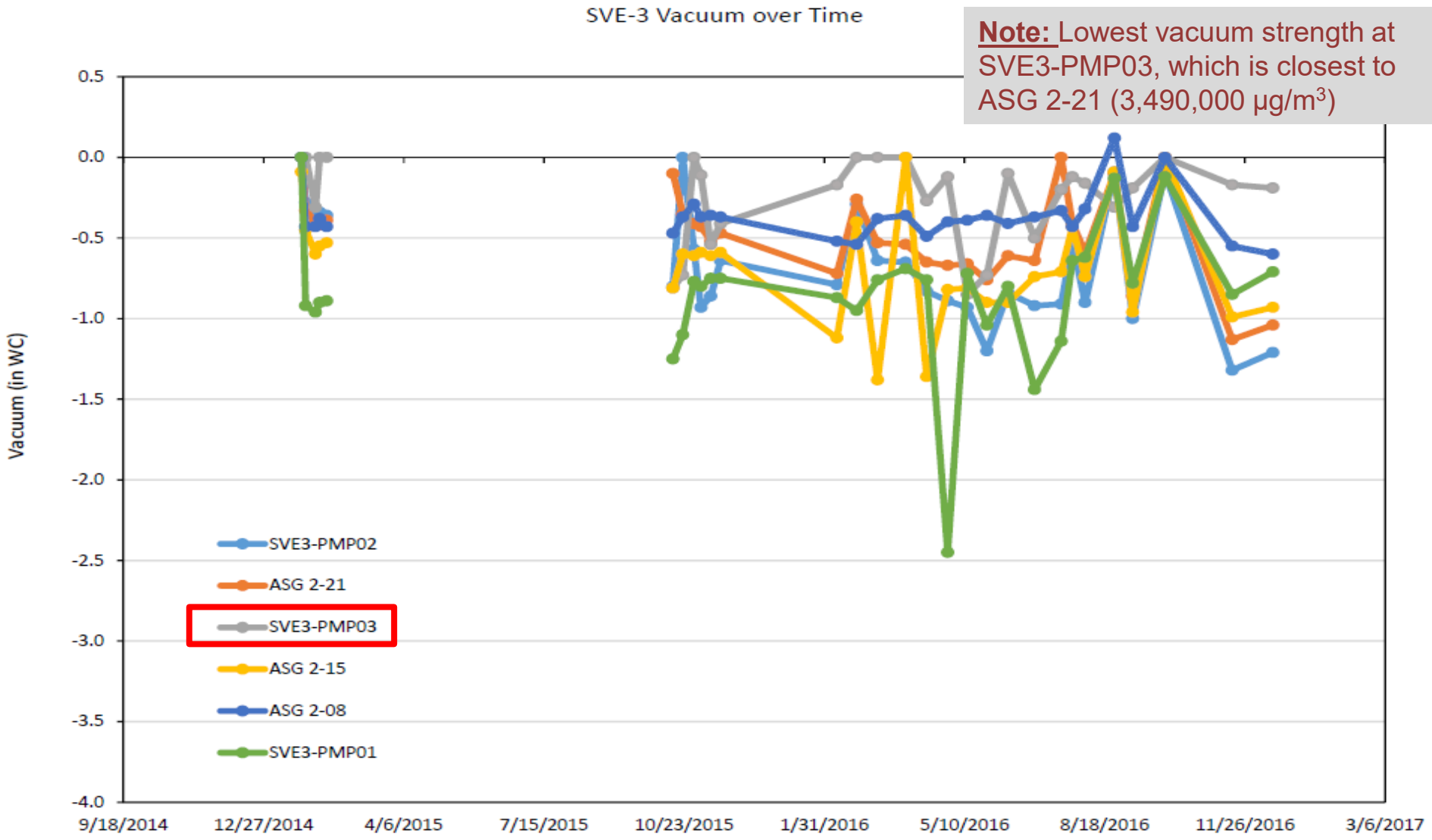
Cross-Section SVE 3



LEGEND

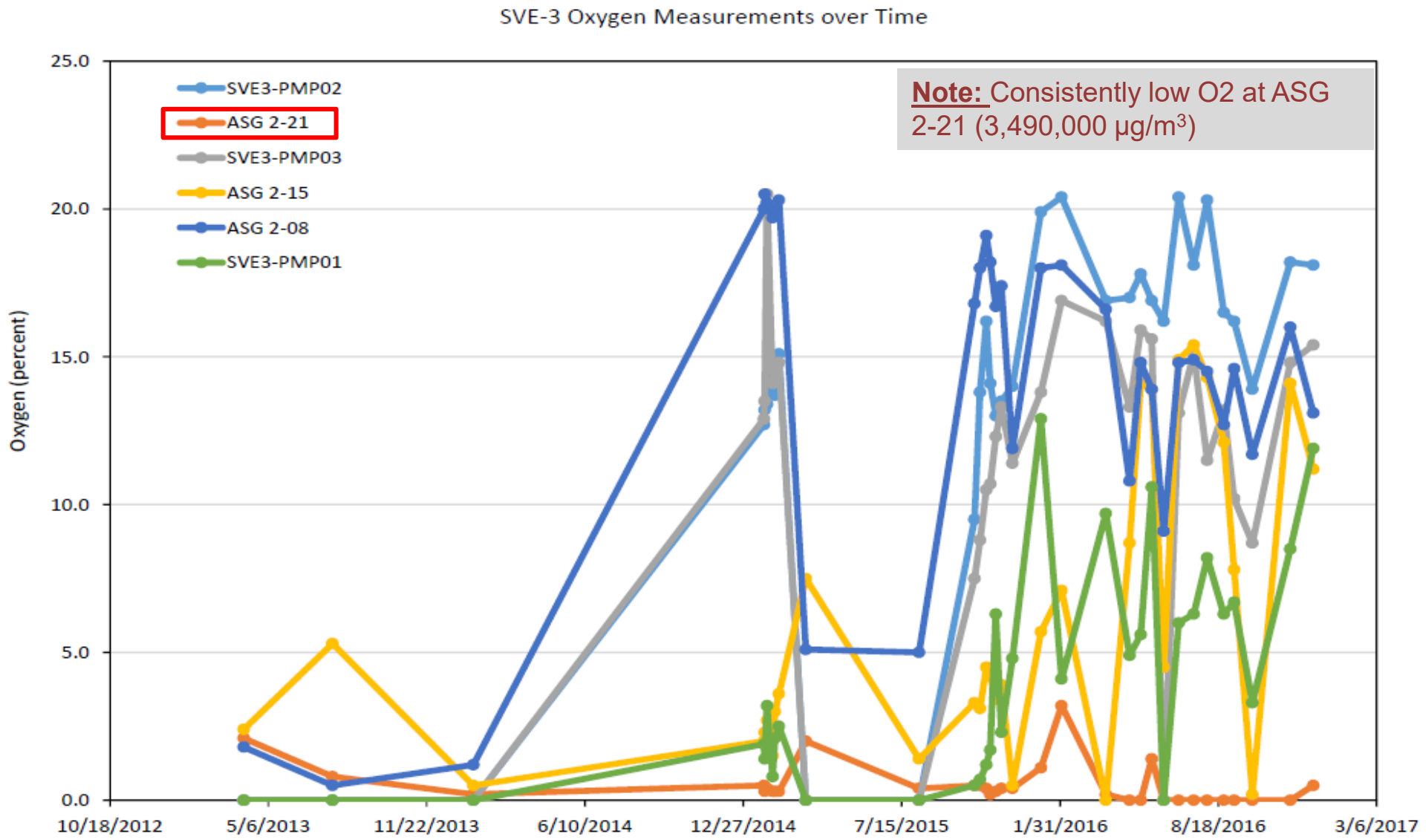
- FILL - medium brown silt with coral sand and gravel
- GRAVELLY SAND (SP1, SC) - very pale brown to gray, medium to coarse-grained coral sand with subordinate coral gravel, trace clay (location BS12)
- SANDY GRAVEL (GP) - gray to grayish brown fine to medium-grained coral gravel with subordinate coarse-grained coral sand, trace clay
- FINE-GRAINED SOIL (CL) - yellowish brown, medium stiff, medium plasticity, up to 20 percent coral sand
- SAND AND GRAVEL WITH TRACE CLAY (GC, SP2) - gray to dark gray coral sand and gravel, up to 10 percent clay
- WEATHERED TUFF (SP3) - very dark grayish brown medium to coarse grained sand fractured by drilling, hard
- VOLCANIC TUFF (Tf) - rock causes drilling refusal for direct-push drilling
- Boring Vertical Profile
- Well Screen Section
- Static Groundwater Level
- Residential Building
- Horizontal Well Slotted Pipe
- Horizontal Well Casing

SVE 3 Vacuum Measurements



Note: Lowest vacuum strength at SVE3-PMP03, which is closest to ASG 2-21 (3,490,000 µg/m^3)

SVE 3 O2 Measurements



Note: Consistently low O2 at ASG 2-21 (3,490,000 µg/m^3)

SVE System Summary

- Asymptotic TPH recovery has been achieved at all locations
- Biodegradation rates exceed all SVE removal rates
- RAO has been achieved at all hot spot locations

Site Challenges

- SVE battery system had to be changed out twice in 2015 ($70,000 replacement each time). Resulted in shut down of the SVE system from Jan – Sept 2015
- Water entrainment has been observed in SVE-1 and SVE-3 which blocks airflow to units. Due to gradual collection of condensation in wells and following precipitation events
  - "Several thousand gallons of water removed from SVE-1" (September 2015)
  - 115 Gal of water removed from SVE-3 (November 1, 2016)
- SVE system doesn't appear to be effectively treating ASG 2-21 (SVE-3) and ASG 3-02 (SVE-1) due to low permeability subsurface conditions
  - The geology in the distal portion of SVE-1 is composed of primarily clays and volcanic tuff, limiting air flow

Contractor Recommendations

- Continued operation of SVE system (RI Phase)
  - Terminate system after EALS have been achieved at ASG 2-21 (SVE-3) and ASG 3-02 (SVE-1)
  - Recommend the following remedies:
    - In-Situ Chemical Oxidation of the hot spots

    OR

    - Isolating vacuum at distal end of SVE-1 or adding an extension to SVE piping
- Conduct a study to assess VOC rebound
  - Rebound study at SVE-2 (EALs have been achieved)

- Prepare Proposed Plan and DD for SVE as final remedy

P-OPT Recommendations

- Shut down of the SVE system and assess rebound from soil vapor monitoring locations
  - Collect soil vapor samples from permanent soil vapor hot spot sampling points in May 2020
  - May receive push back for more sampling. Then consider Feb 2020 and August 2020 (2 consecutive sampling events)
- IF Soil vapor concentrations are below HDOH EALS, then RC the site as RAOs have been achieved
- IF Soil Vapor Concentrations are above HDOH EALS, then considering installing vertical soil gas samplers to identify soil horizon where elevated soil vapor concentrations exist
  - If vapors attenuate below HDOH EALS within the shallow soil (0-5 ft) then we can argue that MNA is addressing vapor exposure risk at the site

Cost Analysis

- **Annual SVE O&M Cost: $560,000 (plus $70,000 battery replacement)**
- **KCH Proposed ISCO Treatability Study: ~ $1.8 Million**
- **P-OPT Recommendations:**
  - **Vertical VI Profiling**
  - **MNA Analysis**

  TOTAL COST: $150,000
- **Estimated Cost Avoidance:**
  - **Compared against continued SVE: $480,000**
  - **Compared against ISCO: $1.7M**

Onizuka Village Optimization Summary

- After 3 years of operation the SVE system was shut down in 2017 to assess rebound
- In May 2020 soil vapor samples were collected
- All concentrations are below HDOH EALs

<u>Regulator Concurrence</u>

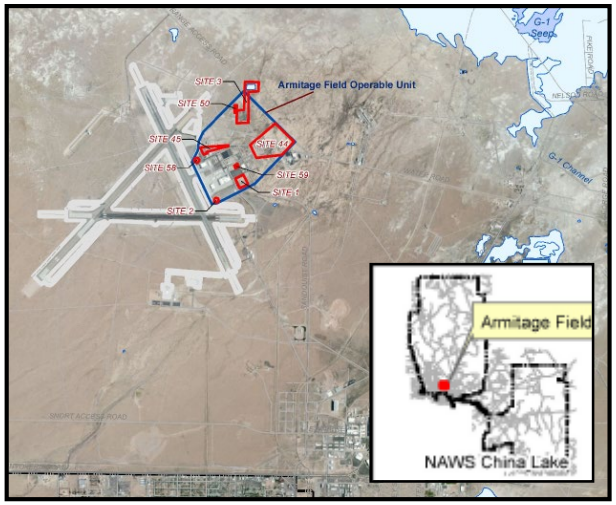
- In November 2022, HDOH issued a concurrence letter to discontinue soil vapor sampling and demobilize the SVE equipment for use at another site

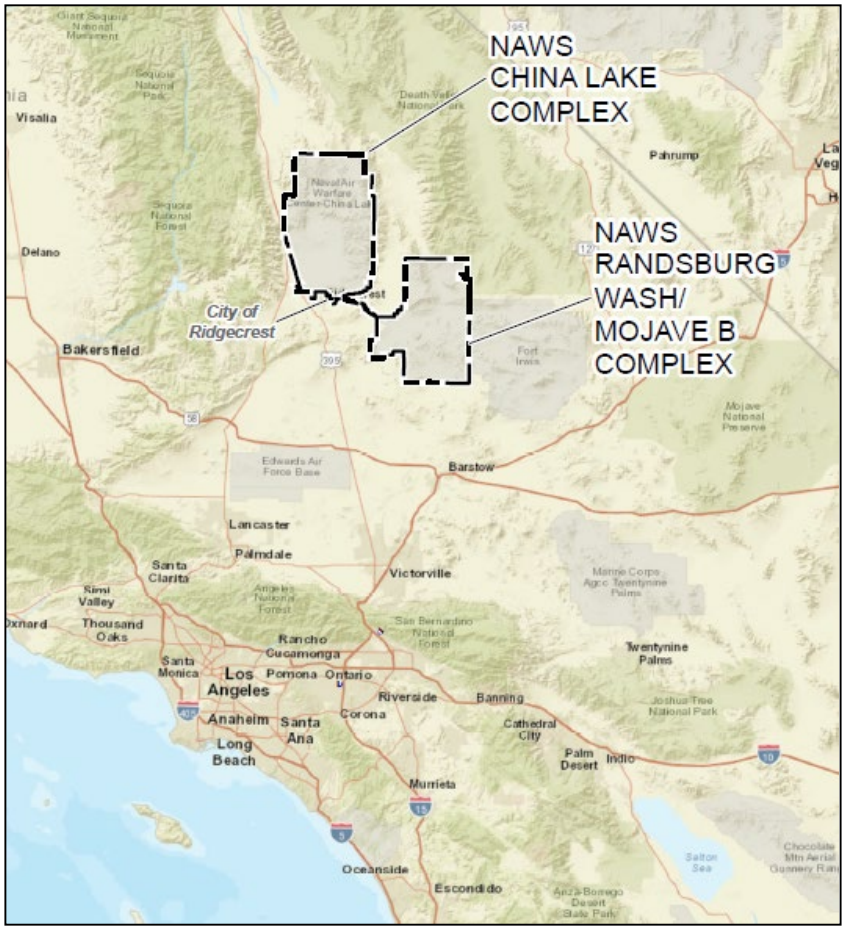
NAVAL AIR WEAPONS STATION (NAWS) CHINA LAKE ARMITAGE FIELD OPERABLE UNIT FREE-PRODUCT RECOVERY SYSTEM OPTIMIZATION

Christine Gaines
NAVFAC SW

NAWS China Lake Armitage Field Operable Unit (AFOU) - Background

- **Site grouping based on wastes disposed.**
  - Off-spec or used fuels, wash water containing degreasers/detergent.
- **Disposal included dumping to ground and dry well disposal**





NAWS China Lake AFOU - Remediation

2007 ROD

MNA and LUCs for GW

Free Product Mitigation*

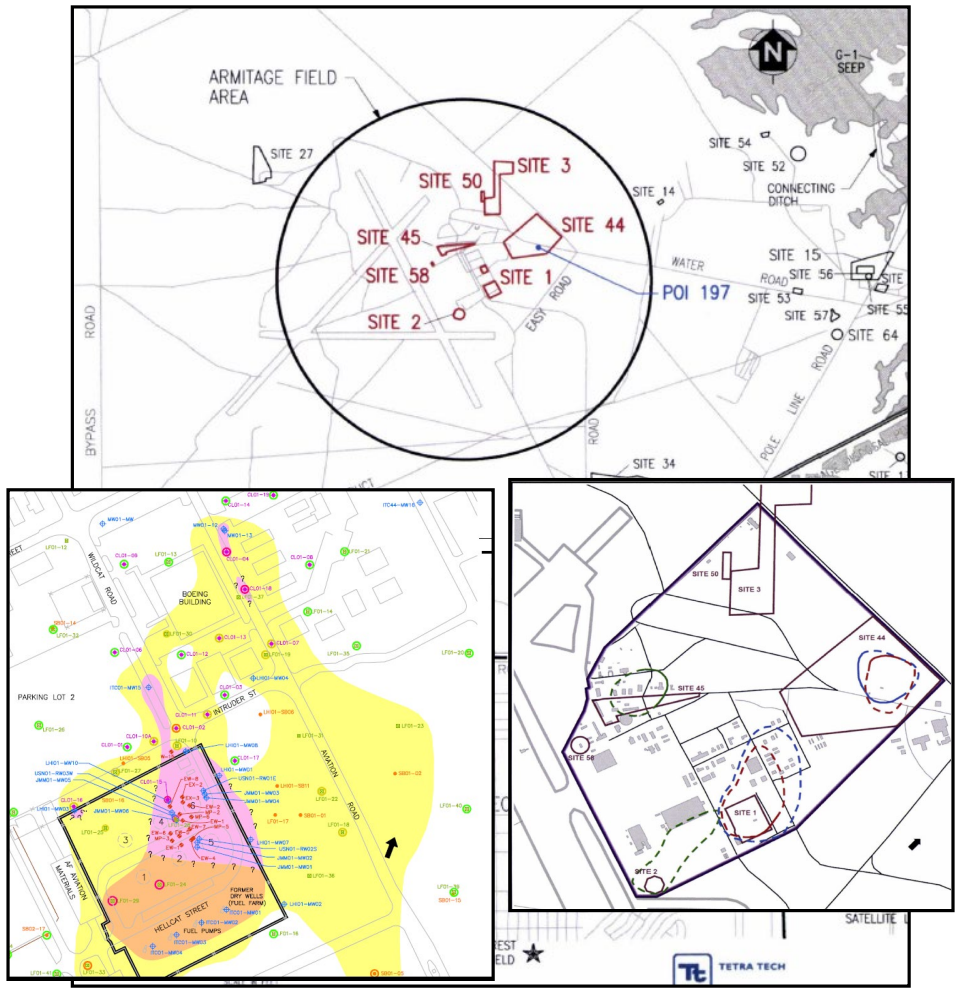
Free Product Mitigation

@ Site 1 through continuation/expansion of vacuum-enhanced skimming (VES) system.

@ Site 44 using mobile product recover system.

2016

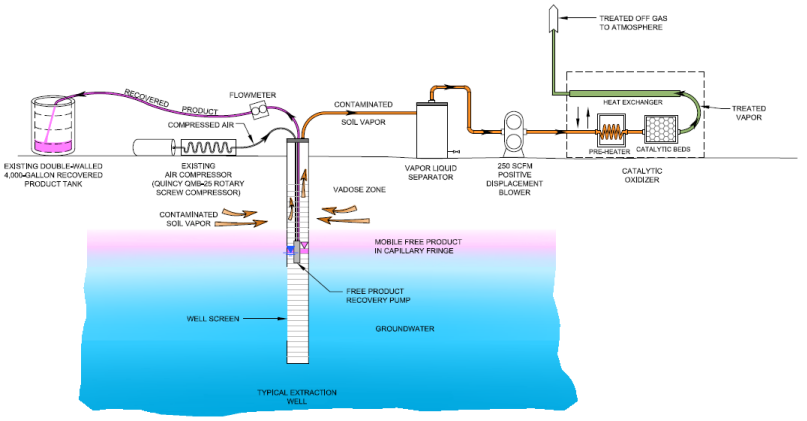
5YR recommends optimization review of the free product recovery systems



*** Remove free product to the maximum extent practicable at IRP Site 1 and 44**

IRP Site 1 SVE and Free Product Recovery System (FPRS) Operations (2016)

- **2016 System Conditions**
  - Continued declining recovery rates of the VES and MPRS.
  - All product recovery wells at IRP Site 1 have yielded <0.5 gallons per day.
  - Average product removal rate for the overall vapor extraction system, ~1 pound per day.
    - ~6.0 pounds per day at EX-1
    - ~3.3 pounds per day at EX-6
    - ~2.1 pounds per day at EX-7
  - Current system installed as a pilot-scale system and not designed for entire site (circa 1988).



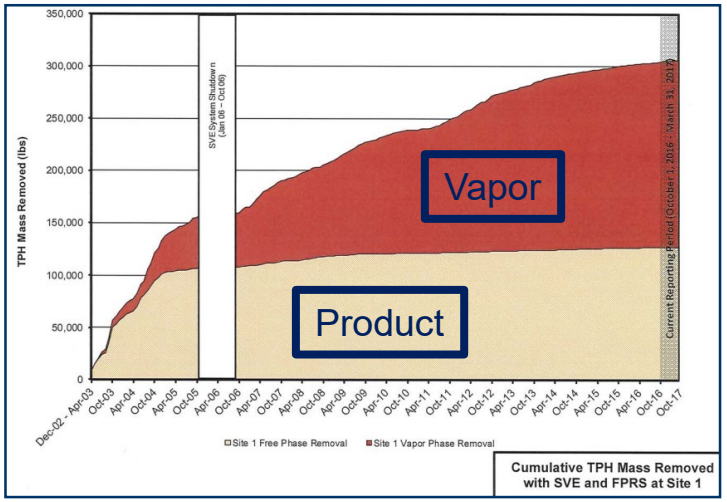
2017 Remediation System Evaluation Work Plan

Purpose - perform technical review of ongoing site cleanup processes to identify opportunities for improving remedy protectiveness, effectiveness, and cost efficiency, and to facilitate progress toward site remediation completion.

1. Determine the current understanding of the lateral and vertical extent of impacts.
2. Identifying natural source zone depletion (NSZD) rates and mechanisms;
3. Re-evaluating RAOs, remedial goals, and the closure strategies (including system shutdown criteria);
4. Assessing the protectiveness of the current remedial solutions being implemented; and
5. Identifying and evaluating opportunities for optimization and cost savings.

Remediation System Evaluation – Data Evaluation & Fieldwork

1. Reviewed remediation system data against shutdown criteria
2. Completed Free Product transmissivity testing
   - An LNAPL transmissivity between the range of 0.1 to 0.8 ft^2/day may be used as a decision point for remedial system operation or technology transitions (ITRC, 2018)
3. Completes Laser Induced Fluorescence and Cone Penetrometer testing
4. Carbon flux and thermal subsurface monitoring
5. ~~Evaluating life-cycle costs~~



System Shutdown Criteria

- Free product yield of 0.5 gallon per day per well for skimming and a TPH removal rate of 2 pounds per day per well for vapor extraction
- Asymptotic trends will be used as an alternative criterion for system shutdown if the recovery rates specified above cannot be achieved
  - In this case, a decrease in removal rate or concentration by 5% or less over a period of 3 months will signify an asymptotic condition
- If either of the two conditions occurs at an individual well, VES at the well will be discontinued and the well will be monitored for product rebound

https://lnapl-3.itrcweb.org

Remediation System Evaluation Fieldwork (2018) Findings

Field Technique	Investigation Outcome
CPT/HPT	• Results suggest that IRP Site 1 and 44 are underlain by unconsolidated alluvium consisting of a very heterogeneous interbedded sequence of clays, silts, sands, and caliche characteristic of the SHZ.
LIF/UVOST	• Site 1: Slight contamination was identified by UVOST at 3 locations at the water table; ranging from 37 feet bgs to 42 feet bgs. • Site 44: No significant contamination was identified by UVOST outside the main plume. • Long wavelength responses (450 nm and longer) were interpreted to be caliche.
LNAPL Transmissivity Testing	• Site 1: TT01-MW01 had a transmissivity of 7.86 feet^2/day and MP-3 had a transmissivity of 7.35 feet^2/day. • Site 44: Transmissivity ranged from 7.47 to 15.1 feet^2/day (5 wells).
Carbon Flux NSZD	• Site 1: The measured NSZD rate ranged from non-detect (ND) to 99 gallons of LNAPL per acre per year (gallons/acre per year). • Site 44: The measured NSZD rate ranged from 57 to 558 gallons/acre per year (5 wells). • The relative percent difference in the average NSZD rates between the two locations is 29%.
Thermal NSZD (Site 1)	• The average NSZD rate for the two thermal monitoring locations TM-1 and TM-2 for the 6-month period is approximately 166 gallons/acre per year.

Regulatory Agency Response to Remedial System Evaluation

CPT/LIF

- Snapshot in time; Need monitoring wells to define extent
- Borings are missing the contamination
- Interpretation of caliche layer as fuel fluorescence – active source

Transmissivity Testing

- Proof free product is mobile and requires active remediation
- Did not include all wells

NSZD

- Snapshot in time; seasonal affects not considered
- Suspicious of the technology and data

SVE System Evaluation

- Don't agree with shut-down criteria; want Navy to establish new criteria
- Require additional investigation and remediation

Conclusion of Remedial System Optimization

Consensus

- Continue Partnering
- Continued push for resolution
- Agreed upon approach

Quality Data

- Involve SMEs
- The right contract/contract or for the job
- Clear objectives

UPDATE: Investigation into Tn Findings of the Previous Remedial System Evaluation (2022)

2018 Sampling and Analysis Plan

- **Proposed using ASTM method E2856-13 (ASTM, 2013) for transmissivity testing**
  - **FINDING:** Did not use recommeded "Spill Buddy" for competent testing.
- **Proposed using American Petroleum Institute (API) LNAPL Transmissivity Workbook (API, 2012) for analysis.**
  - **FINDINGS:**
    - Recovery data was not filtered (required to calculate accurate discharge rates)
    - The drawdown adjustment was not changed to fit the data (the value from the API example was being used)
    - The J-ratio was not adjusted to fit the data
    - And most importantly, the curve fits were not matched for the C&J and CB&P fits
    - Additionally the following 2 conditions could lead to transmissivity (Tn) values biased high:
      - All of the tests were stopped too soon (did not gauge until well was fully recovered), which may lead to high Tn values
      - And the amount of LNAPL recovered was not reported – coupled with short test, it's hard to determine when filter pack (FP) drainage stopped and formation drainage started

Well ID	Report Value (ft2/day)	Revised Value (ft2/day)
MK44-MW03	7.52	0.55
TT44-EW01	8.04	<1.2
TT44-EW05	15.1	NA
TT44-EW09	7.47	0.43
TT44-MW01	8.04	1.68
MP-3	7.35	<0.1
TT01-MW01	7.86	0.01

- **Future Actions**
  - Use of the Spill Buddy
  - Complete testing under the guidance of a Technical Expert
  - Provide Navy "Quality Data Review (QDR)"

QUESTIONS

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- **Former NAWS CL RPMs**
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Questions? Email to EXWC_T2@navy.mil

Wrap Up

A short Survey Monkey will be emailed to webinar registrants and participants

Stay tuned for upcoming OER2's via email:
EXWC_T2@navy.mil

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Thank you for participating!