Project Title: Shallow Soil Vapor Extraction Work Plan RTC
Red Hill Bulk Fuel Storage Facility
Joint Base Pearl Harbor-Hickam, Pearl Harbor, Oahu, Hawaii
Reviewer: EPA and DOH
Date: August 23, 2023

Item	Section No.	Comment
1	General	As described in the Draft Shallow Soil Vapor Extraction and Air Sparging Work Plan, Red Hill Bulk Fuel Storage Facility, Joint Base Pearl Harbor-Hickam, O'ahu, HI (Work Plan), the U.S. Department of the Navy (Navy) began efforts to determine the nature and extent of subsurface contamination in the Red Hill tunnel system near Adit 3 after the November 20, 2021, Jet Propellant 5 (JP-5) release. These efforts have included the installation of temporarily groundwater monitoring wells and soil vapor probes and sampling of soil, groundwater, and soil vapor. In a letter dated August 8, 2022, the Regulatory Agencies (RAs) requested Adit 3 site characterization data to support our independent technical analyses of the 2021 fuel releases' impacts on the aquifer. On October 3, 2022, the RAs received the Navy's response. However, based on the data the Navy recently provided to the RAs, we now assess that a significant portion of data was initially withheld from the October 3, 2022, response and was not used to evaluate baseline conditions for this pilot project. To best understand the effectiveness of this pilot study, the Navy should use the full baseline dataset for comparison.
Response: The Navy is unaware of the data the RAs are referencing and how it impacts the shallow subsurface. The Navy acknowledges the need to use recent data when evaluating the system's effectiveness and will continue to use the most recent data available when evaluating the effectiveness of the SVE system during the pilot study.		
2	Section 5, Project Quality Objectives, PDF Page 17-18	The study questions in Table 2 include an estimate of the proposed soil vapor extraction (SVE) system's zone of influence, evaluation of the spatial distribution of air permeability, and calculation of initial petroleum hydrocarbon mass removal rates. The study questions are to be clarified or new study questions added to: • Estimate the zone of effectiveness achieved by the SVE pilot system; and • Evaluate changes in contaminant flux removed by the SVE pilot and changes in the mass and distribution of subsurface vapor over time, including an evaluation of rebound if the contaminant flux shows an asymptotic decrease over the duration of the test (estimated at two to four months). Achieving these objectives will require periodic laboratory analysis of samples collected from soil vapor monitoring wells, not just the soil vapor exhaust from the SVE system. Please collect vapor samples and have them analyzed via methods TO-3, TO-15, and TO-17. Prior to beginning the study, be sure to collect a statistically relevant set of baseline samples and have them analyzed via the same methods. The study questions and analytical approach shall also include estimates of the contaminant mass targeted by the SVE pilot and the fraction of targeted mass removed during the pilot study or explain why such an analysis is not appropriate.
Response: The Navy will adjust the study questions to state the "zone of effectiveness" rather than the "zone of influence". In addition, the Navy will assess changes in mass removal rates and distribution of vapor-phase NAPL constituents of interest over the operational time of the SVE pilot study evaluation. The Navy plans 3 rounds of baseline shallow soil vapor sampling from 9 to 11 locations (dependent on submergence of some shallow soil vapor monitoring points) prior to start of the pilot study. If the results of the SVE step test and constant rate testing are favorable, continued operation and additional vapor sampling will be completed. This additional vapor sampling will include a mid-point sampling event which will occur during the extended 2 to 4-month operation of the SVE equipment at both the SVMPs and the influent and effluent sample ports at the SVE equipment building. Upon completion of the extended shallow SVE pilot study, 1 round of influent and effluent vapor samples will be collected within the SVE equipment building followed by 3 rounds of SVMP samples that will be collected just prior to the system shutdown. The Navy will use the data collected during SVE operations to estimate mass removal from the subsurface. However, due to minimal three-dimensional access to the subsurface and the nature of the basalt, estimates of in-situ target mass are inherently flawed and are unlikely to be accurate to an order of magnitude. The Navy's estimates of fuel loss during the November 2021 release event will be more accurate than estimates based on environmental data. However, it is unknown how much of the released fuel has already been depleted by volatilization and biodegradation. Due to the uncertainty in using the available environmental data to estimate		

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the in-situ mass that can be targeted by the pilot-scale SVE system, the Navy does not recommend such an analysis.		
3	Section 6.5.1 Hume Line Investigation and SVE Point Installation	The Work Plan describes using the Hume Line, a 6-inch diameter concrete drainage pipe that runs horizontally beneath the tunnel floor, as a horizontal extraction point during the SVE pilot test. The Hume Line was initially installed as a water management system and is set 2.5 to 3 feet below the tunnel floor to act as a conduit for groundwater to migrate to the sump and limit tunnel flooding. The top of the pipe is unsealed to allow for groundwater to migrate into the pipe and flow to the sump. While the RAs appreciate the creativity of utilizing existing infrastructure to serve as a horizontal extraction point, we are concerned the Hume Line may short-circuit and extract atmospheric air from the tunnel rather than extract vapors from the subsurface, which may reduce the overall effectiveness of SVE. Additionally, we are concerned that limiting the evaluation of SVE implementability to the Hume Line and one SVE extraction well may limit the chances for a successful pilot test. We recommend adding one additional SVE extraction well to the study.
Response: The Navy acknowledges the RA's concerns about the Hume Line. Adit-3 is not accessible for drilling due to ongoing defueling activities preventing installation of a second vertical SVE well in the near term. The Navy plans to proceed with the evaluation of the Hume line and original shallow SVE well to gather information to determine if an additional vertical SVE well is needed. The Navy will evaluate and discuss with the RAs the merits of additional shallow, vertical SVE wells based on the initial test results.		
4	Section 6.8 Baseline Monitoring	The Work Plan proposes baseline sampling of soil and perched water prior to initiating any portion of the SVE pilot test. Parameters include petroleum hydrocarbons (total petroleum hydrocarbon-gasoline, total petroleum hydrocarbon-diesel, benzene, toluene, ethylbenzene, xylenes, naphthalene, 1-methylnaphthalene, and 2-methylnaphthalene), geochemical parameters (nitrate, sulfate, dissolved iron, dissolved manganese, and dissolved methane), and field parameters (fluid levels, dissolved oxygen, oxidation-reduction potential, pH, conductivity, and temperature). The parameters shall also include TPH-o, trimethylbenzenes, tetra-methylbenzenes, and relevant fuel additives.
Response: The Navy will proceed with collecting the analytes mentioned by the RAs with exception to Tetra-methylbenzenes and the "relevant fuel additives". Currently, the labs identified with DOD certification and EDMS capability only have the ability to analyze for tetra-methylbenzene as a Tentatively Identified Compound rather than a confirmed compound with known standards. Additionally, the Navy respectfully requests the RAs provide a list of specific fuel additives of concern prior to their addition to the baseline sampling plan.		
5	Section 8, Project Schedule and Reporting	The Work Plan proposes submitting a technical memorandum (TM) four weeks after field activities are completed. The project schedule, included as Appendix E, appears to indicate the TM will be submitted after completing the air sparging and SVE constant rate test. A revised project schedule shall be submitted to the RAs prior to the start of the SVE pilot study. The project schedule shall be updated to include line items for: • The short-term operation phase of the shallow SVE system; • Submittal of a TM with initial results from the short-term operation phase of the shallow SVE system and recommendations for the continued operation of the pilot (e.g., duration of operation, evaluation of the vacuum, radius of influence, rebound study results, proposal whether to pursue air sparging or not); • Justification for the recommendations; and • Submittal of a TM after completing the short-term operation phase. All available data (groundwater, soil, and soil vapor) collected from Adit 3 since the November 2021 release shall be uploaded onto the Navy's Environmental Data Management System (EDMS) as soon as available, provided in both tabular and lab report formats, and included as an appendix in the TM. Analytical results from this pilot shall be included in the TM in both tabular and lab report formats. Raw and validated data shall be uploaded to the EDMS as soon as available. A special purpose meeting between the Navy and RAs shall be scheduled in advance of the TM submittal to provide a preview of data, review results of the pilot, and discuss next steps.

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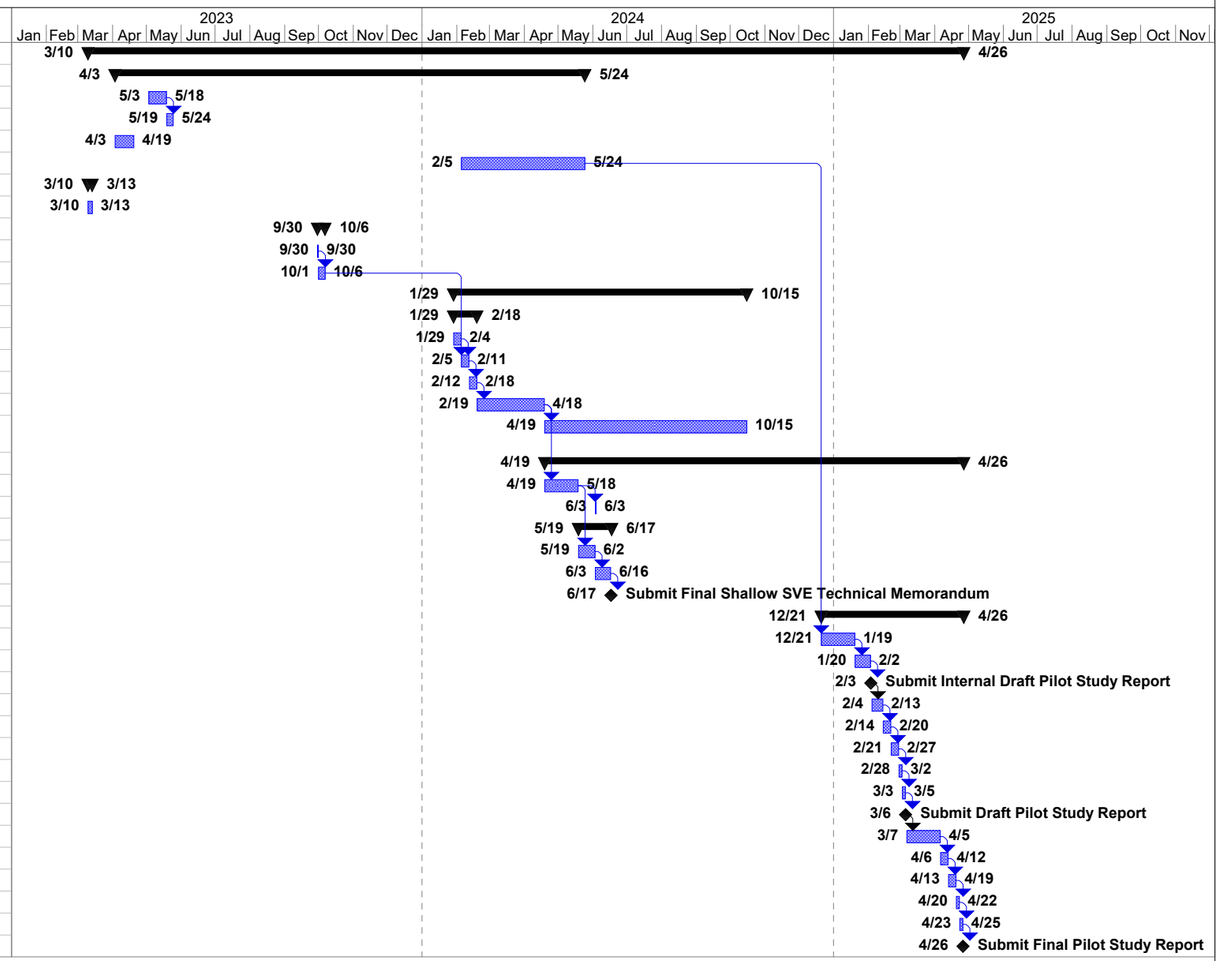
Response: The Navy has adjusted the schedule to account for a technical memorandum outlining initial results from the short-term operational phase of the SVE system. Upon completion of the shallow SVE study, a special purpose meeting will be scheduled with the RAs. The adjusted schedule is attached. All relevant data will continue to be uploaded into EDMS in the same fashion as site investigation data in Adit 3 has been.		
6	Section 8 Project Schedule and Reporting	The project schedule included as Appendix E includes a line item for installation of shallow vapor monitoring wells. Please modify the schedule to show installation of the intermediate depth and deep vapor monitoring wells described or depicted in the Work Plan (e.g., in Section 3.7, Figures 1)
Response: The Navy has identified the vapor monitoring points, which have been installed, as well as the updated schedule for the construction of future vapor monitoring points. The adjusted scheduled is attached.		
7	Table 6 and Section 6.6	• Table 6. TO is incorrectly defined as "task order" in a footnote to the table. • Section 6.6. Provide the RAs clarification as to which portions of the Operations and Maintenance (O&M) Plan, included as Appendix C, apply to the proposed SVE pilot study.
Response: The Table 6 footnote has been corrected to state “Toxic Organics.” The Appendix C attachment, O&M Plan, is an ever-changing document, which adjusts for changes in equipment, operational parameters, and conditions. In addition, the O&M Plan states how the system will be maintained during operation.		
8	Section 1 Introduction and Purpose	The Work Plan proposes to evaluate SVE in the first phase of the pilot study, followed by evaluating air sparging in the second phase of the study. Air sparging systems are designed to remove volatile contaminants from groundwater by moving contaminants into the vapor phase, where they can be removed with SVE. The RAs do not, at this time, support the proposed air sparging pilot-scale test due to the uncertainty of the planned SVE system's ability to capture volatile contaminants mobilized by the injected air. There is also concern that air sparging could potentially increase the mobility of residual fuel present in the subsurface. A decision on the potential benefits, risks, and implementability of air sparging should only be made after the completed SVE pilot study results have been evaluated. The air sparging pilot scope is not approved at this time.
Response: The Navy will use the SVE pilot test data to evaluate the potential benefits, risks, and implementability of air sparging once the SVE pilot studies are complete. The shallow SVE pilot study data and evaluation will be reviewed during the future scheduled special purpose meeting.		

EDMS	Electronic Data Management System
O&M	operation and maintenance
NAPL	nonaqueous-phase liquid
Navy	Department of the Navy, United States
RA	Regulatory Agency
SVE	soil vapor extraction
SVMP	Soil Vapor Monitoring Point
TIC	Tentatively Identified Compound

Shallow SVE Pilot Study (actual dates are TBD)

Last Updated: Wed 10/18/23

ID	Task Name	Dur	Start	Finish	Predecessors
1	**Shallow SVE and AS Pilot Study**	**779 days**	**Fri 3/10/23**	**Sat 4/26/25**	
2	**Drilling**	**418 days**	**Mon 4/3/23**	**Fri 5/24/24**	
3	Air Sparging Point Installation	16 days	Wed 5/3/23	Thu 5/18/23	
4	SVE Well Construction	6 days	Fri 5/19/23	Wed 5/24/23	3
5	Shallow VMP Installation	17 days	Mon 4/3/23	Wed 4/19/23	
6	ISVMP, DSVMP, and Deep SVE Drilling	110 days	Mon 2/5/24	Fri 5/24/24	
7	**Hume Line**	**4 days**	**Fri 3/10/23**	**Mon 3/13/23**	
8	Hume Line Cutout	4 days	Fri 3/10/23	Mon 3/13/23	
9	**Equipment Mob and Install**	**7 days**	**Sat 9/30/23**	**Fri 10/6/23**	
10	SVE System Mob	1 day	Sat 9/30/23	Sat 9/30/23	
11	GAC Mob, Piping Connections, Generator and Utility Connections	6 days	Sun 10/1/23	Fri 10/6/23	10
12	**Pilot Test**	**261 days**	**Mon 1/29/24**	**Tue 10/15/24**	
13	**Start-Up (three weeks)**	**21 days**	**Mon 1/29/24**	**Sun 2/18/24**	
14	Baseline Monitoring	7 days	Mon 1/29/24	Sun 2/4/24	
15	SVE Step Test	7 days	Mon 2/5/24	Sun 2/11/24	14,11
16	SVE Constant Rate Test	7 days	Mon 2/12/24	Sun 2/18/24	15
17	**Short-Term Operation (two months)**	**60 days**	**Mon 2/19/24**	**Thu 4/18/24**	**16**
18	**Continued Operation (length dependent on deep SVE pilot study start-up)**	**180 days**	**Fri 4/19/24**	**Tue 10/15/24**	**17**
19	**Reporting**	**373 days**	**Fri 4/19/24**	**Sat 4/26/25**	
20	Data Evaluation	30 days	Fri 4/19/24	Sat 5/18/24	17
21	Special Purpose Meeting	1 day	Mon 6/3/24	Mon 6/3/24	20FS+15 days
22	**Shallow SVE Technical Memorandum**	**30 days**	**Sun 5/19/24**	**Mon 6/17/24**	
23	Prepare Shallow SVE Technical Memorandum	15 days	Sun 5/19/24	Sun 6/2/24	20
24	Peer Review/Tech Edit	14 days	Mon 6/3/24	Sun 6/16/24	23
25	Submit Final Shallow SVE Technical Memorandum	1 day	Mon 6/17/24	Mon 6/17/24	24
26	**Pilot Study Report (combined shallow and deep)**	**127 days**	**Sat 12/21/24**	**Sat 4/26/25**	
27	Prepare Internal Draft	30 days	Sat 12/21/24	Sun 1/19/25	6FS+210 days
28	Peer Review/Tech Edit	14 days	Mon 1/20/25	Sun 2/2/25	27
29	Submit Internal Draft Pilot Study Report	1 day	Mon 2/3/25	Mon 2/3/25	28
30	Navy Review	10 days	Tue 2/4/25	Thu 2/13/25	29
31	Prepare/Submit RTCs	7 days	Fri 2/14/25	Thu 2/20/25	30
32	Navy Concurrence of RTCs	7 days	Fri 2/21/25	Thu 2/27/25	31
33	Prepare Draft Pilot Study Report	3 days	Fri 2/28/25	Sun 3/2/25	32
34	Peer Review/Tech Edit	3 days	Mon 3/3/25	Wed 3/5/25	33
35	Submit Draft Pilot Study Report	1 day	Thu 3/6/25	Thu 3/6/25	34
36	Regulator Review	30 days	Fri 3/7/25	Sat 4/5/25	35
37	Prepare/Submit RTCs	7 days	Sun 4/6/25	Sat 4/12/25	36
38	Regulator Concurrence of RTCs	7 days	Sun 4/13/25	Sat 4/19/25	37
39	Prepare Final Pilot Study Report	3 days	Sun 4/20/25	Tue 4/22/25	38
40	Peer Review/Tech Edit	3 days	Wed 4/23/25	Fri 4/25/25	39
41	Submit Final Pilot Study Report	1 day	Sat 4/26/25	Sat 4/26/25	40



Project: Schedule.mpp

Task | Milestone | Summary | Summary Progress

Run Date: Wed 10/18/23