IN SITU CHEMICAL REDUCTION INTERIM MEASURES WORK PLAN
HOT SPOT 3
MOBILE LAUNCHER PLATFORM REHABILITATION SITES / VEHICLE ASSEMBLY BUILDING AREA (SWMU 056)
KENNEDY SPACE CENTER, FLORIDA

Prepared for:

Environmental Assurance Branch
National Aeronautics and Space Administration
Kennedy Space Center, Florida 32899

A-E Contract 80KSC019D0010
Task Order 80KSC019F0075

December 2023
Revision 0

Prepared by:
AECOM Technical Services, Inc.
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Orlando, Florida 32801
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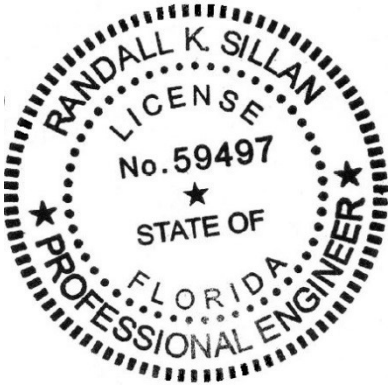
In accordance with the provisions of Florida Statutes, Chapter 471, this Interim Measures Work Plan for Hot Spot 3, located at the Kennedy Space Center Mobile Launcher Platform Rehabilitation Sites / Vehicle Assembly Building Area located in Merritt Island, Florida, has been prepared under the direct supervision of a Professional Engineer registered in the State of Florida. This document and the work described herein comply with standard professional practices and the requirements of Chapter 62-780, Florida Administrative Code (F.A.C.,) and other rules of the Florida Department of Environmental Protection according to Rule 62-780.400(1), F.A.C. This work was performed in accordance with generally accepted professional engineering practices pursuant to Chapter 471 of the Florida Statutes. The data, findings, recommendations, specifications, or professional opinions were prepared solely for the use of the National Aeronautics and Space Administration and the Florida Department of Environmental Protection. AECOM makes no other warranty, either expressed or implied and is not responsible for the interpretation by others of these data.



This item has been digitally signed and sealed by:
December 11, 2023

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TABLE OF CONTENTS

ABBREVIATIONS, ACRONYMS, AND SYMBOLS ..... **v**

EXECUTIVE SUMMARY **1**

1. INTRODUCTION **1-1**
- 1.1 Overview 1-1
- 1.2 Site Location 1-1
- 1.3 Purpose 1-2
- 1.4 Interim Measures Objective 1-2

2. SITE CONDITIONS **2-1**
- 2.1 Background 2-1
- 2.2 Lithology 2-3
- 2.3 Hydrogeology 2-3

3. SITE CHARACTERIZATION/PRE-INTERIM MEASURES ACTIVITIES **3-1**
- 3.1 Supplemental DPT Sampling 3-1
- 3.2 DPT Sampling Results 3-1
- 3.3 Summary of Current Site Conditions 3-2

4. PERMITTING REQUIREMENTS AND SITE PREPARATION **4-1**
- 4.1 Permitting 4-1
- 4.2 Spill Prevention, Control, and Countermeasures 4-1
- 4.3 Dilution Water 4-2

5. ISCR DESIGN **5-1**
- 5.1 Amendment Selection and Dosing 5-1
- 5.2 Injection Locations and Depth 5-2
- 5.3 Application 5-4
- 5.4 Waste Management 5-5

6. PERFORMANCE MONITORING **6-1**
- 6.1 Proposed Monitoring Well Installation 6-1
- 6.2 Sampling Plans 6-1

7. REPORTING **7-1**
- 7.1 Interim Measures Implementation Work Plan 7-1
- 7.2 Interim Measures and Performance Monitoring Documentation 7-1

8. SCHEDULE AND COST **8-1**
- 8.1 Cleanup Timeframe 8-1
- 8.2 Costing 8-1

9. REFERENCES **9-1**

APPENDICES

Appendix A KSCRT Meeting Minutes: September 2021

Appendix B Hot Spot 3 Performance Monitoring ADP dated September 17, 2021

Appendix C EVS Model of CVOCs Distribution

Appendix D Distribution of CVOCs in Proposed Injection Intervals

Appendix E Product Safety Data Sheet and Technical Data Sheet

Appendix F Provect-IR Handling and Application Guidelines

Appendix G UIC Acceptance Letter for Provect-IR

FIGURES

Figure 1-1 Site Location Map

Figure 1-2 Topographic Quadrangle Map

Figure 1-3 Facilities in the Vicinity of the MLP Area

Figure 1-4 Layout of the MLP Rehab Site

Figure 2-1 Hot Spot 3 2017 Bioremediation IM Injection Locations

Figure 2-2 Hot Spot 3 CVOC Groundwater Impacts, 2017 and 2019

Figure 2-3 Hot Spot 3 Lithologic Cross Section

Figure 2-4 Site-Wide Groundwater Contour Map, Shallow Interval (2 to 20 feet bls), March 18, 2021

Figure 2-5 Site-Wide Groundwater Contour Map, Intermediate Interval (20 to 45 feet bls), March 18, 2021

Figure 3-1 Hot Spot 3 DPT Groundwater Sampling Locations, 2021

Figure 5-1 Hot Spot 3 Shallow Injection Point Locations Relative to NADC Plume

Figure 5-2 Hot Spot 3 Deep Injection Point Locations Relative to NADC Plume

Figure 5-3 Hot Spot 3 Subsurface Obstructions

Figure 6-1 Hot Spot 3 Proposed Monitoring Well Locations

Figure 6-2 Hot Spot 3 Proposed Monitoring Well Locations (Performance and LCP wells)

Figure 6-3 Typical Monitoring Well Construction

TABLES

Table 3-1 DPT Groundwater Analytical Results: Chlorinated Volatile Organic Compounds, Hot Spot 3

Table 3-2 DPT Groundwater Analytical Results: Dissolved Gases, Sulfate, Sulfide, and Total Organic Carbon

Table 5-1 Slurry and Dosing Details (within text)

Table 5-2 Injection Point Coordinates and Injection Details

Table 6-1 Rationale for Proposed Monitoring Wells

Table 6-2 Performance and UIC Monitoring Plan

Table 6-3 Low Concentration Plume Monitoring Plan

Table 8-1 Estimated Costs to Implement ISCR IMWP

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ABBREVIATIONS, ACRONYMS, AND SYMBOLS

3-D	three-dimensional
10xNADC	10 times the Natural Attenuation Default Concentration
µg/L	micrograms per liter
ADP	Advance Data Package
AECOM	AECOM Technical Services, Inc.
bls	below land surface
CCR	Construction Completion Report
1,1-DCE	1,1-dichloroethene
cDCE	cis-1,2-dichloroethene
cm^2	square centimeters
CMD	Corrective Measures Design
CMI	Corrective Measures Implementation
CVOC	chlorinated volatile organic compound
Dhc	Dehalococcoides
DPT	direct push technology
EE	Engineering Evaluation
ERD	enhanced reductive dichlorination
EVS	Earth Volumetric Studio
F.A.C.	Florida Administrative Code
FDEP	Florida Department of Environmental Protection
GCTL	Groundwater Cleanup Target Level
Geosyntec	Geosyntec Consultants, Inc.
gpm	gallons per minute
HCP	High Concentration Plume
IDW	investigation derived waste
IM	Interim Measures
IMWP	Interim Measures Work Plan
IP	injection point
ISCR	in situ chemical reduction
KSC	John F. Kennedy Space Center

KSCRT	KSC Remediation Team
mg/L	milligrams per liter
MLP	Mobile Launcher Platform
MLP/VAB	Mobile Launcher Platform Rehabilitation Sites/Vehicle Assembly Building Area
NADC	Natural Attenuation Default Concentration
NAM	natural attenuation monitoring
NASA	National Aeronautics and Space Administration
psi	pounds per square inch
PVC	polyvinyl chloride
RCRA	Resource Conservation and Recovery Act
Rehab	Rehabilitation
RFI	RCRA Facility Investigation
RPM	Remediation Project Manager
SDS	Safety Data Sheet
SPCC	Spill Prevention, Control, and Countermeasure
STS	Space Transportation System
SWMU	Solid Waste Management Unit
SWPPP	Stormwater Pollution Prevention Plan
TCE	trichloroethene
tDCE	trans-1,2-dichloroethene
TDS	total dissolved solids
TOC	total organic carbon
UIC	underground injection control
USEPA	U.S. Environmental Protection Agency
VAB	Vehicle Assembly Building
VABRA	Vehicle Assembly Building Reassessment Area
VC	vinyl chloride
ZOD	zone of discharge
ZVI	zero valent iron

EXECUTIVE SUMMARY

This document presents the design details of an In Situ Chemical Reduction (ISCR) Interim Measures Work Plan for Hot Spot 3 within Mobile Launcher Platform Rehabilitation Sites/Vehicle Assembly Building Area, Solid Waste Management Unit (SWMU) 056 (SWMU 056), located at the John F. Kennedy Space Center, Florida. The interim measures (IM) treatment zone encompasses an area identified as the High Concentration Plume (HCP), which is defined as the area with chlorinated volatile organic compound (CVOC) groundwater concentrations greater than their respective Natural Attenuation Default Concentration (NADC). The objective of the IM is to remove CVOC mass within the treatment area to levels that facilitate a transition to natural attenuation monitoring.

The IM design consists of the selected ISCR amendment, Provect-IR, which is a mixture of solid reagents in a single product that promotes enhanced reductive dechlorination and ISCR. Provect-IR includes natural antimethanogenic compounds; multiple hydrophilic, nutrient-rich organic carbon sources; zero valent iron; chemical oxygen scavengers; and vitamin and mineral sources. The proposed treatment area for this IM encompasses less than 1 acre and includes three vertical treatment intervals to reach the NADC plumes that vary per CVOC and depth: 4 to 10 feet below land surface (bls), 10 to 18 feet bls, and 42 to 52 feet bls. The amendment will be distributed through 16 injection points (IP01 through IP16) using dosing rates ranging from 0.4% to 0.6% of soil mass within the treatment interval and a 15% or 20% slurry strength. Dosage rates and slurry strength are based on groundwater geochemistry, soil characteristics, and contaminant concentrations.

To aid in the evaluation of the ISCR IM performance, six performance monitoring wells will be installed following injections and sampled semiannually. CVOC parameters will be sampled until concentrations reduce to below their NADC. Underground Injection Control parameters will be sampled until concentrations decrease to background levels or to levels that meet respective groundwater standards. Sampling frequency will be evaluated annually and modified as needed.

The path forward for the ISCR IM implementation includes preparing the IM Implementation Work Plan, ISCR injections, monitoring well installation, performance monitoring, and reporting.

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1. INTRODUCTION

1.1 OVERVIEW

The National Aeronautics and Space Administration (NASA), through its Environmental Assurance Branch, is managing cleanup of four sites in the Mobile Launcher Platform Rehabilitation Sites / Vehicle Assembly Building (MLP/VAB) Area of John F. Kennedy Space Center (KSC), Florida. The MLP/VAB Area has been designated Solid Waste Management Unit (SWMU) 056 (SWMU 056) under KSC's Resource Conservation and Recovery Act (RCRA) Corrective Action Program.

AECOM Technical Services, Inc. (AECOM) has prepared this Interim Measures Work Plan (IMWP) for NASA under Contract 80KSC019D0010, Task Order 80KSC019F0075. An Advance Data Package (ADP) presenting site characterization data and the proposed bioremediation approach received KSC Remediation Team (KSCRT) approval in September 2021 in preparation for developing an IMWP (Decision Item 2109-D35). The meeting minutes are included in **Appendix A**.

1.2 SITE LOCATION

The MLP/VAB Area is located within KSC on the east-central Atlantic Coast of Florida in the northern portion of Merritt Island, between the Indian River and Banana River Lagoons in Brevard County (**Figure 1-1**). The MLP/VAB Area is located within KSC in Sections 7, 8, 17, and 18 of Township 22 South, Range 37 East, as shown on the Orsino, Florida Quadrangle map (United States Geological Survey 1976) (**Figure 1-2**).

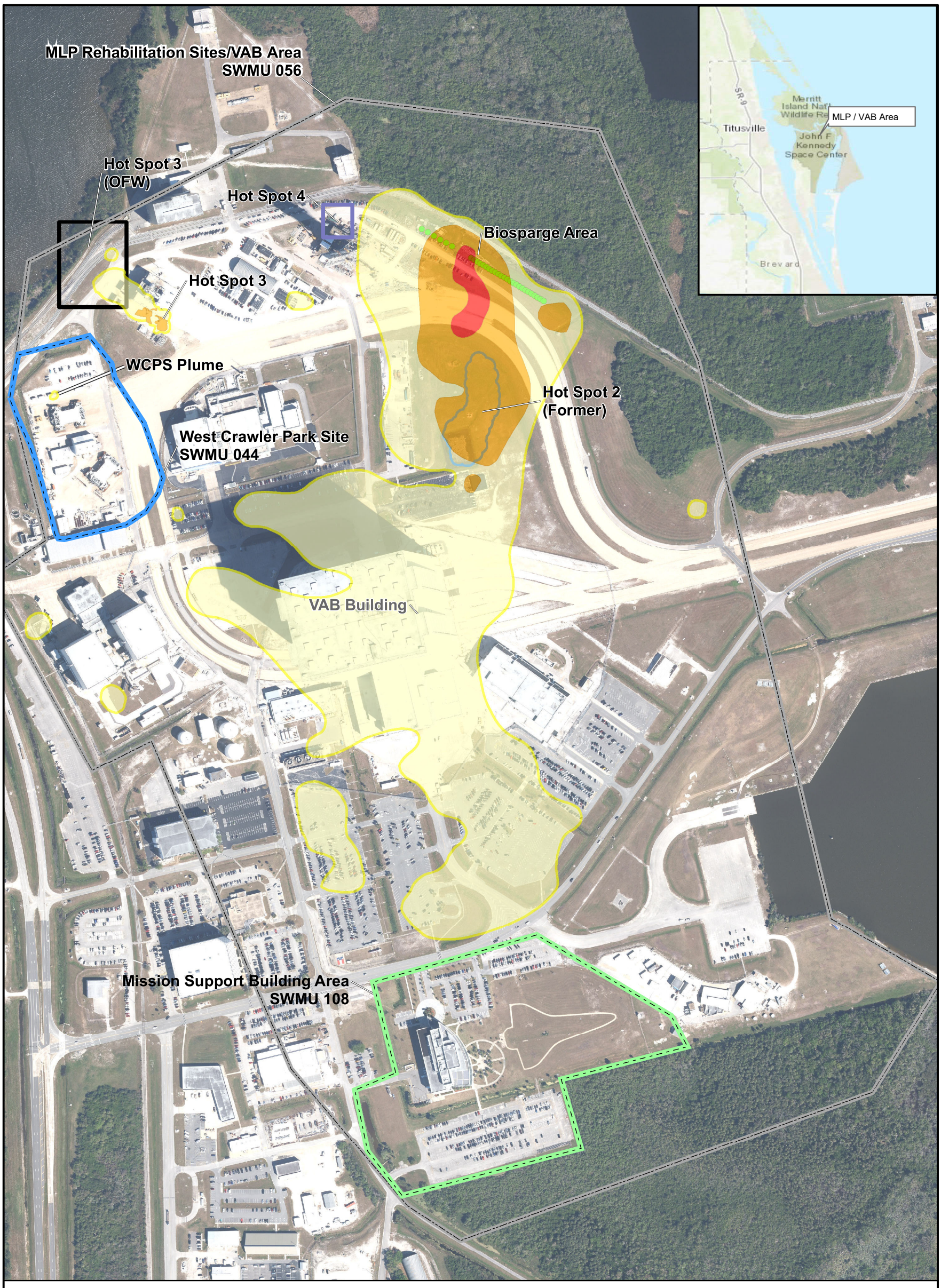
The MLP/VAB facilities were originally built to support the Apollo/Saturn V vehicle assembly and were later modified (1975) to support Space Transportation System (STS) shuttle missions. The MLP area was used to repair post launch corrosion and/or blast damage on the launch platforms prior to reuse. The VAB was used to stack and prepare the space vehicles prior to launch (NASA 2018a). The MLP area was originally comprised of three platforms, also known as three rehabilitation (rehab) sites: East Rehab Site, Central (or Center) Rehab Site, and Western (or West) Rehab Site. The central platform was removed in 1991 and replaced with storage facilities and office trailers for local operations, the western platform was removed in 2021, and the remaining areas are currently construction sites. **Figure 1-3** and **Figure 1-4** are excerpts from the RCRA Facility Investigation (RFI) (NASA 2000), illustrating the location of the MLP area in respect to the surrounding facilities on a 1995 aerial and the layout of the MLP Rehab Sites, respectively. **Section 2** details the identification and history of Hot Spot 3 (**Figure 1-1**), an area adjacent to the former Western Rehab Site (or western MLP structure) located partially beneath and south of the former western MLP structure and adjacent to the crawler tracks, which is the focus of this IMWP.

1.3 PURPOSE

This IMWP presents current site characteristics and remediation strategy for a second injection event at Hot Spot 3, supplementary to the May 2016 Hot Spot 3 Bioremediation IMWP (NASA 2016a). The purpose of these injections is to treat the chlorinated volatile organic compound (CVOC) high concentration plume (HCP) in groundwater near the former western MLP structure. The HCP is defined by the volume of contaminant concentrations that are greater than their respective Natural Attenuation Default Concentration (NADC). The remediation approach is in situ chemical reduction (ISCR) within an updated treatment area and modified treatment intervals based on recent characterization data. The Interim Measure (IM) treatment area is approximately 5,000 square feet and extends vertically from 4 to 52 feet below land surface (bls). Exact treatment intervals vary throughout the plume footprint and are discussed in detail in **Section 5**.

1.4 INTERIM MEASURES OBJECTIVE

The objective of the IMWP is to implement ISCR to treat CVOC concentrations within the treatment area to below NADC levels and thereby transition the sampling program to natural attenuation monitoring (NAM).



Legend

- Biosparge Well Location
- Air sparge area of influence (35 feet)
- Composite Greater than NADC Isocontour (2021 Data)
- Composite NADC Isocontour (2012-2021 Data)
- Composite GCTL Isocontour (2012-2021 Data)
- MLP Rehabilitation Sites /VAB Area - SWMU #56
- Mission Support Building Area - SWMU #108
- West Crawler Park Site - SWMU #44
- OFW Investigation area

Notes:
1. MLP/VAB = Mobile Launcher Platform Rehabilitation Sites / Vehicle Assembly Building Area (MLP/VAB), (Solid Waste Management Unit [SWMU] 056)
2. IGM = Interim groundwater monitoring
3. OFW = Outstanding Florida Waters
4. Source of plume boundaries: 2021 IGM data, 2021 Direct push technology data.
5. WCPS = West Crawler Park Site
6. GCTL = Groundwater Cleanup Target Levels as provided in 62-777, F.A.C.
7. NADC = Natural Attenuation Default Concentration as provided in 62-777, F.A.C.

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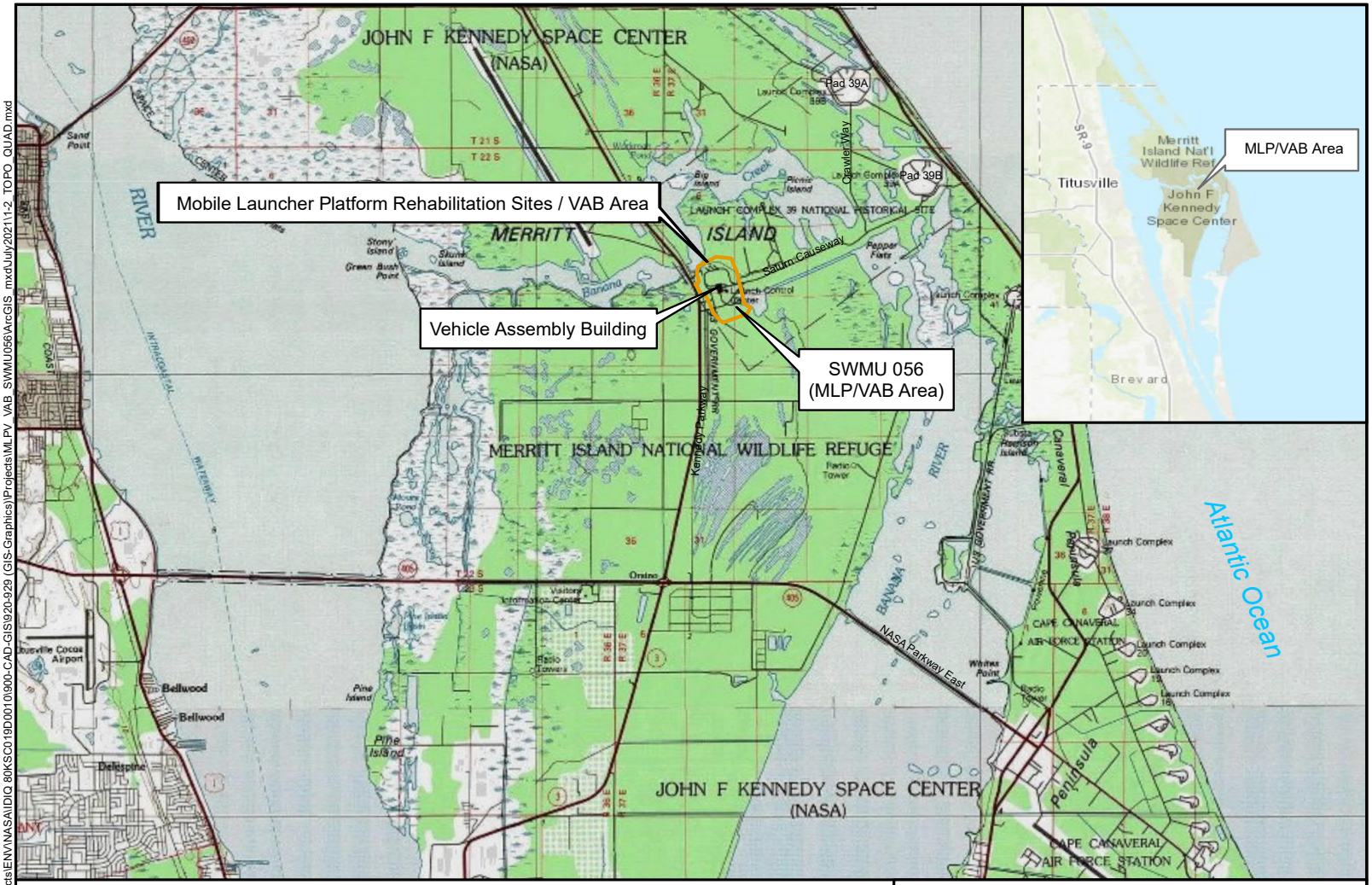
0 400 800 Feet

FIGURE 1-1
Site Location Map

MLP/VAB (SWMU 056)
NASA Kennedy Space Center, Florida



Notes:
1. MLP/VAB = Mobile Launcher Platform Rehabilitation Sites / Vehicle Assembly Building (MLP/VAB).
2. Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

N

0 10,000 20,000 Feet

FIGURE 1-2
Topographic Quadrangle Map

MLP/VAB (SWMU 056)
NASA Kennedy Space Center, Florida

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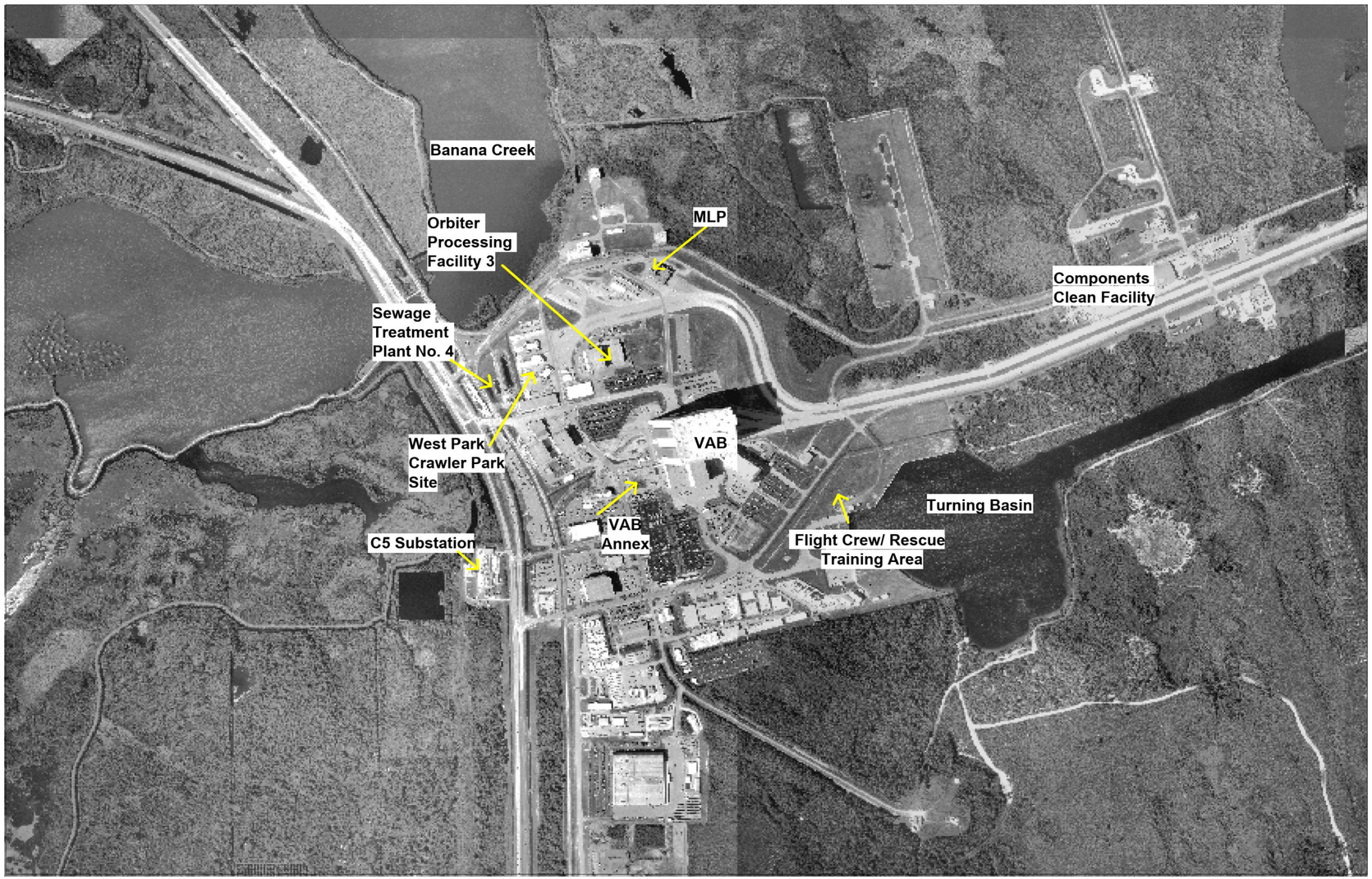

KSC-JJ-4642
MLP RFI - SECTION I

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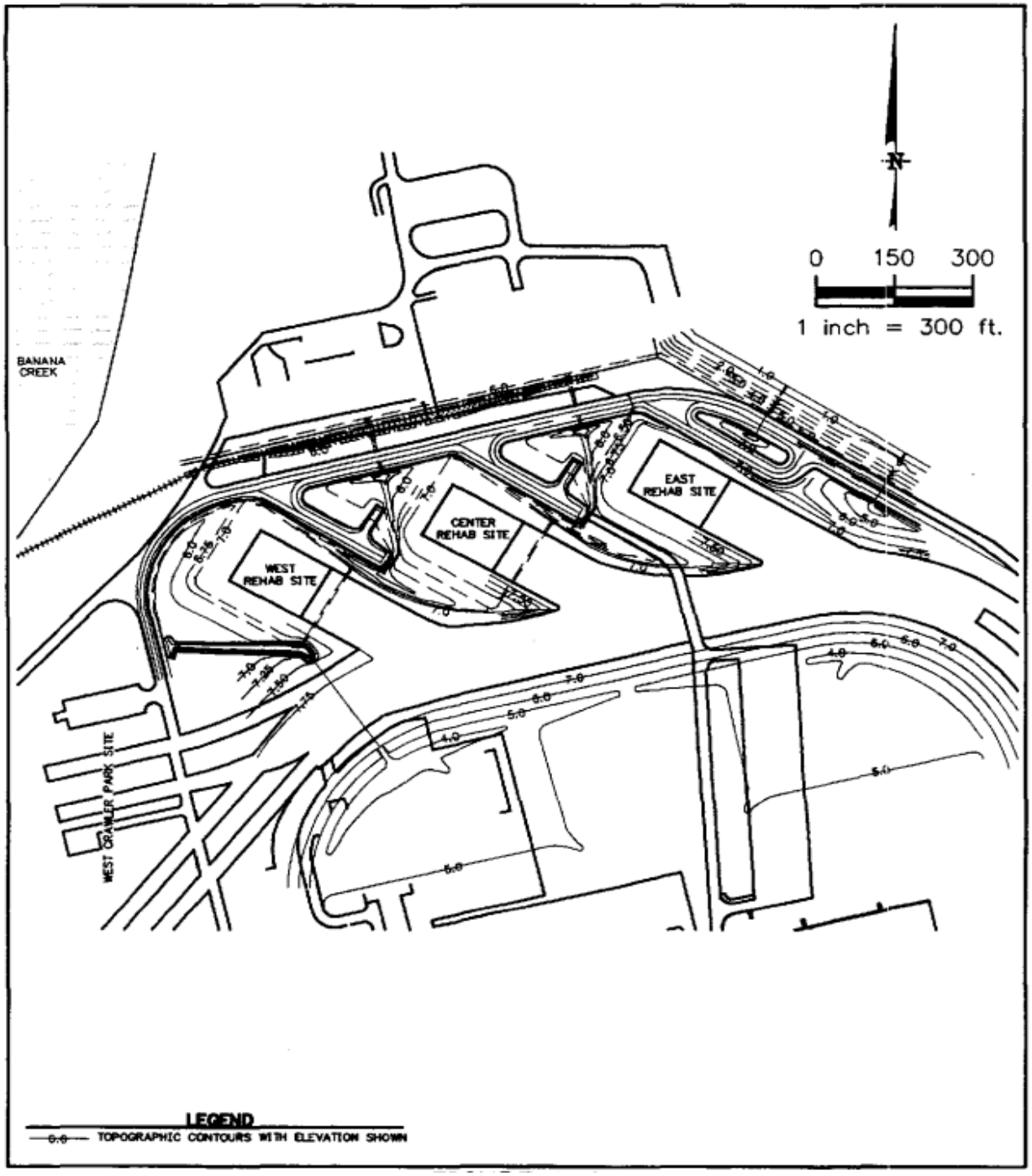
Approximate Scale
1 Inch =800 Feet

Notes: Aerial Photo taken March 1995
MLP - Mobile launcher platform
VAB - Vehicle assembly building

Source: NASA. 2000. Mobile Launcher Platform Rehabilitation Sites, SWMU No. 056, RCRA Facility Investigation Report, John F. Kennedy Space Center, Florida (Revision 2). Prepared by Geosyntec Consultants Inc., Boca Raton, Florida.

Figure 1-3
Facilities in the Vicinity of the MLP Area

MLP/VAB (SWMU 056)
NASA Kennedy Space Center, Florida



Source: Figure 1-2; NASA. 2000. Mobile Launch Platform Rehabilitation Sites, SWMU No. 056, RCRA Facility Investigation Report, John F. Kennedy Space Center, Florida (Revision 2). Prepared by Geosyntec Consultants Inc., Boca Raton, Florida.

Notes:
1. MLP/VAB Mobile Launcher Platform Rehabilitation Sites / Vehicle Assembly Building Area (MLP/VAB), Solid Waste Management Unit (SWMU) 056

Figure 1-4
Layout of the MLP Rehab Site

MLP/VAB (SWMU 056)
NASA Kennedy Space Center, Florida

2. SITE CONDITIONS

2.1 BACKGROUND

During the RFI and pre-Corrective Measures Design (CMD) activities, CVOC groundwater impacts encompassing a SWMU-wide area of approximately 115 acres were delineated (NASA 2000, 2003) in the MLP/VAB Area (SWMU 056). In addition, a trichloroethene (TCE) source area was identified (within the CVOC impacted area) beneath the parking lot northeast of the VAB, which was associated with an anecdotal TCE spill (approximately 4,000 gallons) that occurred in 1966. A CMD presented a multicomponent remedial strategy developed for the source area and the 115-acre CVOC plume (NASA 2004).

Additional assessments that occurred at the site included a reassessment of the VAB area that was commissioned by Ground Systems Development & Operations following the completion of the STS Program. The reassessment activities were performed throughout the VAB Reassessment Area (VABRA) from 2012 through 2014. These activities evaluated the absence or presence of groundwater and soil impacts associated with electrical equipment (NASA 2015a). Through the various site investigations, four hot spot areas were identified (Hot Spots 1 through Hot Spot 4).

The area adjacent to the former western MLP structure with the presence of a CVOC HCP was identified as Hot Spot 3 (**Figure 1-1**). Specifically, groundwater impacts associated with Hot Spot 3 included a TCE source zone (TCE greater than 11,000 micrograms per liter [µg/L]), a CVOC HCP, and a CVOC Low Concentration Plume (CVOCs greater than the Florida Department of Environmental Protection [FDEP] Groundwater Cleanup Target Levels [GCTLs]). The activities in this area followed the KSCRT multi-step engineering evaluation (EE) process, and details are provided in the following documents:

- Site Characterization EE ADP (formerly referred to as Step 1 EE) (NASA 2015b),
- Remedial Alternative Evaluation EE ADP (formerly referred to as Step 2 EE) (NASA 2016b),
- Hot Spot 3 Bioremediation IMWP (NASA 2016a),
- Hot Spot 3 Bioremediation Implementation Work Plan (NASA 2017),
- Hot Spot 3 Bioremediation Construction Completion Report (CCR) (NASA 2018a), and
- Hot Spot 3 Bioremediation IM Annual Report (NASA 2018b).

The TCE source area and HCP were treated from July through August 2017 with the injection of a diluted solution of SRS-SD (a slow release, small droplet, neutral pH emulsified vegetable oil [soybean oil] from TerraSystems, Inc.) and microbial culture (KB-1) into the subsurface at 29 injection locations to predetermined varied depth intervals. **Figure 2-1** is an excerpt from the Hot Spot 3 Bioremediation CCR (NASA 2018a) illustrating the 2017 IM injection locations. A low-pressure injection (average pressure of 76 pounds per square inch [psi]) was utilized for the high permeability zone (approximately 4 to 52 feet bls). A high-pressure injection (average pressure

of 175 psi) was utilized for the low permeability zone (approximately 52 to 57 feet bls). Approximately 174,300 gallons of SRS-SD solution, 4,250 gallons of anaerobic chase water, and 43 liters of KB-1 were injected during bioremediation activities. Following injection activities, nine performance monitoring wells (MLPV-IW0065 through MLPV-IW0073) were installed via direct push technology (DPT) in August 2017. The baseline bioremediation performance monitoring sampling event was performed in August 2017 (post monitoring well installation) and included the collection of groundwater samples from the nine newly installed wells and monitoring well VABRA-MW0002. Samples were analyzed for CVOCs, and select samples were analyzed for dissolved gases, sulfate, sulfide, total organic carbon (TOC), Dehalococcoides (Dhc), reductive dehalogenase genes, and Underground Injection Control (UIC) constituents (NASA 2018a).

The baseline sampling results were compared to the 2018 and 2019 performance monitoring results to evaluate bioremediation progress. Compared to baseline data, there was an approximately 80% to 100% reduction in dissolved CVOCs (based on TCE equivalent concentrations) in the shallow treatment area and an approximately 94% to 96% reduction in dissolved CVOCs in the deep treatment area. Results for TOC generally indicated that the injection activities were successful at obtaining the designed 8-foot radius of influence, except for the areas around performance monitoring wells MLPV-IW0066, MLPV-IW0069, and MLPV-IW0073. UIC sampling results were below their screening criteria, except for total dissolved solids (TDS). However, the TDS concentrations within the treatment area were consistent with those results outside of the treatment area, which suggests there were no adverse impacts to site groundwater from the injection activities (NASA 2018a, 2019).

Two additional performance monitoring wells were installed in the shallow treatment area (MLPV-IW0074) and deep treatment area (MLPV-IW0075) in September 2018 for monitoring downgradient impacts of potential plume collapse from bioremediation IM (NASA 2019). September 2018 sampling results indicated no detections in MLPV-IW0074 and vinyl chloride (VC) detection above its GCTL (1 microgram per liter [µg/L]) at 95 µg/L in MLPV-IW0075 (NASA 2018a). These wells were sampled again in February 2019, and results were similar; no detections in MLPV-IW0074 and VC detection above the NADC (100 µg/L) at 110 µg/L in MLPV-IW0075 (NASA 2019).

DPT groundwater sampling was conducted in March 2019 to evaluate post-bioremediation IM conditions approximately 1.5 years post injection. Evaluation of the March 2019 DPT results concluded implementation of the bioremediation IM reduced the CVOC groundwater impacts. The TCE source zone area (TCE concentrations greater than 11,000 µg/L) reduced from 0.023 acre to 0.0007 acre (no TCE source zone present from 41 to 55 feet bls); the area with CVOC concentrations greater than 10xNADC was reduced from 0.09 acre to 0.02 acre (approximately 80% reduction); and the area with CVOC concentrations greater than the NADC was reduced from 0.19 acre to 0.10 acre (approximately 50% reduction) (outside treatment area). **Figure 2-2** is an excerpt from the 2018 Corrective Measures Implementation (CMI) and IM

Annual Report (NASA 2019) and illustrates the reduction of the CVOC plumes from 2017 to 2019.

Due to the access restrictions around the former MLP structure imposed from a commercial leasing partner in 2019, all Hot Spot 3 IM area monitoring wells (VABRA-MW0001 through VABRA-MW0005 and VABRA-IW0065 through VABRA-IW0075) were abandoned in April 2019 (NASA 2019). Following the reinstatement of site access in March 2021, a DPT performance monitoring event was performed in March and April 2021 to evaluate current conditions and determine whether additional substrate is required to promote continued dissolved plume degradation. DPT activities are detailed in **Section 3** Based on 2021 DPT analytical results, this IMWP for supplemental injections to promote ISCR of CVOCs was developed.

2.2 LITHOLOGY

Based on a review of historical soil cores, lithology for Hot Spot 3 has been revised from the generalized lithology reported in the Hot Spot 3 Bioremediation IMWP (NASA 2016a). Eight historical borings (MLPV-IW4I, MLP-SB3, MLPV-IW13I, SB-1466, SB-1473, SB-2001, SB-2002, and SB-2003) were used to provide an east-west cross section to a total depth of 70 feet bls and is presented on **Figure 2-3.** The east side of Hot Spot 3 is primarily well sorted fine to medium sand with shells, with an increased silt content toward the west. Clayey soil is predominant around 60 feet bls. Geotechnical testing completed in 2015 indicated the permeability of the clayey sand/sandy clay from 47 to 61 feet bls was between 10^{-9} square centimeters (cm^2) and 10^{-11} cm^2 (NASA 2016c). The lithological data combined with calculated permeability indicate that the layer between 52 to 60 feet bls consists of low permeability.

2.3 HYDROGEOLOGY

Groundwater zones for the Hot Spot 3 area have been generally defined as follows: (1) shallow groundwater less than 28 feet bls; (2) intermediate groundwater from 28 to 40 feet bls; and (3) deep groundwater greater than 40 feet bls. Annual groundwater elevations are collected as part of the site-wide MLP/VAB area monitoring well sampling. The most recent sampling event was performed in March 2021, and shallow and intermediate groundwater elevation data are presented on **Figure 2-4** and **Figure 2-5**, respectively. Groundwater flow in the Hot Spot 3 area is generally to the northeast, which is consistent with historical data.

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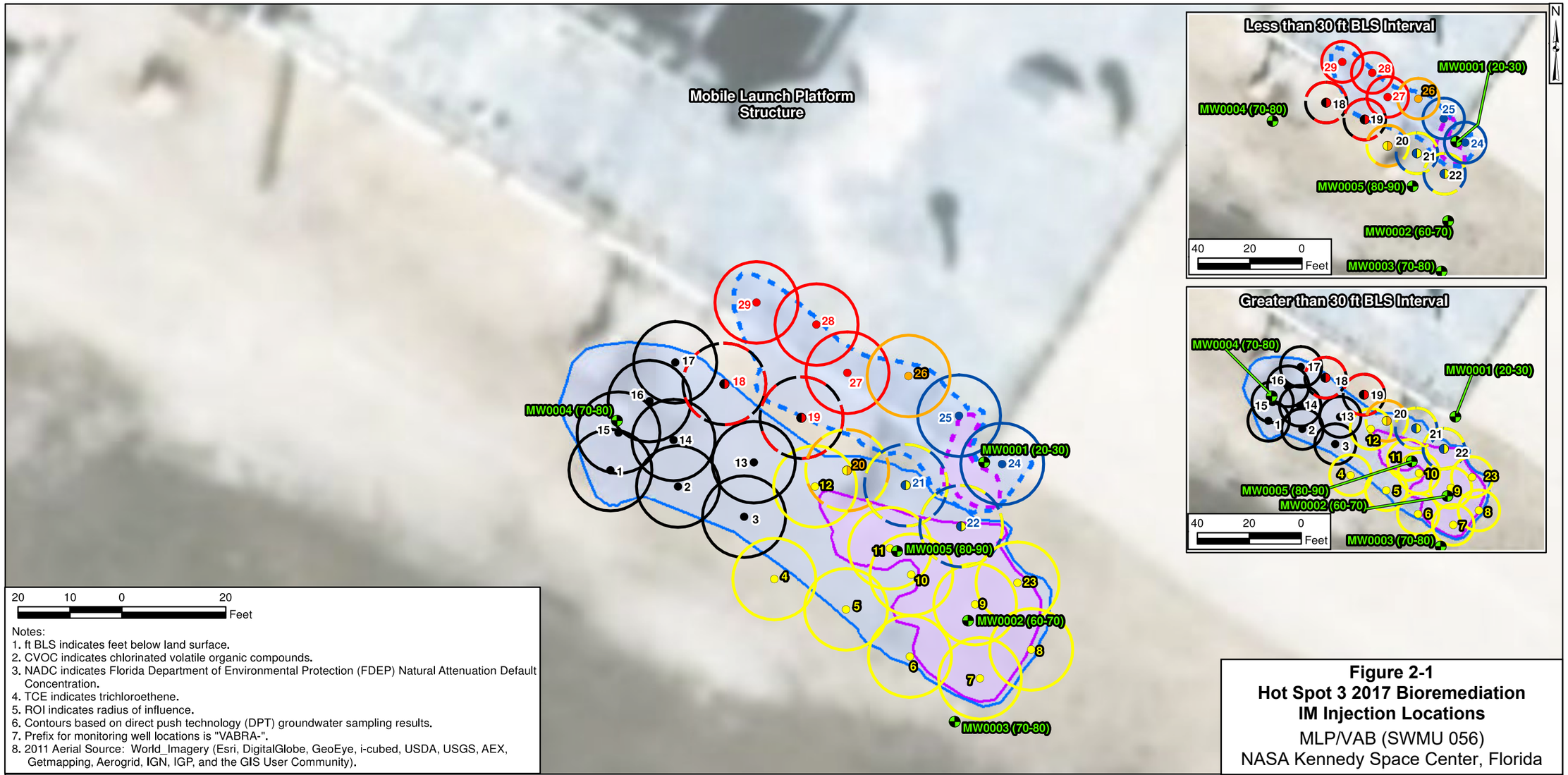

Notes:
1. ft BLS indicates feet below land surface.
2. CVOC indicates chlorinated volatile organic compounds.
3. NADC indicates Florida Department of Environmental Protection (FDEP) Natural Attenuation Default Concentration.
4. TCE indicates trichloroethene.
5. ROI indicates radius of influence.
6. Contours based on direct push technology (DPT) groundwater sampling results.
7. Prefix for monitoring well locations is "VABRA-".
8. 2011 Aerial Source: World_Imagery (Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community).

Figure 2-1
Hot Spot 3 2017 Bioremediation IM Injection Locations
MLP/VAB (SWMU 056)
NASA Kennedy Space Center, Florida

Legend

- Monitoring Well Location
- June 2017 Overall TCE 1% Solubility Contour (dashed contours are 6 to 16 ft BLS interval and solid contours are 41 to 55 ft BLS interval)
- June 2017 Overall CVOC 10xNADC Contour (dashed contours are 6 to 26 ft BLS interval and solid contours are 41 to 55 ft BLS interval)
- Injection Location with estimated 8 ft ROI for 4 to 28 ft BLS (Total = 2)
- Injection Location with estimated 8 ft ROI for 10 to 28 ft BLS (Total = 1)
- Injection Location with estimated 8 ft ROI for 39 to 57 ft BLS (Total = 10)
  Low pressure injection from 39 to 51 ft BLS
  High pressure injection from 51 to 57 ft BLS
- Injection Location with estimated 8 ft ROI for 4 to 28 and 39 to 57 ft BLS (Total = 2)
  Low pressure injection from 4 to 28 and 39 to 51 ft BLS
  High pressure injection from 51 to 57 ft BLS
- Injection Location with estimated 8 ft ROI for 16 to 24 ft BLS (Total = 3)
- Injection Location with estimated 8 ft ROI for 44 to 52 ft BLS (Total = 8)
- Injection Location with estimated 8 ft ROI for 10 to 28 and 39 to 57 ft BLS (Total = 1)
- Injection Location with estimated 8 ft ROI for 16 to 24 and 44 to 52 ft BLS (Total = 2)

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Excerpt from MLP/VAB Area, SWMU No. 056, Hot Spot 3 Bioremediation Construction Completion Report (Revision 0). Prepared by Geosyntec Consultants Inc., Titusville, Florida. February 2018.

Excerpt from MLP/VAB Area, SWMU No. 056, Hot Spot 3 Bioremediation Construction Completion Report (Revision 0). Prepared by Geosyntec Consultants Inc., Titusville, Florida. February 2018.

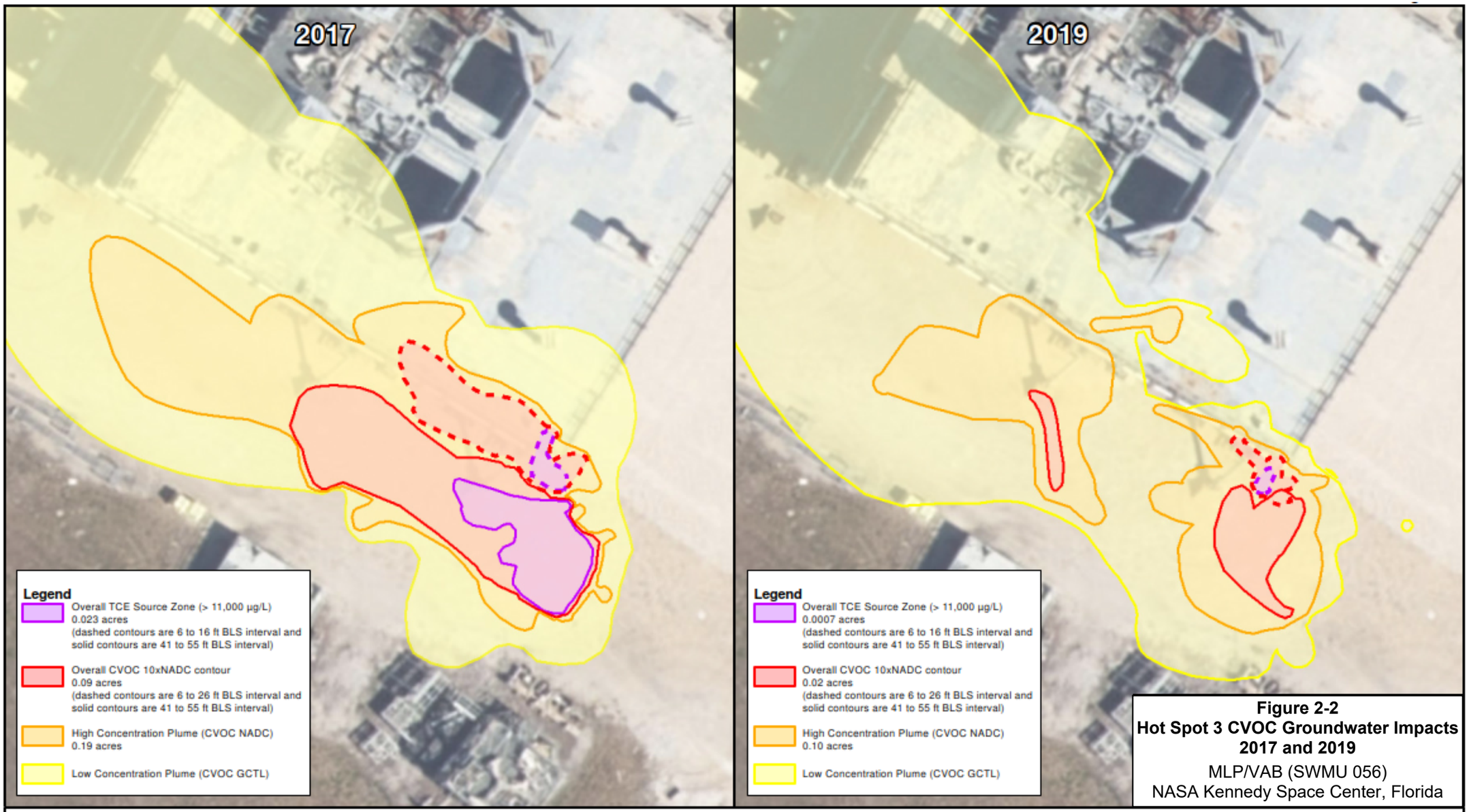

Figure 2-2
Hot Spot 3 CVOC Groundwater Impacts 2017 and 2019
MLP/VAB (SWMU 056)
NASA Kennedy Space Center, Florida

Notes:
1. ft BLS indicates feet below land surface.
2. µg/L indicates micrograms per liter.
3. CVOC indicates chlorinated volatile organic compounds.
4. Contours based on direct push technology (DPT) groundwater sampling results.
5. GCTL indicates the Florida Department of Environmental Protection Groundwater Cleanup Target Level.
6. NADC indicates the FDEP Natural Attenuation Default Concentration.
7. TCE indicates trichloroethene.
8. 2015 Aerial Source: World Imagery (Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community).

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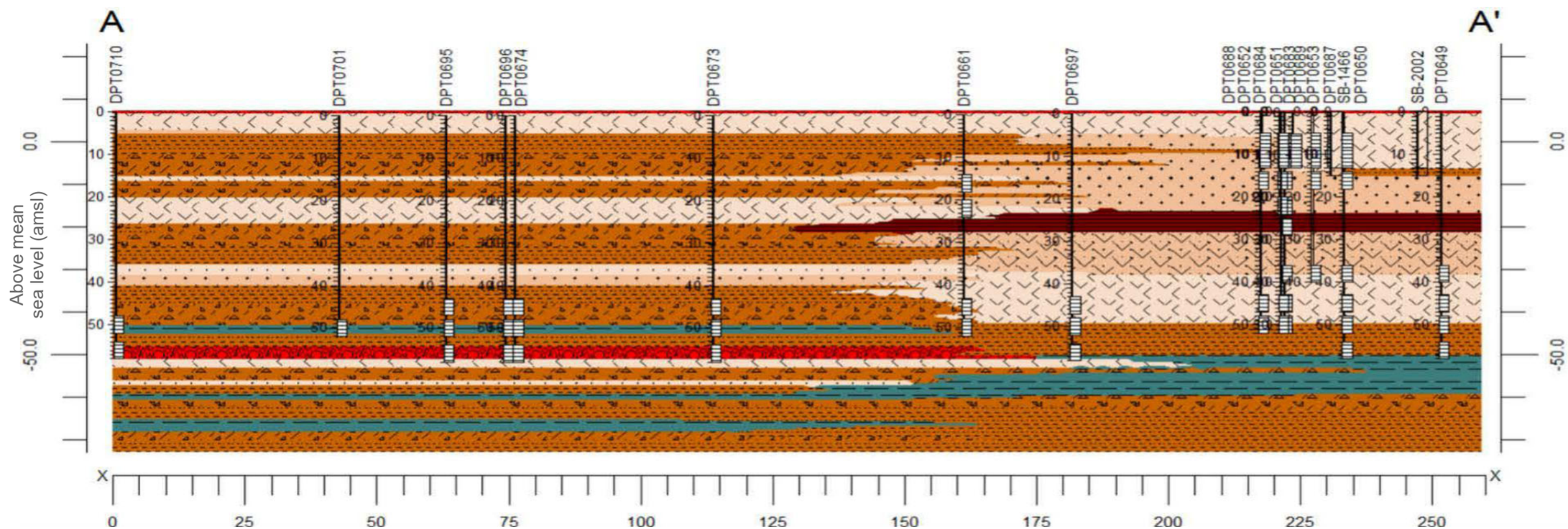

Lithology Index

- Fine Sand
- Fine Sand with Shells
- Gravelly Sand
- Medium Sand
- Medium Sand with Shells
- Sandy Clay
- Shell Hash
- Silty Clay
- Silty Sand
- Silty Sand with Shells

Notes:
1. DPT = Direct Push Technology
2. MLP/VAB Mobile Launcher Platform Rehabilitation Sites / Vehicle Assembly Building Area (MLP/VAB), Solid Waste Management Unit (SWMU) 056

FIGURE 2-3
Hot Spot 3
Lithologic Cross-section

MLP/VAB (SWMU 056)
NASA Kennedy Space Center, Florida

Legend

- Shallow Monitoring Well
- Groundwater Contour (NAVD88 feet)
- Approximate Direction of Groundwater Flow
- Biosparge Well Location

Notes:
1. bls = below land surface.
2. NAVD88 = North American Vertical Datum of 1988.
3. * = elevation was not used for contouring.
4. ND = no data.
5. MLP/VAB = Mobile Launcher Platform Rehabilitation Sites /Vehicle Assembly Building Area
6. SWMU = Solid Waste Management Unit
7. CNL = Could Not Locate
8. MW = Monitoring well
9. WCPS = West Crawler Park Site
10. PCCA = Processing Control Center Area
11. PRES = Press Site
12. OPF = Orbiter Processing Facility
13. IW = Investigation well
14. NASA = National Aeronautics Space Association

N

0 500 1,000 Feet

FIGURE 2-4
Site-Wide Groundwater Contour Map
Shallow Interval (2 to 20 feet bls)
March 18, 2021

MLP/VAB (SWMU 056)
NASA Kennedy Space Center, Florida

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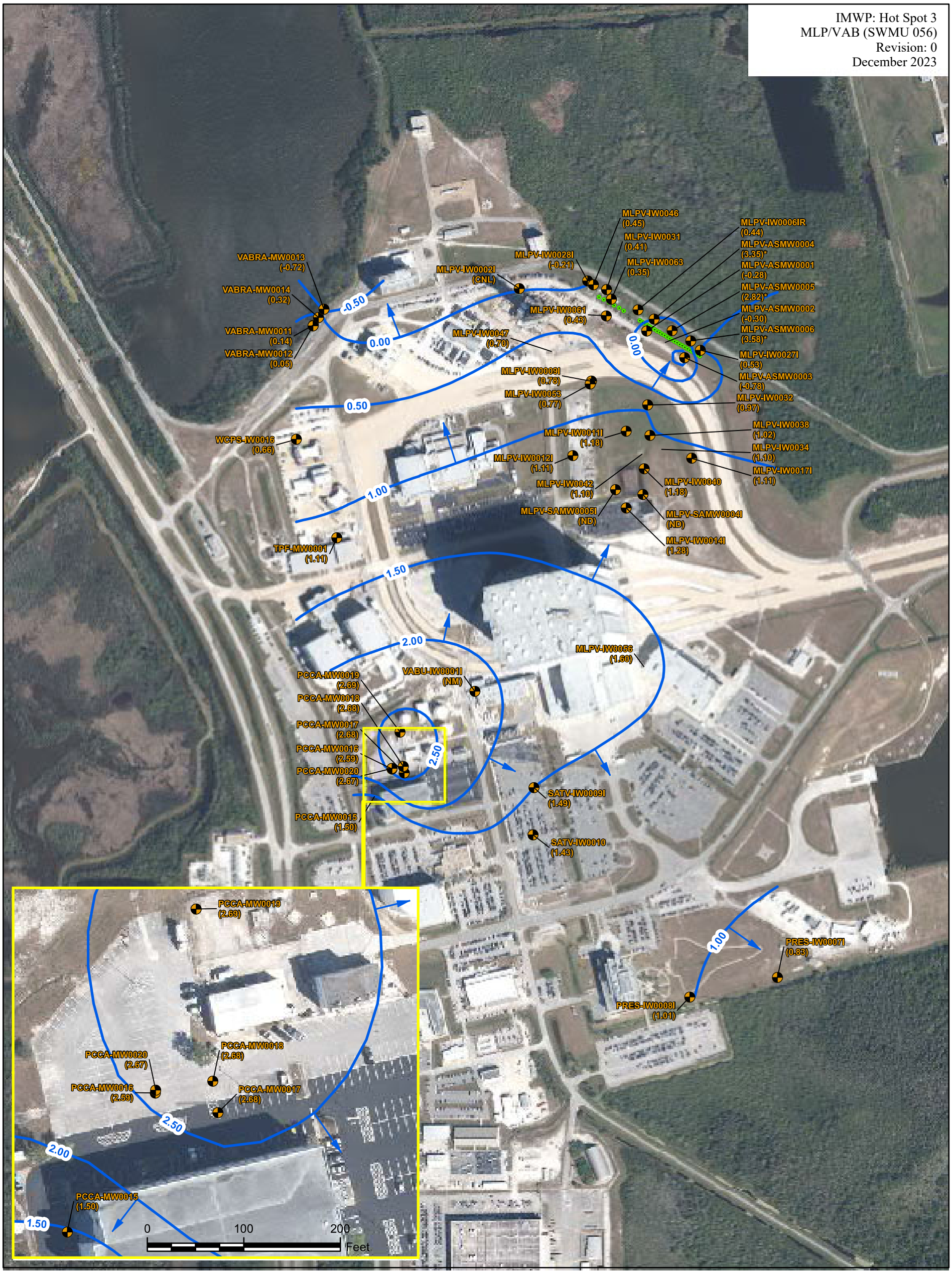

Legend

- Intermediate Monitoring Well (Groundwater Elevation NAVD88 ft.)
- Groundwater Contour (NAVD88 ft.)
- Approximate Direction of Groundwater Flow
- Biosparge Well Location

Notes:
1. bls = below land surface
2. NAVD88 = North American Vertical Datum of 1988
3. * = elevation was not used for contouring
4. NM = not measured
5. ND = no data
5. MLP/VAB = Mobile Launcher Platform Rehabilitation Sites /Vehicle Assembly Building Area
6. SWMU = Solid Waste Management Unit
7. CNL = Could Not Locate
8. MW = Monitoring well
9. WCPS = West Crawler Park Site
10. PCCA = Processing Control Center Area
11. PRES = Press Site
12. SATV = Saturn V
13. TPF = Thermal Protection Facility
14. VABRA = Vehicle Assembly Building Reassessment Area
15. IW = Investigation well
16. NASA = National Aeronautics Space Association

N

0 500 1,000 Feet

FIGURE 2-5
Site-Wide Groundwater Contour Map
Intermediate Interval (20 to 45 feet bls)
March 18, 2021

MLP/VAB (SWMU 056)
NASA Kennedy Space Center, Florida

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3. SITE CHARACTERIZATION/PRE-INTERIM MEASURES ACTIVITIES

In March 2021, site access to Hot Spot 3 was reinstated, and DPT performance monitoring was implemented to evaluate the extent of current CVOC contamination above NADCs. This data were presented in the 2021 CMI and IM Annual Status Report (NASA 2022).

3.1 SUPPLEMENTAL DPT SAMPLING

A total of 188 DPT groundwater samples from 62 locations (MLPV-DPT0644 through MLPV-DPT0702 and MLPV-DPT0709 through MLPV-DPT0711) were completed in the Hot Spot 3 area. Groundwater samples were submitted for laboratory analysis for select CVOCs (tetrachloroethene, TCE, cis-1,2-dichloroethene [cDCE], trans-1,2-dichloroethene [tDCE], 1,1-dichloroethene [1,1-DCE], and VC) by U.S. Environmental Protection Agency (USEPA) Method 5030 by a mobile laboratory. Additionally, 43 groundwater samples were submitted to a fixed laboratory and analyzed for sulfate, sulfide, and TOC by USEPA Method 9060a, and dissolved gasses ethane, ethene, and methane by laboratory method RSK-175. DPT groundwater sampling locations are presented on **Figure 3-1**.

3.2 DPT SAMPLING RESULTS

The April 2021 DPT analytical results are summarized below:

- Shallow interval (above 28 feet bls):
    - contains the maximum CVOC concentrations for TCE (129,000 µg/L), cDCE (88,000 µg/L), and VC (21,000 µg/L);
    - shows the center of CVOC plumes remains near the southeast corner of the former MLP platform and is likely the source of TCE contamination; and
    - has the maximum concentration of methane (16 milligrams per liter [mg/L]).
- Intermediate interval (between 28 and 39) contains no CVOC concentrations above NADCs.
- Deep interval (below 40 feet bls):
    - includes CVOC concentrations that are less than in the shallow groundwater interval and generally decrease with depth and
    - has the maximum concentrations of sulfate (1,200 mg/L) , sulfide (130 mg/L), TOC (2,800 mg/L), and ethene (12 mg/L).

The DPT groundwater analytical results for Hot Spot 3 CVOCs are summarized in **Table 3-1** and illustrated on **Figure 3-1.** The geochemical parameters from DPT groundwater sampling are summarized in **Table 3-2.**

Details of the April 2021 DPT sampling were presented at the September 2021 KSCRT, and team consensus was reached to proceed with the IMWP to implement ISCR (Decision Item 2109-D35). A copy of the MLP/VAB Hot Spot 3 ADP from September 2021 includes CVOC

plume maps per interval and details regarding geochemical parameters and is provided in **Appendix B.**

To support the understanding of CVOC distribution in groundwater, Earth Volumetric Studio (EVS) was used to visualize the DPT data by using geostatistical analysis to interpolate the DPT concentration data to a three-dimensional (3-D) grid. Horizontal slices through the 3-D model were used to evaluate the distribution of CVOCs at different depths in groundwater and are provided in **Appendix C**. The 3-D model was used to identify potential injection intervals and the DPT locations and data used to estimate the distribution of CVOCs in groundwater greater than NADCs. The iso-concentration contours that define the NADC plumes, along with the DPT locations and data in the potential injection intervals, are provided in **Appendix D**.

3.3 SUMMARY OF CURRENT SITE CONDITIONS

The DPT site evaluation at Hot Spot 3 indicates that the extents of the NADC plumes vary per CVOC and depth. CVOC plumes are defined below.

- Shallow interval (land surface to 28 feet bls):
    - TCE: The NADC plume is approximately 10 feet in diameter from 5 to 9 feet bls and 14 to 18 feet bls. From 9 to 13 feet bls, the NADC plume is larger (approximately 20 feet in diameter) and has the greatest concentration (129,000 µg/L in MLPV-DPT0683), which may be indicative of DNAPL presence. TCE concentrations from 20 to 24 feet bls (maximum of 37 µg/L) are less than its NADC.
    - cDCE: The NADC plume area with depth is similar to TCE with the larger area (approximately 20 feet in diameter) in the 9 to 13 feet bls interval. Although the NADC plume area is less in the 14 to 18 feet bls interval, this plume includes the greatest cDCE concentrations (49,000 and 88,000 µg/L in MLPV-DPT0683 and MLPV-DPT0653, respectively). cDCE concentrations from 20 to 24 feet bls (maximum of 22 µg/L) are less than its NADC.
    - VC: The NADC plume is larger than the other CVOC plumes in the shallow interval and determines the areal extent of the treatment area, which is approximately 20 feet by 30 feet. The maximum VC concentration (21,000 µg/L in MLPV-DPT0653) is in the 14 to 18 feet bls interval. VC concentrations from 20 to 24 feet bls (maximum of 27 µg/L in MLPV-DPT0697) are less than its NADC.
- Intermediate interval (between 28 and 39) contained no CVOC concentrations above NADCs. Since the IM objective is to treat the NADC plume, this was eliminated as a targeted treatment interval.
- Deep interval (greater than 40 feet bls):
    - TCE: The NADC plume is approximately 20 feet in diameter with a maximum concentration (55,000 µg/L in MLPV-DPT0654) in the 43 to 47 feet bls interval. TCE

concentrations were less than its NADC from 48 to 58 feet bls except for one location (MLPV-DPT0696) from 54 to 58 feet bls where the TCE concentration was 1,300 µg/L. Note that MLPV-DPT0696 is located approximately 150 feet downgradient of the original source area.

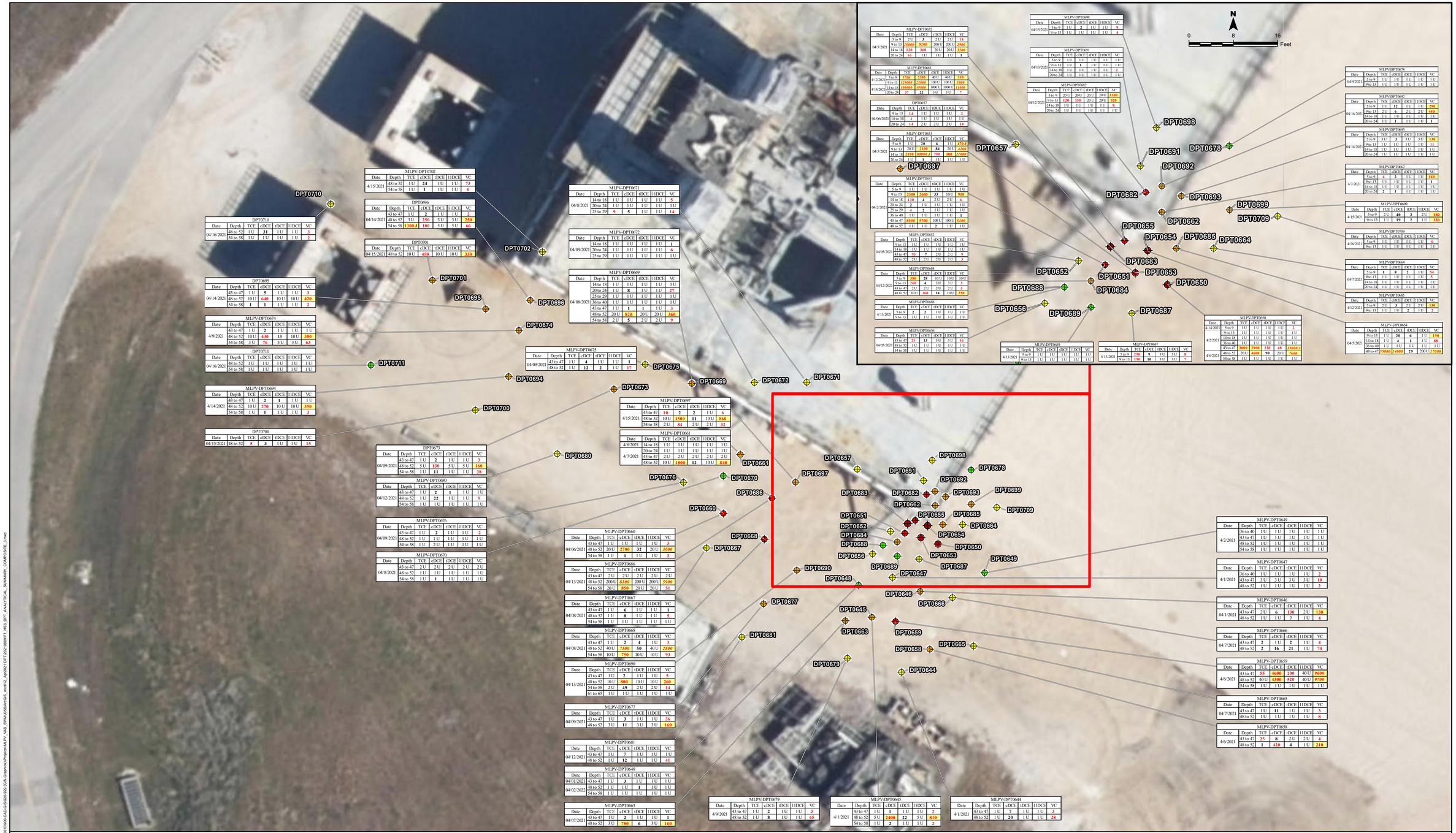
- cDCE: The NADC plume has multiple footprints from 43 to 58 feet bls. From 43 to 47 feet bls, two areas (20 feet and 10 feet diameter, respectively) are identified near the original source and an area approximately 30 feet south-southwest. The maximum cDCE concentration (14,000 µg/L in MLPV-DPT0654) is near the original source area from 43 to 47 feet bls. From 48 to 52 feet bls, the NADC plume expands downgradient to an area approximately 60 feet long by 40 feet wide. From 54 to 58 feet bls, the cDCE concentrations at MLPV-DPT0668 (750 µg/L) and MLPV-DPT0686 (850 µg/L) define a small NADC plume in the lower permeability silty sand.
- VC: Similar to cDCE, the VC NADC plume has multiple footprints from 43 to 52 feet bls. From 43 to 47 feet bls, two areas (20 feet and 15 feet diameter, respectively) are identified near the original source and an area approximately 30 feet south-southwest. The maximum VC concentration (17,000 µg/L in MLPV-DPT0654) is near the original source area from 43 to 47 feet bls. From 48 to 52 feet bls, the two NADC plumes expand the VC footprint downgradient to areas approximately 75 feet long by 60 feet wide and 90 feet long by 35 feet wide. VC concentrations from 54 to 58 feet bls (maximum of 93 µg/L in MLPV-DPT0668) are less than its NADC.

Results for TOC, sulfate/sulfide and dissolved gases are indicative of geochemical and redox conditions during enhanced reductive dechlorination (ERD) of the CVOCs following the injection of the electron donor in 2017. Sulfate concentrations ranged up to 1,200 mg/L and were generally less in shallow groundwater (above 28 feet bls) and greater in deeper groundwater (below 38 feet bls). The sulfate concentrations are high and can promote biooxidation of the electron donor by sulfate reducing bacteria, which can limit the availability of an electron donor that supports ERD. Reduction of sulfate resulted in detection of sulfide that ranged up to 130 mg/L at the same depth (43 to 47 feet bls) as the greatest sulfate concentrations. Detection and accumulation of sulfide in groundwater may have inhibited ERD and indicates the limited presence of iron in the aquifer that typically removes sulfide from groundwater as an iron sulfide precipitate.

The average TOC concentration of 117 mg/L and a maximum concentration of 2,800 mg/L (MLPV-DPT0658) indicate that electron donor is still present to support ERD following the 2017 injection. However, TOC concentrations were less in shallow groundwater (average of 17 mg/L), where CVOC concentrations are greatest. The greatest TOC concentrations were measured in groundwater from 43 to 47 feet bls, which is also the same depth interval for high sulfate and sulfide.

Detection of ethene in groundwater shows ERD is completely degrading CVOCs. The greatest ethene concentrations (maximum of 12,100 µg/L in MLPV-DPT0659) were measured in samples

from 43 to 47 and 48 to 52 feet bls, which is the same interval with greater TOC concentrations and sulfate/sulfide. Methane concentrations are high throughout the vertical interval of groundwater samples and the 2017 treatment interval, with an average of approximately 7 mg/L and a maximum of 16.4 mg/L (MLPV-DPT0651). The high methane concentrations indicate methanogenesis is very active and competing with ERD since methanogens consume the electron donor.



MLPV-DPT0702

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/15/2021	48 to 52	1 U	**24**	1 U	1 U	73
	54 to 58	1 U	**1**	1 U	1 U	4

DPT0096

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/14/2021	43 to 47	1 U	**2**	1 U	1 U	2
	48 to 52	3 U	**250**	3 U	3 U	250
	54 to 58	1300 J	100	5 U	5 U	66

DPT0710

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/16/2021	48 to 52	1 U	**31**	1 U	1 U	3
	54 to 58	1 U	1 U	1 U	1 U	2

DPT0701

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/15/2021	48 to 52	10 U	450	10 U	10 U	330

MLPV-DPT0671

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/8/2021	14 to 18	1 U	1 U	1 U	1 U	5
	20 to 24	1 U	1 U	1 U	1 U	1
	25 to 29	9	**5**	1 U	1 U	14

MLPV-DPT0672

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/09/2021	14 to 18	1 U	1 U	1 U	1 U	1
	20 to 24	1 U	1 U	1 U	1 U	6
	25 to 29	1 U	1 U	1 U	1 U	1 U

MLPV-DPT0669

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/08/2021	5 to 9	100	**2**	1 U	1 U	1 U
	14 to 18	1 U	1 U	1 U	1 U	1 U
	20 to 24	1 U	**8**	1 U	1 U	27
	25 to 29	1 U	1 U	1 U	1 U	1 U
	36 to 40	1 U	1 U	1 U	1 U	1 U
	43 to 47	1 U	**1**	1 U	1 U	3
	48 to 52	20 U	820	20 U	20 U	360
	54 to 58	2 U	**5**	2 U	2 U	9

MLPV-DPT0675

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/09/2021	43 to 47	1 U	**4**	1 U	1 U	**1**
	48 to 52	1 U	**12**	**2**	1 U	17

MLPV-DPT0695

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/14/2021	43 to 47	1 U	**5**	1 U	1 U	3
	48 to 52	10 U	640	10 U	10 U	420
	54 to 58	1	**1**	1 U	1 U	2

MLPV-DPT0674

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/9/2021	43 to 47	1 U	**2**	1 U	1 U	1 U
	48 to 52	10 U	430	**13**	10 U	380
	54 to 58	3 U	**76**	3 U	3 U	63

MLPV-DPT0711

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/16/2021	48 to 52	1 U	1 U	1 U	1 U	1 U
	54 to 58	1 U	1 U	1 U	1 U	1 U

MLPV-DPT0694

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/14/2021	43 to 47	1 U	**2**	**2**	1 U	1 U
	48 to 52	10 U	270	10 U	10 U	350
	54 to 58	1 U	**1**	1 U	1 U	3

DPT0700

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/15/2021	48 to 52	5	**3**	1 U	1 U	15

MLPV-DPT0697

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/15/2021	43 to 47	10	**2**	**2**	1 U	6
	48 to 52	10 U	1500	**11**	10 U	860
	54 to 58	2 U	**84**	2 U	2 U	32

MLPV-DPT0661

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/6/2021	14 to 18	1 U	1 U	1 U	1 U	1 U
	20 to 24	1 U	1 U	1 U	1 U	1 U
4/7/2021	43 to 47	2 U	2 U	2 U	2 U	2 U
	48 to 52	10 U	1800	**12**	10 U	840

DPT0673

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/09/2021	43 to 47	1 U	**2**	1 U	1 U	3
	48 to 52	5 U	130	5 U	5 U	160
	54 to 58	1 U	**11**	1 U	1 U	38

MLPV-DPT0680

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/12/2021	43 to 47	1 U	**2**	**1**	1 U	1 U
	48 to 52	1 U	**22**	1 U	1 U	5
	54 to 58	1 U	1 U	1 U	1 U	1 U

MLPV-DPT0676

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/09/2021	43 to 47	1 U	**2**	1 U	1 U	2
	48 to 52	1 U	1 U	1 U	1 U	1 U
	54 to 58	1 U	2 U	1 U	1 U	1 U

MLPV-DPT0670

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/8/2021	43 to 47	2 U	2 U	2 U	2 U	2 U
	48 to 52	1 U	1 U	1 U	1 U	1 U
	54 to 58	1 U	**1**	1 U	1 U	1 U

MLPV-DPT0660

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/06/2021	43 to 47	1 U	1 U	1 U	1 U	3
	48 to 52	20 U	2700	**32**	20 U	1400
	54 to 58	1 U	**1**	1 U	1 U	3

MLPV-DPT0686

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/13/2021	43 to 47	2 U	2 U	2 U	2 U	2 U
	48 to 52	200 U	4100	200 U	200 U	5900
	54 to 58	20 U	850	20 U	20 U	51

MLPV-DPT0667

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/08/2021	43 to 47	1 U	**6**	1 U	1 U	**1**
	48 to 52	1 U	**8**	1 U	1 U	5
	54 to 58	1 U	1 U	1 U	1 U	1 U

MLPV-DPT0668

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/08/2021	43 to 47	1 U	**2**	**4**	1 U	3
	48 to 52	40 U	7100	**50**	40 U	2800
	54 to 58	10 U	750	10 U	10 U	93

MLPV-DPT0690

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/13/2021	43 to 47	1 U	**2**	1 U	1 U	5
	48 to 52	10 U	800	10 U	10 U	260
	54 to 58	2 U	**49**	2 U	2 U	14
	61 to 65	1 U	1 U	1 U	1 U	1 U

MLPV-DPT0677

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/09/2021	43 to 47	1 U	**3**	1 U	1 U	36
	48 to 52	3 U	**11**	3 U	3 U	160

MLPV-DPT0681

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/12/2021	43 to 47	1 U	7	1 U	1 U	1 U
	48 to 52	1 U	**12**	1 U	1 U	41

MLPV-DPT0648

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/01/2021	43 to 47	1 U	**3**	1 U	1 U	1 U
04/02/2022	48 to 52	1 U	1 U	**1**	1 U	1 U
	54 to 58	1 U	1 U	1 U	1 U	1 U

MLPV-DPT0663

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/07/2021	43 to 47	1 U	**2**	1 U	1 U	**1**
	48 to 52	3 U	780	**6**	3 U	160

MLPV-DPT0655

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/5/2021	5 to 9	2 U	**3**	2 U	2 U	14
	9 to 13	2600	8200	200 U	200 U	2900
	14 to 18	120	360	20 U	20 U	1200
	20 to 24	16	1 U	1 U	1 U	**1**

MLPV-DPT0683

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/12/2021	5 to 9	1700	2300	40 U	40 U	310
	9 to 13	27000	21000	100 U	100 U	1000
4/14/2021	14 to 18	18000	49000	1000 U	1000 U	11000
	20 to 24	37	**22**	3 U	3 U	7

DPT0657

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/06/2021	9 to 13	14	1 U	1 U	1 U	3
	14 to 18	**1**	1 U	1 U	1 U	1 U
	20 to 24	14	2 U	2 U	2 U	14

MLPV-DPT0653

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/5/2021	5 to 9	1 U	**20**	**6**	1 U	470 J
	9 to 13	20 U	3100	**84**	20 U	2300
	14 to 18	2100	48000 J	790	100	21000
	20 to 24	1 U	**1**	1 U	1 U	1 U

MLPV-DPT0651

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/2/2021	5 to 9	1 U	1 U	1 U	1 U	1 U
	9 to 13	2300	2600	33	10 U	910
	14 to 18	130	**4**	2 U	2 U	6
	20 to 24	**2**	1 U	1 U	1 U	1 U
	25 to 29	**4**	**2**	1 U	1 U	1 U
	36 to 40	1 U	1 U	1 U	1 U	**1**
	43 to 47	4900	5700	100 U	100 U	5400
	48 to 52	1 U	1 U	**2**	1 U	1 U

MLPV-DPT0652

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/05/2021	9 to 13	1 U	1 U	1 U	1 U	1 U
	14 to 18	1 U	1 U	1 U	1 U	1 U
	43 to 47	93	7	2 U	2 U	8
	48 to 52	2 U	2 U	2 U	2 U	**3**

MLPV-DPT0684

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/12/2021	5 to 9	100	**28**	10 U	10 U	10 U
	9 to 13	260	**4**	3 U	3 U	3
	43 to 47	2 U	2 U	2 U	2 U	3
	48 to 52	10 U	360	**14**	10 U	250

MLPV-DPT0688

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/13/2021	5 to 9	**2**	**2**	1 U	1 U	1 U
	9 to 13	1 U	1 U	1 U	1 U	1 U

MLPV-DPT0656

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/05/2021	43 to 47	11	**13**	3 U	3 U	16
	48 to 52	1 U	1 U	1 U	1 U	1 U
	54 to 58	1 U	1 U	1 U	1 U	1 U

MLPV-DPT0608

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/15/2021	5 to 9	1 U	**2**	1 U	1 U	9
	9 to 13	1 U	1 U	1 U	1 U	4

MLPV-DPT0691

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/13/2021	5 to 9	1 U	1 U	1 U	1 U	1 U
	9 to 13	1 U	**1**	1 U	1 U	1 U
	14 to 18	1 U	1 U	1 U	1 U	**2**
	20 to 24	1 U	1 U	1 U	1 U	1 U

MLPV-DPT0662

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/12/2021	5 to 9	20 U	20 U	20 U	20 U	1100
	9 to 13	120	150	20 U	20 U	920
	14 to 18	1 U	1 U	1 U	1 U	**8**
	20 to 24	1 U	1 U	1 U	1 U	1 U

MLPV-DPT0699

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/13/2021	5 to 9	1 U	1 U	1 U	1 U	1 U
	9 to 13	1 U	1 U	1 U	1 U	1 U

MLPV-DPT0687

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/13/2021	5 to 9	150	**9**	1 U	3 U	**8**
	9 to 13	190	**10**	1 U	3 U	7

MLPV-DPT0650

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/14/2021	5 to 9	1 U	1 U	1 U	1 U	**2**
	9 to 13	1 U	1 U	1 U	1 U	1 U
	14 to 18	1 U	1 U	1 U	1 U	1 U
	36 to 40	1 U	1 U	1 U	1 U	1 U
4/2/2021	43 to 47	3000	2900	220	48	15000 J
	48 to 52	20 U	4600	**90**	20 U	7600
	54 to 58	1 U	1 U	1 U	1 U	1 U

MLPV-DPT0678

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/9/2021	5 to 9	1 U	1 U	1 U	1 U	1 U
	9 to 13	1 U	1 U	1 U	1 U	1 U

MLPV-DPT0692

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/14/2021	5 to 9	1 U	**12**	1 U	1 U	290
	9 to 13	2 U	**6**	2 U	2 U	440
	14 to 18	1 U	1 U	1 U	1 U	11
	20 to 24	1 U	**1**	1 U	1 U	**1**

MLPV-DPT0693

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/14/2021	5 to 9	3 U	**3**	3 U	3 U	130
	9 to 13	1 U	1 U	1 U	1 U	11
	14 to 18	1 U	1 U	1 U	1 U	1 U
	20 to 24	1 U	1 U	1 U	1 U	1 U

MLPV-DPT0662

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/7/2021	5 to 9	**4**	**2**	1 U	1 U	140
	9 to 13	1 U	1 U	1 U	1 U	**1**
	14 to 18	1 U	1 U	1 U	1 U	1 U
	20 to 24	**2**	1 U	1 U	1 U	1 U

MLPV-DPT0699

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/15/2021	5 to 9	2 U	**40**	**3**	2 U	180
	9 to 13	1 U	**19**	**2**	1 U	130

MLPV-DPT0709

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/16/2021	5 to 9	1 U	1 U	1 U	1 U	6
	9 to 13	1 U	1 U	1 U	1 U	1 U

MLPV-DPT0664

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/7/2021	5 to 9	**1**	**8**	**2**	1 U	54
	9 to 13	1 U	1 U	1 U	1 U	5
	14 to 18	1 U	1 U	1 U	1 U	1 U
	20 to 24	1 U	1 U	1 U	1 U	1 U

MLPV-DPT0685

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/12/2021	5 to 9	1 U	**3**	1 U	1 U	130
	9 to 13	1 U	1 U	**2**	1 U	**2**

MLPV-DPT0654

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/5/2021	9 to 13	1 U	**20**	**6**	1 U	190
	14 to 18	1 U	**4**	**1**	1 U	88
	36 to 40	1 U	1 U	1 U	1 U	1 U
	43 to 47	5000 J	4000	**29**	200 U	7000

MLPV-DPT0649

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/2/2021	36 to 40	1 U	1 U	1 U	1 U	1 U
	43 to 47	1 U	1 U	1 U	1 U	1 U
	48 to 52	1 U	1 U	1 U	1 U	1 U
	54 to 58	1 U	1 U	1 U	1 U	1 U

MLPV-DPT0647

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/1/2021	36 to 40	1 U	1 U	1 U	1 U	**2**
	43 to 47	3 U	3 U	3 U	3 U	10
	48 to 52	1 U	1 U	1 U	1 U	**2**

MLPV-DPT0646

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/1/2021	43 to 47	2 U	**6**	130	2 U	130
	48 to 52	1 U	1 U	**7**	1 U	4

MLPV-DPT0666

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/7/2021	43 to 47	**2**	1 U	**2**	1 U	4
	48 to 52	**2**	**16**	**21**	1 U	74

MLPV-DPT0659

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/6/2021	43 to 47	55	4600	200	40 U	9000
	48 to 52	40 U	4300	520	40 U	9700
	54 to 58	1 U	1 U	1 U	1 U	1 U

MLPV-DPT0665

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/7/2021	43 to 47	1 U	**11**	1 U	1 U	**3**
	48 to 52	1 U	1 U	1 U	1 U	**8**

MLPV-DPT0658

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/6/2021	43 to 47	25	**8**	2 U	2 U	4
	48 to 52	**1**	420	**4**	1 U	210

MLPV-DPT0679

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/9/2021	43 to 47	1 U	**1**	1 U	1 U	3
	48 to 52	1 U	**8**	1 U	1 U	65

MLPV-DPT0645

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/1/2021	43 to 47	1 U	**1**	1 U	1 U	2
	48 to 52	5 U	2400	**22**	5 U	810
	54 to 58	1 U	**2**	1 U	1 U	2

MLPV-DPT0644

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/1/2021	43 to 47	1 U	**7**	1 U	1 U	3
	48 to 52	1 U	**20**	1 U	1 U	28

Legend

- DPT sampling location
- Monitoring well location (screen interval (ft bls)) (most recent VC concentration (µg/L))
- 1 µg/L VC isopleth (dashed where inferred)
- 100 µg/L VC isopleth (dashed where inferred)
- 1,000 µg/L VC isopleth

Symbology Color Coding

- CVOC concentration less than or equal to GCTLs
- CVOC concentration greater than GCTLs
- CVOC concentration greater than NADCs and less than or equal to 10xNADC
- CVOC concentration greater than 10xNADC
- CVOC concentration greater than 100xNADC
- CVOC detection limit greater than GCTLs
- Sample not collected at this interval

Notes:
1. Concentrations are in micrograms per liter (µg/L)
2. U = Indicates that the analyte was undetected
3. I= Indicates the analyte was detected but below the reporting limit; therefore, an estimated value
4. Q = Results from run #2
5. **Bold** indicates a detected value
6. **Red bold font** indicates an exceedance of FDEP GCTLs
7. **Highlighted Red bold font** indicates an exceedance of FDEP NADCs
8. ***Highlighted Red italic font*** indicates an exceedance of FDEP 10xNADCs
9. bls = below land surface
10. GCTL = Groundwater Cleanup Target Levels as provided in 62-777, F.A.C.
11. NADC = Natural Attenuation Default Concentration as provided in 62-777, F.A.C.
12. MLP/VAB = Mobile Launcher Platform Rehabilitation Sites / Vehicle Assembly Building Area
13. SWMU = Solid Waste Management Unit
14. Aerial Source: FDOT 2018

Abbreviation	Analyte	GCTL	NADC
TCE	Trichloroethene	3	300
cDCE	1,1-Dichloroethene	70	700
11DCE	cis-1,2-Dichloroethene	7	70
tDCE	trans-Dichloroethene	100	1000
VC	Vinyl Chloride	1	100

Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

N
0 15 30 Feet

FIGURE 3-1
Hot Spot 3 DPT Sampling Locations 2021

Hot Spot 3
MLP/VAB (SWMU 056)
NASA Kennedy Space Center, Florida

Date Saved: 8/10/2021
Document Path: P:\CICP\Projects\NYNAS\AECOM\SOW\19\50\19\50-CAD-GIS\50-529\GIS-Graphics\1Projects\MLPV_VAB_SWMU056\ArcGIS_mxd\12_Apr2021 DPT\2021\069\F1_HS3_DPT_ANALYTICAL_SUMMARY_COMPOSITE_3.mxd

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Table 3-1
DPT Groundwater Analytical Results: Chlorinated Volatile Organic Compounds
Mobile Launcher Platform Rehabilitation Sites / Vehicle Assembly Building Area (MLP/VAB): Hot Spot 3

		Category	Volatile Organic Compounds (VOCs) by Method 8260					
		Analyte	TETRACHLOROETHENE	TRICHLOROETHENE	CIS-1,2-DICHLOROETHENE	TRANS-1,2-DICHLOROETHENE	1,1-DICHLOROETHENE	VINYL CHLORIDE
State of Florida GCTLs (µg/L)			3	3	70	100	7	1
State of Florida NADCs (µg/L)			300	300	700	1000	70	100
Location ID	Sample Date	Sample Depth (feet bls)						
MLPV-DPT0644	4/1/2021	43 to 47	1 U	1 U	7	1 U	1 U	3
		48 to 52	1 U	1 U	20	1 U	1 U	28
MLPV-DPT0645	4/1/2021	43 to 47	1 U	1 U	1	1 U	1 U	2
		48 to 52	1 U	1 U	2400	22	1 U	810
		54 to 58	1 U	1 U	2	1 U	1 U	2
MLPV-DPT0646	4/1/2021	43 to 47	2 U	2 U	6	130	2 U	130
		48 to 52	1 U	1 U	1 U	7	1 U	4
MLPV-DPT0647	4/1/2021	36 to 40	1 U	1 U	1 U	1 U	1 U	2
		43 to 47	3 U	3 U	3 U	3 U	3 U	10
		48 to 52	1 U	1 U	1 U	1 U	1 U	2
MLPV-DPT0648	4/1/2021	43 to 47	1 U	1 U	3	1 U	1 U	1 U
	4/2/2021	48 to 52	1 U	1 U	1 U	1	1 U	1 U
		54 to 58	1 U	1 U	1 U	1 U	1 U	1 U
MLPV-DPT0649	4/2/2021	36 to 40	1 U	1 U	1 U	1 U	1 U	1 U
		43 to 47	1 U	1 U	1 U	1 U	1 U	1 U
		48 to 52	1 U	1 U	1 U	1 U	1 U	1 U
		54 to 58	1 U	1 U	1 U	1 U	1 U	1 U
MLPV-DPT0650	4/14/2021	5 to 9	1 U	1 U	1 U	1 U	1 U	2
	4/2/2021	9 to 13	1 U	1 U	1 U	1 U	1 U	1 U
		14 to 18	1 U	1 U	1 U	1 U	1 U	1 U
		36 to 40	1 U	1 U	1 U	1 U	1 U	1 U
		43 to 47	20 U	3000	2900	220	48	15000 J
		DUP	100 U	2800	2600	200	100 U	15400
	4/6/2021	48 to 52	20 U	20 U	4600	90	20 U	7600
		54 to 58	1 U	1 U	1 U	1 U	1 U	1 U
MLPV-DPT0651	4/2/2021	5 to 9	1 U	1 U	1 U	1 U	1 U	1 U
		9 to 13	10 U	2300	2600	33	10 U	910
		14 to 18	2 U	130	4	2 U	2 U	6
		20 to 24	1 U	2	1 U	1 U	1 U	1 U
		25 to 29	1 U	4	2	1 U	1 U	1 U
		36 to 40	1 U	1 U	1 U	1 U	1 U	1
		43 to 47	100 U	8900	5700	100 U	100 U	5400
		48 to 52	1 U	1 U	1 U	2	1 U	1 U
MLPV-DPT0652	4/5/2021	9 to 13	1 U	1 U	1 U	1 U	1 U	1 U
		14 to 18	1 U	1 U	1 U	1 U	1 U	1 U
		43 to 47	2 U	93	7	2 U	2 U	9
		48 to 52	2 U	2 U	2 U	2 U	2 U	3
MLPV-DPT0653	4/5/2021	5 to 9	1 U	1 U	20	6	1 U	470 J
		DUP	2 U	2 U	19	6	2 U	430
		9 to 13	20 U	20 U	2100	84	20 U	4200
		14 to 18	100 U	2100	88000 J	790	100	21000
		36 to 40	1 U	1 U	1	1 U	1 U	1 U
MLPV-DPT0654	4/5/2021	9 to 13	1 U	1 U	20	6	1 U	190
		14 to 18	1 U	1 U	4	1	1 U	88
		36 to 40	1 U	1 U	1 U	1 U	1 U	1 U
		43 to 47	200 U	55000	14000	29	200 U	17000
MLPV-DPT0655	4/5/2021	5 to 9	2 U	2 U	3	2 U	2 U	14
		9 to 13	200 U	25000	5200	220	200 U	2900
		14 to 18	20 U	120	360	20 U	20 U	3200
		20 to 24	1 U	16	1 U	1 U	1 U	1
MLPV-DPT0656	4/5/2021	43 to 47	3 U	21	13	3 U	3 U	16
		48 to 52	1 U	1 U	1 U	1 U	1 U	1 U
		54 to 58	1 U	1 U	1 U	1 U	1 U	1 U
MLPV-DPT0657	4/6/2021	9 to 13	1 U	11	1 U	1 U	1 U	2
		DUP	1 U	14	1 U	1 U	1 U	3
		14 to 18	1 U	1	1 U	1 U	1 U	1 U
		20 to 24	2 U	14	2 U	2 U	2 U	14

Table 3-1
DPT Groundwater Analytical Results: Chlorinated Volatile Organic Compounds
Mobile Launcher Platform Rehabilitation Sites / Vehicle Assembly Building Area (MLP/VAB): Hot Spot 3

		Category	Volatile Organic Compounds (VOCs) by Method 8260					
		Analyte	TETRACHLOROETHENE	TRICHLOROETHENE	CIS-1,2-DICHLOROETHENE	TRANS-1,2-DICHLOROETHENE	1,1-DICHLOROETHENE	VINYL CHLORIDE
State of Florida GCTLs (µg/L)			3	3	70	100	7	1
State of Florida NADCs (µg/L)			300	300	700	1000	70	100
Location ID	Sample Date	Sample Depth (feet bls)						
MLPV-DPT0658	4/6/2021	43 to 47	2 U	25	8	2 U	2 U	4
		48 to 52	1 U	1	420	4	1 U	210
MLPV-DPT0659	4/6/2021	43 to 47	40 U	55	4600	200	40 U	9000
		48 to 52	40 U	40 U	4300	520	40 U	9700
		54 to 58	1 U	1 U	1 U	1 U	1 U	1 U
MLPV-DPT0660	4/6/2021	43 to 47	1 U	1 U	1 U	4	1 U	3
		48 to 52	20 U	20 U	2700	32	20 U	3000
		54 to 58	1 U	1 U	1	1 U	1 U	3
MLPV-DPT0661	4/6/2021	14 to 18	1 U	1 U	1 U	1 U	1 U	1 U
	4/7/2021	20 to 24	1 U	1 U	1 U	1 U	1 U	1 U
		43 to 47	2 U	2 U	2 U	2 U	2 U	2 U
		48 to 52	10 U	10 U	1600	12	10 U	770
		DUP	10 U	10 U	1800	13	10 U	840
MLPV-DPT0662	4/7/2021	5 to 9	1 U	4	2	1 U	1 U	140
		9 to 13	1 U	1 U	1 U	1 U	1 U	1
		14 to 18	1 U	1 U	1 U	1 U	1 U	1 U
		20 to 24	1 U	2	1	1 U	1 U	1 U
MLPV-DPT0663	4/7/2021	43 to 47	1 U	1 U	2	1 U	1 U	1
		48 to 52	3 U	3 U	780	6	3 U	160
MLPV-DPT0664	4/7/2021	5 to 9	1 U	1	8	2	1 U	54
		9 to 13	1 U	1 U	1 U	1 U	1 U	5
		14 to 18	1 U	1 U	1 U	1 U	1 U	1 U
		20 to 24	1 U	1 U	1 U	1 U	1 U	1 U
MLPV-DPT0665	4/7/2021	43 to 47	1 U	1 U	11	1 U	1 U	3
		48 to 52	1 U	1 U	1 U	1 U	1 U	8
MLPV-DPT0666	4/7/2021	43 to 47	1 U	2	1 U	2	1 U	4
		48 to 52	1 U	2	16	21	1 U	74
MLPV-DPT0667	4/8/2021	43 to 47	1 U	1 U	6	1 U	1 U	1
		48 to 52	1 U	1 U	8	1 U	1 U	4
		DUP	1 U	1 U	8	1 U	1 U	5
		54 to 58	1 U	1 U	1 U	1 U	1 U	1 U
MLPV-DPT0668	4/8/2021	43 to 47	1 U	1 U	2	4	1 U	3
		48 to 52	40 U	40 U	7100	50	40 U	2800
		54 to 58	10 U	10 U	750	10 U	10 U	93
MLPV-DPT0669	4/8/2021	14 to 18	1 U	1 U	1 U	1 U	1 U	1 U
		20 to 24	1 U	1 U	8	1 U	1 U	27
		25 to 29	1 U	1 U	1 U	1 U	1 U	1 U
		36 to 40	1 U	1 U	1 U	1 U	1 U	1 U
		43 to 47	1 U	1 U	1	1	1 U	3
		48 to 52	20 U	20 U	820	20 U	20 U	360
		54 to 58	2 U	2 U	5	2 U	2 U	9
MLPV-DPT0670	4/8/2021	43 to 47	2 U	2 U	2 U	2 U	2 U	2 U
		48 to 52	1 U	1 U	1 U	1 U	1 U	1 U
		54 to 58	1 U	1 U	1	1 U	1 U	1 U
MLPV-DPT0671	4/8/2021	14 to 18	1 U	1 U	1 U	1 U	1 U	5
		20 to 24	1 U	1 U	1 U	1 U	1 U	1 U
		25 to 29	1 U	9	5	1 U	1 U	14
MLPV-DPT0672	4/8/2021	14 to 18	1 U	1 U	1 U	1 U	1 U	1
	4/9/2021	20 to 24	1 U	1 U	1 U	1 U	1 U	6
		25 to 29	1 U	1 U	1 U	1 U	1 U	1 U
MLPV-DPT0673	4/9/2021	43 to 47	1 U	1 U	2	1 U	1 U	3
		48 to 52	5 U	5 U	130	5 U	5 U	160
		DUP	5 U	5 U	130	5 U	5 U	180
		54 to 58	1 U	1 U	11	1 U	1 U	38
MLPV-DPT0674	4/9/2021	43 to 47	1 U	1 U	2	1 U	1 U	1 U
		48 to 52	10 U	10 U	430	13	10 U	380
		54 to 58	3 U	3 U	76	3 U	3 U	63

Table 3-1
DPT Groundwater Analytical Results: Chlorinated Volatile Organic Compounds
Mobile Launcher Platform Rehabilitation Sites / Vehicle Assembly Building Area (MLP/VAB): Hot Spot 3

		Category	Volatile Organic Compounds (VOCs) by Method 8260					
		Analyte	TETRACHLOROETHENE	TRICHLOROETHENE	CIS-1,2-DICHLOROETHENE	TRANS-1,2-DICHLOROETHENE	1,1-DICHLOROETHENE	VINYL CHLORIDE
State of Florida GCTLs (µg/L)			3	3	70	100	7	1
State of Florida NADCs (µg/L)			300	300	700	1000	70	100
Location ID	Sample Date	Sample Depth (feet bls)						
MLPV-DPT0675	4/9/2021	43 to 47	1 U	1 U	4	1 U	1 U	1
		48 to 52	1 U	1 U	12	2	1 U	17
MLPV-DPT0676	4/9/2021	43 to 47	1 U	1 U	2	1 U	1 U	2
		48 to 52	1 U	1 U	1 U	1 U	1 U	1 U
		54 to 58	1 U	1 U	1 U	1 U	1 U	1 U
MLPV-DPT0677	4/9/2021	43 to 47	1 U	1 U	3	1 U	1 U	36
		48 to 52	3 U	3 U	11	3 U	3 U	160
MLPV-DPT0678	4/9/2021	5 to 9	1 U	1 U	1 U	1 U	1 U	1 U
		9 to 13	1 U	1 U	1 U	1 U	1 U	1 U
MLPV-DPT0679	4/9/2021	43 to 47	1 U	1 U	2	1 U	1 U	3
		48 to 52	1 U	1 U	8	1 U	1 U	65
MLPV-DPT0680	4/12/2021	43 to 47	1 U	1 U	2	1	1 U	1 U
		DUP	1 U	1 U	2	1 U	1 U	1 U
		48 to 52	1 U	1 U	22	1 U	1 U	5
		54 to 58	1 U	1 U	1 U	1 U	1 U	1 U
MLPV-DPT0681	4/12/2021	43 to 47	1 U	1 U	7	1 U	1 U	1 U
		48 to 52	1 U	1 U	12	1 U	1 U	41
MLPV-DPT0682	4/12/2021	5 to 9	20 U	20 U	20 U	20 U	20 U	1100
		9 to 13	20 U	120	150	20 U	20 U	920
	4/14/2021	14 to 18	1 U	1 U	1 U	1 U	1 U	8
		20 to 24	1 U	1 U	1 U	1 U	1 U	1 U
MLPV-DPT0683	4/12/2021	5 to 9	40 U	5700	2300	40 U	40 U	310
		9 to 13	100 U	129000	25000	100 U	100 U	3000
	4/14/2021	14 to 18	1000 U	100000	49000	1000 U	1000 U	11000
		20 to 24	3 U	37	22	3 U	3 U	7
MLPV-DPT0684	4/12/2021	5 to 9	10 U	380	28	10 U	10 U	10 U
		9 to 13	3 U	260	4	3 U	3 U	3
		43 to 47	2 U	2 U	2 U	2 U	2 U	3
		48 to 52	10 U	10 U	360	14	10 U	250
MLPV-DPT0685	4/12/2021	5 to 9	2 U	2 U	3	2 U	2 U	130
		9 to 13	1 U	1 U	1 U	2	1 U	2
MLPV-DPT0686	4/13/2021	43 to 47	2 U	2 U	2 U	2 U	2 U	2 U
		48 to 52	200 U	200 U	8100	200 U	200 U	5900
		DUP	100 U	100 U	7700	100 U	100 U	5700
		54 to 58	20 U	20 U	850	20 U	20 U	51
MLPV-DPT0687	4/13/2021	5 to 9	3 U	250	9	3 U	3 U	8
		9 to 13	3 U	190	10	3 U	3 U	7
MLPV-DPT0688	4/13/2021	5 to 9	1 U	2	2	1 U	1 U	1 U
		9 to 13	1 U	1 U	1 U	1 U	1 U	1 U
MLPV-DPT0689	4/13/2021	5 to 9	1 U	1 U	1 U	1 U	1 U	1 U
		9 to 13	1 U	1 U	1 U	1 U	1 U	1 U
MLPV-DPT0690	4/13/2021	43 to 47	1 U	1 U	2	1 U	1 U	5
		48 to 52	10 U	10 U	800	10 U	10 U	260
		54 to 58	2 U	2 U	49	2 U	2 U	14
		61 to 65	1 U	1 U	1 U	1 U	1 U	1 U
MLPV-DPT0691	4/13/2021	5 to 9	1 U	1 U	1 U	1 U	1 U	1 U
		9 to 13	1 U	1 U	1	1 U	1 U	1 U
		14 to 18	1 U	1 U	1 U	1 U	1 U	2
		20 to 24	1 U	1 U	1 U	1 U	1 U	1 U
MLPV-DPT0692	4/14/2021	5 to 9	1 U	1 U	12	1 U	1 U	280 J
		DUP	2 U	2 U	11	2 U	2 U	290
		9 to 13	2 U	2 U	6	2 U	2 U	440
		14 to 18	1 U	1 U	1 U	1 U	1 U	1 U
		20 to 24	1 U	1 U	1	1 U	1 U	1
MLPV-DPT0693	4/14/2021	5 to 9	3 U	3 U	4	3 U	3 U	130
		9 to 13	1 U	1 U	1 U	1 U	1 U	11
		14 to 18	1 U	1 U	1 U	1 U	1 U	1 U
		20 to 24	1 U	1 U	1 U	1 U	1 U	1 U

Table 3-1
DPT Groundwater Analytical Results: Chlorinated Volatile Organic Compounds
Mobile Launcher Platform Rehabilitation Sites / Vehicle Assembly Building Area (MLP/VAB): Hot Spot 3

		Category	Volatile Organic Compounds (VOCs) by Method 8260					
		Analyte	TETRACHLOROETHENE	TRICHLOROETHENE	CIS-1,2-DICHLOROETHENE	TRANS-1,2-DICHLOROETHENE	1,1-DICHLOROETHENE	VINYL CHLORIDE
State of Florida GCTLs (µg/L)			3	3	70	100	7	1
State of Florida NADCs (µg/L)			300	300	700	1000	70	100
Location ID	Sample Date	Sample Depth (feet bls)						
MLPV-DPT0694	4/14/2021	43 to 47	1 U	1 U	**2**	**1**	1 U	1 U
		48 to 52	10 U	10 U	**270**	10 U	10 U	**350**
		54 to 58	1 U	1 U	**1**	1 U	1 U	**3**
MLPV-DPT0695	4/14/2021	43 to 47	1 U	1 U	**5**	1 U	1 U	**3**
		48 to 52	10 U	10 U	**640**	10 U	10 U	**420**
		54 to 58	1 U	**1**	**1**	1 U	1 U	**2**
MLPV-DPT0696	4/14/2021	43 to 47	1 U	1 U	**2**	1 U	1 U	**2**
		48 to 52	3 U	3 U	**250**	3 U	3 U	**250**
		54 to 58	5 U	**1300 J**	**100**	5 U	5 U	**66**
		DUP	10 U	**1300**	**95**	10 U	10 U	**59**
MLPV-DPT0697	4/15/2021	43 to 47	1 U	**10**	**2**	**2**	1 U	**6**
		48 to 52	10 U	10 U	**1500**	**11**	10 U	**860**
		54 to 58	1 U	1 U	**84**	1 U	1 U	**32**
MLPV-DPT0698	4/15/2021	5 to 9	1 U	1 U	**2**	1 U	1 U	**9**
		9 to 13	1 U	1 U	1 U	1 U	1 U	**4**
MLPV-DPT0699	4/15/2021	5 to 9	2 U	2 U	**40**	**3**	2 U	**180**
		9 to 13	1 U	1 U	**19**	**2**	1 U	**130**
MLPV-DPT0700	4/15/2021	48 to 52	1 U	**5**	**3**	1 U	1 U	**15**
MLPV-DPT0701	4/15/2021	48 to 52	10 U	10 U	**450**	10 U	10 U	**330**
MLPV-DPT0702	4/15/2021	48 to 52	1 U	1 U	**24**	1 U	1 U	**73**
		54 to 58	1 U	1 U	**1**	1 U	1 U	**4**
MLPV-DPT0709	4/16/2021	5 to 9	1 U	1 U	1 U	1 U	1 U	**6**
		9 to 13	1 U	1 U	1 U	1 U	1 U	1 U
MLPV-DPT0710	4/16/2021	48 to 52	1 U	1 U	**31**	1 U	1 U	**3**
		54 to 58	1 U	1 U	1 U	1 U	1 U	**2**
MLPV-DPT0711	4/16/2021	48 to 52	1 U	1 U	1 U	1 U	1 U	1 U
		54 to 58	1 U	1 U	1 U	1 U	1 U	1 U

Notes:
Bolded results indicate the presence of an analyte at the specified concentration.
Red font indicates an exceedance of FDEP GCTLs or Site Approved Target Levels for UIC sampling.
Yellow highlighted cell indicates an exceedance of FDEP NADCs.
Blank cells indicate the analyte was not analyzed for that specific well and date.
bls = below land surface
DPT = direct push technology
DUP = duplicate
FDEP = Florida Department of Environmental Protection
GCTL = Groundwater Cleanup Target Level, Chapter 62-777 Florida Administrative Code, Table 1 (2005)
NADC = Natural Attenuation Default Concentration, Chapter 62-777 Florida Administrative Code, Table V (April 2005)
J = An estimated value
µg/L = micrograms per liter
U = The analyte was not detected
UIC = Underground Injection Control
"MLPV-" is the prefix used for identifying the site within the Remediation Information System database.

Table 3-2
DPT Groundwater Analytical Results: Dissolved Gases, Sulfate, Sulfide, and Total Organic Carbon
Mobile Launcher Platform Rehabilitation Sites / Vehicle Assembly Building Area (MLP/VAB): Hot Spot 3

		Category	General Chemistry			Dissolved Gases		
		Analyte	SULFATE	SULFIDE	TOTAL ORGANIC CARBON	ETHANE	ETHENE	METHANE
		State of Florida GCTLs (µg/L)	250000	-	-	-	-	-
		State of Florida NADCs (µg/L)	2500000	-	-	-	-	-
Location ID	Sample Date	Depth (feet bls)						
MLPV-DPT0644	4/1/2021	43 to 47	**1200000**	**5100**	**19000**	5.10 U	5.10 U	**230**
		48 to 52	**490000**	**480 I**	**12000**	5.10 U	**23.5**	**5200**
MLPV-DPT0645	4/1/2021	48 to 52	**370000**	**1400**	**11000**	5.10 U	**1160**	**8590**
MLPV-DPT0646	4/1/2021	43 to 47	**570000**	**120000**	**31000**	5.10 U	**5490**	**10200**
MLPV-DPT0650	4/6/2021	43 to 47	**1100000**	**52000**	**130000**	**18.3**	**4740**	**5500**
		48 to 52	**440000**	**2700**	**16000**	5.10 U	**128**	**177**
MLPV-DPT0651	4/2/2021	9 to 11	**17000**	**800 I**	**22000**	**123**	**65.3**	**16400**
	4/7/2021	25 to 29	**8800**	**14000**	**15000**	5.10 U	5.10 U	**7330**
	4/2/2021	36 to 40	**73000**	**39000**	**150000**	5.10 U	**13.2**	**9200**
		43 to 47	**9800 I**	**78000**	**850000**	5.10 U	**409**	**7690**
		48 to 52	**3200 I**	**2100**	**28000**	5.10 U	5.10 U	**7120**
MLPV-DPT0653	4/5/2021	9 to 11	**1800 I**	450 U	**22000**	**648**	**791**	**7970 J**
MLPV-DPT0654	4/5/2021	9 to 11	**1900 I**	**2100**	**28000**	**100**	**16.0**	**10600**
		14 to 18	**1500 I**	**2400**	**19000**	5.10 U	5.10 U	**602**
		36 to 40	**18000**	**4300**	**12000**	5.10 U	5.10 U	**7490**
MLPV-DPT0655	4/5/2021	9 to 11	**2200 I**	**2400**	**16000**	**115**	**386**	**12300**
		14 to 18	**3400 I**	**3400**	**51000**	**451**	**620**	**9820**
		20 to 24	**15000**	**17000**	**7100**	5.10 U	5.10 U	**13400**
MLPV-DPT0656	4/5/2021	43 to 47	**7900 I**	**130000**	**370000 V**	**97.9**	**6060**	**6400**
		48 to 52	130 U	**2700**	**81000**	**13.9**	**26.9**	**6370**
		54 to 58	66 U	**1100**	**28000**	5.10 U	5.10 U	**10200**
MLPV-DPT0658	4/6/2021	43 to 47	**9900 I**	**54000**	**2800000**	**9.11**	**167**	**10100**
		48 to 52	**230000**	**1800**	**13000**	5.10 U	**11.5**	**8580**
MLPV-DPT0659	4/6/2021	43 to 47	**1100000**	**14000**	**23000**	5.10 U	**295**	**7680**
		48 to 52	**51000**	**16000**	**50000 V**	**11.4**	**12100**	**3680**
MLPV-DPT0660	4/6/2021	48 to 52	**340000**	**960 I**	**14000**	**17.4**	**592**	**6950**
MLPV-DPT0662	4/7/2021	5 to 9	**3700 I**	**920 I**	**11000**	**66.8**	**32.8**	**11100**
MLPV-DPT0663	4/7/2021	48 to 52	**360000**	**600 I**	**11000**	5.10 U	**266**	**2450**
MLPV-DPT0667	4/8/2021	48 to 52	**530000**	**1200**	**14000**	5.10 U	5.10 U	**200**
MLPV-DPT0668	4/8/2021	48 to 52	**320000**	**920 I**	**13000**	**46.0**	**848**	**7760**
MLPV-DPT0670	4/8/2021	48 to 52	130 U	**1200**	**26000**	5.10 U	5.10 U	**10400**
MLPV-DPT0671	4/8/2021	20 to 24	**25000**	**13000**	**7200**	**6.79**	5.10 U	**5950**
MLPV-DPT0672	4/9/2021	20 to 24	**24000**	**10000**	**9200**	**17.4**	5.10 U	**14200**
MLPV-DPT0683	4/12/2021	5 to 9	**11000**	450 U	**14000**	**75.1**	**25.1**	**4090**
MLPV-DPT0684	4/12/2021	5 to 9	**10000**	450 U	**2800**	5.10 U	5.10 U	**9150**
MLPV-DPT0685	4/12/2021	5 to 9	**2600 I**	450 U	**12000**	**198**	**34.2**	**9230**
MLPV-DPT0686	4/13/2021	48 to 52	**400000**	**1100**	**10000**	**13.3**	**1150**	**2250**
MLPV-DPT0687	4/13/2021	5 to 9	**84000**	**480 I**	**4400**	**7.33**	5.10 U	**7720**
		9 to 11	**10000**	**2900**	**7500**	**50.6**	**11.4**	**11200**
MLPV-DPT0688	4/13/2021	5 to 9	**7200**	450 U	**1500**	5.10 U	5.10 U	**88.8**
		9 to 11	**5800**	**2700**	**5500**	5.10 U	5.10 U	4.00 U
MLPV-DPT0691	4/13/2021	5 to 9	**10000**	**1400**	**43000**	5.10 U	5.10 U	**1820**
		9 to 11	**11000**	**2600**	**38000**	5.10 U	5.10 U	**1490**

Notes:
Bolded results indicate the presence of an analyte at the specified concentration.
Red font indicates an exceedance of FDEP GCTLs or Site Approved Target Levels for UIC sampling.
bls = below land surface
DPT = direct push technology .
FDEP = Florida Department of Environmental Protection
GCTL = Groundwater Cleanup Target Level, Chapter 62-777 Florida Administrative Code, Table 1 (2005)
ID = identification
NADC = Natural Attenuation Default Concentration, Chapter 62-777 Florida Administrative Code, Table V (April 2005)
I = Result is greater than or equal to the laboratory MDL but less than the PQL
J = An estimated value
MDL = Minimum Detection Limit
µg/L = micrograms per liter
PQL = Practical Quantitation Limit
U = The analyte was not detected
UIC = Underground Injection Control
V = Analyte was detected in both the sample and the associated method blank
"MLPV-" is the prefix used for identifying the site within the Remediation Information System database.

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4. PERMITTING REQUIREMENTS AND SITE PREPARATION

The following sections identify the necessary permitting requirements and site preparations for implementation of ISCR IM at Hot Spot 3.

4.1 PERMITTING

IM activities at Hot Spot 3 will be conducted under NASA's RCRA permit for KSC. Site-specific permits will be required for the implementation of the IM utilizing the selected ISCR technology. A general listing and description of applicable site-specific permitting activities follows:

- Completion and submittal of a Site Plan and adherence to any actions required by the comments attached to the approved Site Plan;
- Completion and submittal of an Environmental Checklist and adherence to any actions required by the Record of Environmental Consideration following the submittal of the Environmental Checklist;
- Completion and submittal of dig permits for all ground penetrating work and adherence to any comments attached to the approved dig permit;
- Completion of utility locates by both the KSC Utility Locate office and Florida's Sunshine 811 following approval of a dig permit and before beginning ground penetration activities;
- A National Pollutant Discharge Elimination System storm water general permit and Stormwater Pollution Prevention Plan (SWPPP) is not required for the land disturbance activities (direct push injections) since activities are in an area less than 1 acre;
- Completion and submittal of a UIC permit request to FDEP for the injection of Provect-IR into the subsurface and adherence to any requirements in the final permit issued;
- Completion and submittal of the permit application to Brevard County and St. Johns River Water Management District by the licensed water well contractor for any monitoring wells installed at the site;

Planned IM activities will not impact protected and/or threatened and endangered species; therefore, a biological survey will not be required. No air emissions will be generated with the ISCR technology; therefore, no notification or permitting is required.

4.2 SPILL PREVENTION, CONTROL, AND COUNTERMEASURES

Although a Spill Prevention, Control, and Countermeasure (SPCC) Plan is not required, SPCC will be practiced during implementation of the IM. The IM will include temporary storage of the remediation amendment that is a non-hazardous dry powder. The amendment will be stored in 2,000-pound super sack bags on-site until mixed with water immediately prior to injection in the subsurface. The super sacks will be delivered wrapped in plastic to prevent rain from wetting the dry powder. In addition, the super sack bags will be covered in plastic tarps until use. The mixing of the dry powder with water to make slurries is contained within a trailer-mounted mixing system that will be staged in temporary secondary containment to capture potential spills.

Investigation-derived waste (IDW) from well installation, development and purging will be contained in 55-gallon drums staged on NASA-provided covered spill pallets as secondary containment. IDW will also include decontamination water from cleaning of direct push equipment used for monitoring well installation and ISCR amendment injection.

4.3 DILUTION WATER

A total of up to 15,000 gallons of water are anticipated for use to create slurries with the remediation product that will be delivered in situ using direct push techniques. The maximum daily water use during the ISCR injections is anticipated to be less than 2,000 gallons. Water will be obtained from an approved KSC fire hydrant near the site or an alternate water source.

5. ISCR DESIGN

In 2017, an electron donor and microbial culture were injected to promote ERD of the CVOCs through biostimulation and bioaugmentation. During ERD, sequential removal of chlorine atoms occurred as microbes used the CVOC as the electron acceptor while biooxidizing the electron donor during halorespiration. Thus, the presence of appropriate microbial communities along with anaerobic conditions and availability of electron donor are critical for long-term reduction of CVOCs.

ISCR can include promotion of ERD with an electron donor but typically focuses on addition of zero-valent iron (ZVI) to promote highly reducing conditions in groundwater and the abiotic processes known as beta elimination and hydrogenolysis to completely degrade chlorinated ethenes. Beta elimination and hydrogenolysis occur through direct contact of chlorinated ethenes with ZVI to remove chloride atoms and produce ferrous iron (Fe^{2+}). In the absence of dissolved oxygen (anaerobic conditions), ZVI is oxidized in water to ferrous iron and electrons (H_2). When sulfide is produced from the reduction of sulfate, the ferrous iron and sulfide will precipitate as iron sulfide, which can also degrade chlorinated ethenes via beta elimination. In general, ZVI can support ISCR of chlorinated ethenes in groundwater for many years and typically lasts longer than an electron donor-only amendment after one injection event.

5.1 AMENDMENT SELECTION AND DOSING

The selected ISCR amendment is Provect-IR, which is a mixture of solid reagents in a single product that promotes ERD and ISCR. Provect-IR includes natural antimethanogenic compounds; multiple hydrophilic, nutrient-rich organic carbon sources; ZVI; chemical oxygen scavengers; and vitamin and mineral sources. The Safety Data Sheet (SDS) and Technical Data Sheet for Provect-IR are provided in **Appendix E**. The organic components (fibrous land-based plants and marine plants) are nutrient rich, hydrophilic compounds with high surface area that provides ideal support for growth of bacteria in the groundwater environment. Initially, indigenous bacteria grow on the organic amendment and consume dissolved oxygen, thereby reducing the redox potential in groundwater. In addition, the bacteria ferment the organic carbon and release a variety of volatile fatty acids (acetic, propionic, butyric), which diffuse from the site of fermentation into the groundwater plume and serve as electron donors for other bacteria, including dehalogenators and halorespiring species. The ZVI particles provide substantial reactive surface area that stimulates direct abiotic dechlorination and an additional drop in the redox potential of the groundwater.

The proposed Provect-IR amendment (Provect-IR) contains 60% ZVI on a weight basis. Proposed average dosing rates of Provect-IR to the subsurface varies with the treatment depth and ranges from 0.4% to 0.6% of soil mass within the targeted treatment area and depth interval. From 4 to 10 feet bls, the proposed mass dosing rate of 0.4% is lower based on experience in sandy soil to limit amendment surfacing at the required injection pressures. In addition, the recommended slurry strength for this injection depth interval is lower at 15% to minimize

injection pressures. At this dosing rate and slurry strength, the estimated radius of Provect-IR distribution is 7.5 feet, and the recommended spacing between injection points is 10 feet. Assuming the bulk density of the sandy soil is approximately 100 pounds per cubic foot, the estimated mass injection rate is 71 pounds of Provect-IR per foot of injection interval.

From 10 to 18 feet bls, more overburden allows higher injection pressures, dosing rate (0.5%), and slurry strength (20%) to treat the greatest CVOC concentrations at the site. At this dosing rate and slurry strength, the estimated radius of Provect-IR distribution is 10 feet in sandy soil. The estimated mass injection rate is 157 pounds of Provect-IR per foot of injection interval from 10 to 18 feet bls. For the deep treatment interval from 42 to 52 feet bls, the highest dosing rate of 0.6% and a slurry strength of 20% are estimated to create a radius of distribution of 15 feet. The estimated mass injection rate is 424 pounds of Provect-IR per foot of injection interval from 42 to 52 feet bls.

Slurry preparation information is provided in the *Provect-IR® Handling and Application Guidelines* (**Appendix F**) and specifies that 34 and 24 gallons of water per 50-pound bag of Provect-IR are required to create 15% and 20% slurries, respectively. Based on the variable estimated mass injection rates and slurry strengths, the estimated required water varies from 48 to 204 gallons per foot of injection interval. The dosing rates, estimated distribution radii, mass injection rates, and estimated water needed to make the slurries are summarized in **Table 5-1**.

Table 5-1. Slurry and Dosing Details

Injection Interval (feet bls)	Provect-IR Dosing Rate (% of soil mass)	Estimated Radius of Provect-IR Distribution (feet)	Provect-IR Mass Injection Rate (pounds/feet)	Recommended Slurry Strength (% by weight)	Water Injection Rate (gal/feet)
4 to 10 Fine sand and medium sand with shells	0.4	7.5	71	15	48
10 to 18 Fine sand	0.5	10	157	20	75
42 to 52 East side medium sand with shells, silty sand towards west	0.6	15	424	20	204

5.2 INJECTION LOCATIONS AND DEPTH

The areal extents of the treatment areas are planned to cover the estimated extents of the CVOC plumes as defined by CVOC concentrations greater than their NADC, as summarized in **Section 3.3**. At most depth intervals, the VC plume where concentrations exceed 100 µg/L has the largest areal extent and determines the proposed treatment area, which varies with depth. Using the estimated radii of Provect-IR distribution for the various depth intervals, injection point locations were selected to create the treatment areas for each depth interval by overlapping the estimated distribution for Provect-IR. Although the estimated Provect-IR distribution increases with depth

for the shallow interval, the injection point locations did not change and increased the overlap of the estimated distribution with depth. Sixteen injection points are proposed to create the treatment areas. Six injection points (IP01 to IP06) are designated for the treatment areas from 4 to 18 feet bls, and ten injection points (IP07 to IP16) are designated for the treatment areas from 42 to 52 feet bls. The State Plane coordinates of the injection points, along with injection intervals, Provect-IR injection rates, and total mass, and required water to create slurries, are presented in **Table 5-2**.

The locations of the injection points and their estimated radii of Provect-IR distribution relative to the treatment area (NADC plume) for the shallow groundwater interval (4 to 18 feet bls) are shown on **Figure 5-1**. Six injection points (IP01 to IP06) target the NADC plumes in the 4 to 10 feet bls and 10 to 14 feet bls intervals. The number of injection points decreases to two (IP05 and IP06) from 14 to 18 feet bls as the treatment area decreases and the radius of distribution increases from 7.5 to 10 feet. In addition, injection points are located where feasible near DPT groundwater samples with the greatest CVOC concentrations (e.g., IP05 and MLPV-DPT0683).

The locations of the injection points and the estimated radius of Provect-IR distribution (15 feet) relative to the treatment area (NADC plume) for the deep groundwater interval (42 to 52 feet bls) are shown on **Figure 5-2**. Two injection points (IP07 and IP08) target the NADC plumes in the 42 to 48 feet bls interval. IP07 is located between the DPT locations (MLPV-DPT0650, MLPV-DPT0651, and MLPV-DPT0654) with the greatest CVOC concentrations in samples from 43 to 47 feet bls. Interpolation of TCE and VC distributions from 43 to 47 feet bls indicates that NADC plumes may extend beyond the radius of Provect-IR distribution northwest of IP07. However, a review of the DPT data trends at MLPV-DPT0651 and MLPV-DPT0652 west of IP07 indicates that the NADC plumes are likely smaller and contained within the treatment area for IP07. This significant decrease in CVOC concentrations with distance was also observed in the shallow groundwater near this location and IP07. IP08 is located near MLPV-DPT0659, which had concentrations of cDCE and VC greater than NADCs, to treat the estimated extents of the NADC plumes in an area south of the suspected source location.

Ten injection points (IP07 to IP16) target the NADC plumes in the 48 to 52 feet bls interval. Between IP08 and IP09, one groundwater sample from MLPV-DPT0663 had concentrations of cDCE (780 µg/L) and VC (160 µg/L) slightly greater than NADCs that is not within the estimated area of Provect-IR distribution. However, IP08 is expected to create conditions upgradient and in the vicinity of MLPV-DPT0663 to reduce CVOC concentrations between IP08 and IP09 to less than NADCs. Shorter distances between IP09 through IP11 target cDCE and VC concentrations at MLPV-DPT0660, MLPV-DPT0668, and MLPV-DPT0686, that are 10 times greater than NADCs. The locations of IP14 to IP16 are designed to treat VC above NADCs within the estimated areas of Provect-IR distribution and downgradient groundwater. Thus, IP14 to IP16 are expected to create a treatment transect that supports reduction of the downgradient VC plume similar to the area downgradient of IP08.

5.3 APPLICATION

Based on a total quantity of 29,625 pounds of Provect-IR, the Provect-IR is expected to be packaged and shipped as a dry powder in fifteen 2,000-pound super sack bags that can be safely unloaded and moved with a forklift. The super sack bags are typically shipped on 4-feet square wooden pallets that are wrapped in water-resistant plastic to avoid exposure to rain. Provect-IR is non-hazardous and is safely handled using standard personal protective equipment (PPE) (safety glasses, steel-toed boots, and gloves), which may include dust masks when mixing with water to make the injection slurries.

The Provect-IR will be mixed with clean water from an approved water source (hydrant) to create the aqueous slurries for the various injection intervals as specified in **Section 5.1**. Based on field conditions, an experienced injection contractor may modify the slurry mixture to make lighter or heavier mixtures to increase or decrease injection volumes and distribution. A typical setup includes mixture of the Provect-IR in a trailer-mounted solids hopper that is fed by a super sack. The slurry is fed to a high-capacity ChemGrout mixing system with a piston pump, fittings, meters, valves, and hoses capable of injecting the slurry at 30 gallons per minute (gpm) and 1,500 psi. Provect-IR slurries are typically injected at pressures of 100 to 200 psi but may require higher pressures to initiate the injection. Pressures over 500 psi and injection capacity of 10 gpm may be used for deeper injections.

Injection points will be precleared based on site knowledge and experience from previous DPT groundwater sampling events. **Figure 5-3** illustrates approximate locations of subsurface obstructions. Preclearance to 5 feet bls with hand augers is not feasible for the shallow injection interval (top at 4 feet bls). At each injection point, the contractor will use a size-appropriate DPT rig to advance a 1.75-inch diameter pressure activated jetting tool to the top injection interval. Using a top-down injection approach, the specified slurry volume will be injected while recording flowrate and pressure for the injection interval (typically 4 feet). The injection approach may be modified in the field to bottom-up if field observations and injection contractor experience with Provect-IR slurries indicate a bottom-up approach would provide similar distribution with less potential for slurry daylighting, especially for the shallow injection interval.

After the depth-specific slurry volume is injected, the injection tooling will be moved (typically 4 feet) to the next injection interval, and the process repeated to provide even distribution of slurry over the target treatment interval. Once the injection point is completed, a small volume of water (15 gallons) will be used to clear slurry out of the rods and injection tool, and the rods will be removed from the boring. The portion of the boring that remains open after removal of the rods and injection tooling (typically the portion above the water table) will be filled with cement grout. Note that the volume of slurry and water to be injected at each boring is minimal; thus, the volume of groundwater displaced will be minimal.

The contractor is expected to have multiple injection tools and may deploy injection tooling and rods at multiple locations to allow alternating injection of the slurry at locations sufficiently

distanced to prevent short-circuiting of the slurry. Between use at injection points, the rods and injection tooling will be cleaned in a temporary containment pad or containment area integrated into the injection equipment trailer. The mass of Provect-IR and volume of slurry injected into each injection interval, and injection point will be recorded. In addition, injection pressures and flowrates will be recorded along with other observations that may include slurry surfacing. If slurry surfacing occurs, slurry strength, injection pressure, injection flowrate, and injection depth may be modified to minimize surfacing through potential pathways such as abandoned monitoring wells.

Groundwater monitoring wells will be installed after the Provect-IR injections are completed. Thus, groundwater monitoring wells will not be present in the vicinity of the treatment area to monitor groundwater elevations and Provect-IR distribution during the injections.

5.4 WASTE MANAGEMENT

Types of waste expected to be generated during the performance of the IM include soil from monitoring well installation, monitoring well development and purge water, decontamination fluids from cleaning injection and well installation tooling, PPE, wood pallets, and empty super sacks. Based on historical site activities and types of contaminants present, none of these IDW materials are expected to present a significant risk to human health or the environment when properly managed.

IDW generated during field activities (e.g., soil, decontamination water, purge water) will be placed in approved 55-gallon drums and stored on NASA-provided covered spill pallets secured with cargo straps. When a drum is 80% full, a sample will be collected, sent to an analytical laboratory for waste characterization analysis, and the results will be provided to the NASA Remediation Project Manager (RPM). Approximate IDW quantities, pH levels (and adjustment), and spill pallet and drum IDs will be documented on an IDW Log that is provided to the NASA RPM following each field activity. Solid waste that is non-hazardous, such as miscellaneous trash, construction debris, and cleaned PPE, will be disposed of in on-site trash receptacles (e.g., dumpsters).

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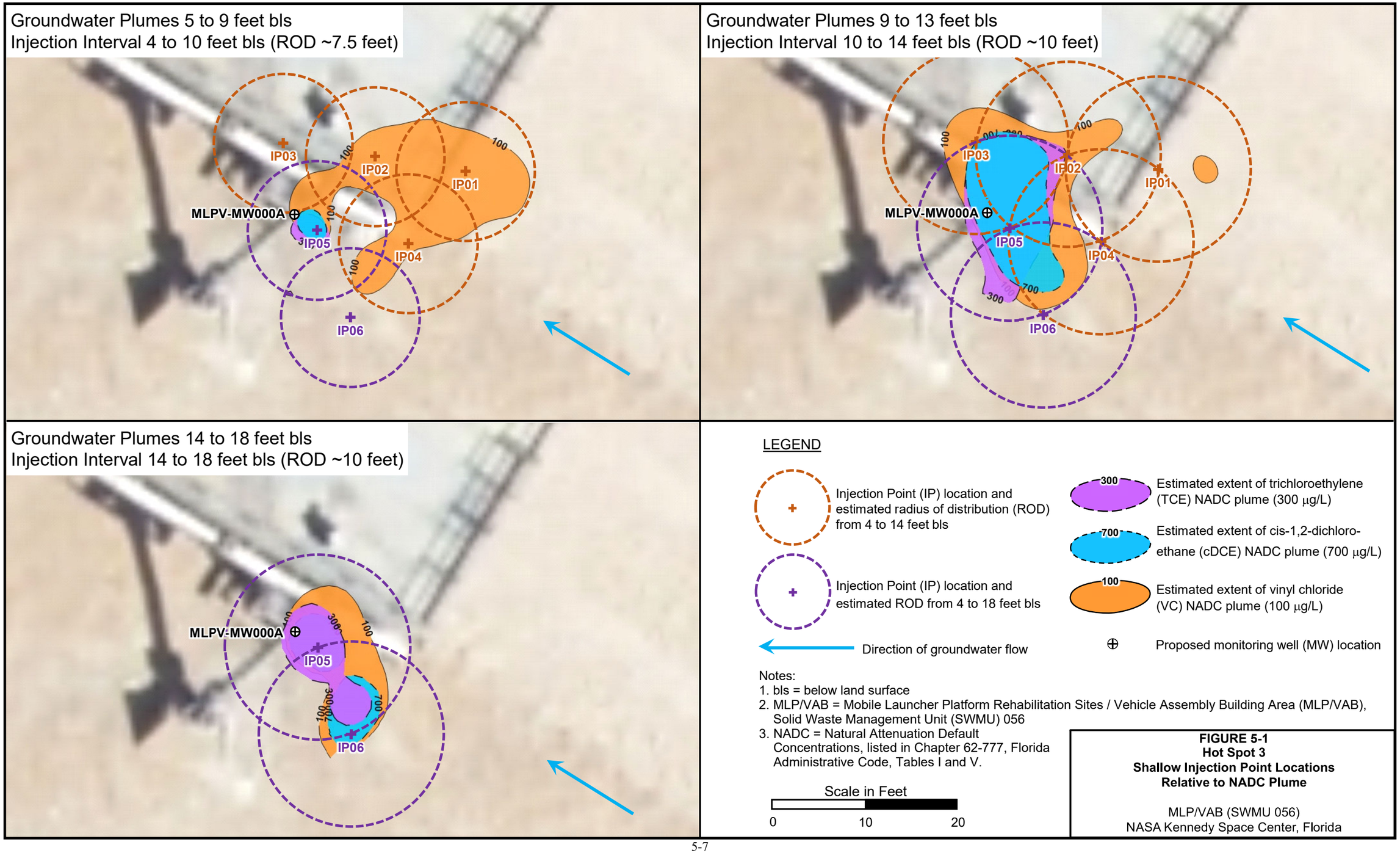
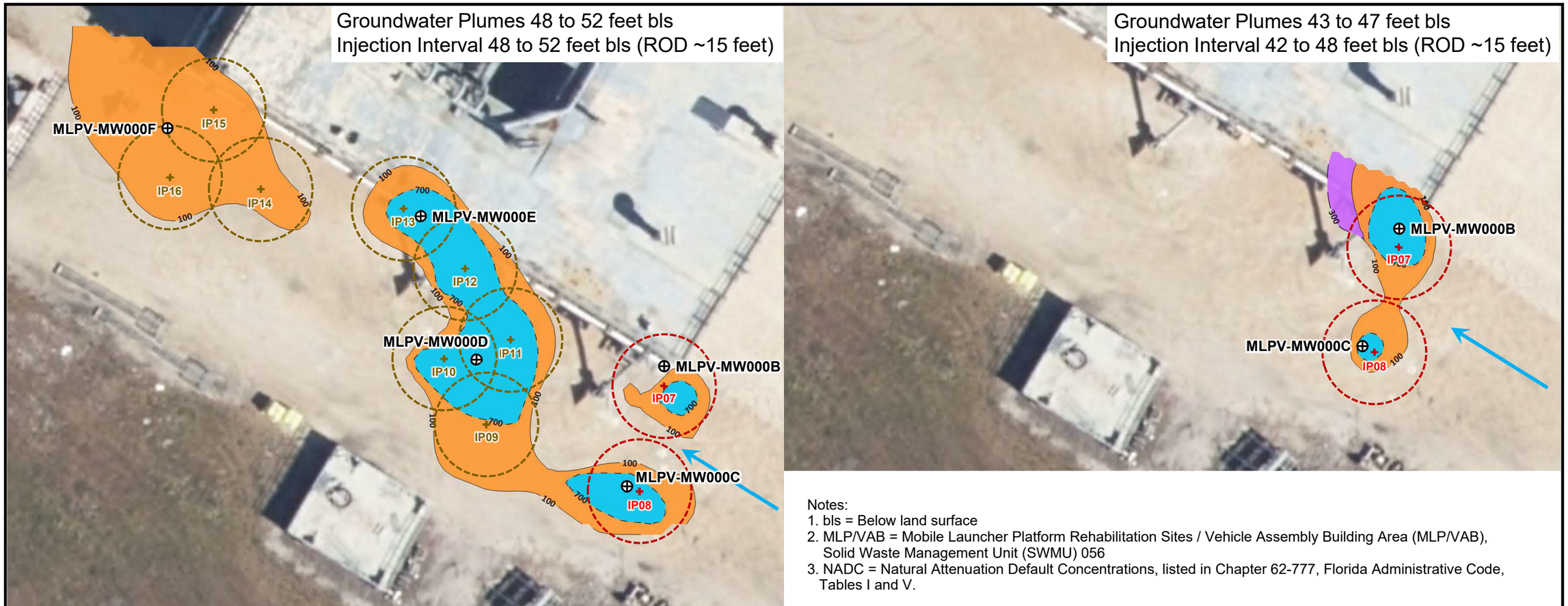


FIGURE 5-1
Hot Spot 3
Shallow Injection Point Locations Relative to NADC Plume

MLP/VAB (SWMU 056)
NASA Kennedy Space Center, Florida



Notes:
1. bls = Below land surface
2. MLP/VAB = Mobile Launcher Platform Rehabilitation Sites / Vehicle Assembly Building Area (MLP/VAB), Solid Waste Management Unit (SWMU) 056
3. NADC = Natural Attenuation Default Concentrations, listed in Chapter 62-777, Florida Administrative Code, Tables I and V.

LEGEND

Injection Point (IP) location and estimated radius of distribution (ROD) from 42 to 52 ft bls

Injection Point (IP) location and estimated ROD from 48 to 52 ft bls

300 — Estimated extent of trichloroethylene (TCE) NADC plume (300 µg/L)

700 — Estimated extent of cis-1,2-dichloro-ethane (cDCE) NADC plume (700 µg/L)

100 — Estimated extent of vinyl chloride (VC) NADC plume (100 µg/L)

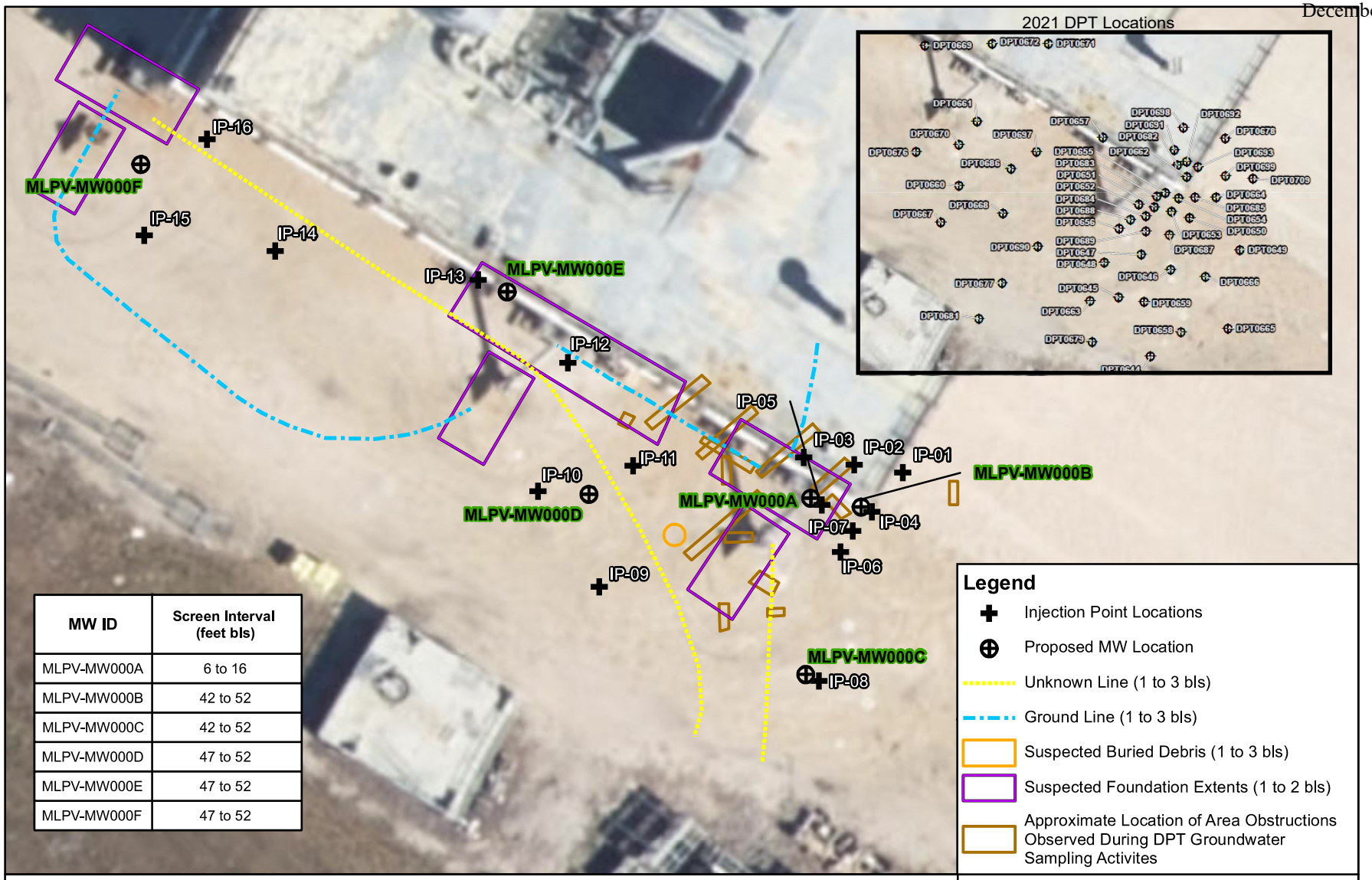
⊕ Proposed monitoring well (MW) location

Direction of groundwater flow

Scale in Feet
0 10 20

FIGURE 5-2
Hot Spot 3
Deep Injection Point Locations
Relative to NADC Plume

MLP/VAB (SWMU 056)
NASA Kennedy Space Center, Florida



MW ID	Screen Interval (feet bls)
MLPV-MW000A	6 to 16
MLPV-MW000B	42 to 52
MLPV-MW000C	42 to 52
MLPV-MW000D	47 to 52
MLPV-MW000E	47 to 52
MLPV-MW000F	47 to 52

Notes:
1. bls = Below land surface
2. DPT = Direct push technology
3. IP = Injection point
4. MLP/VAB = Mobile Launcher Platform Rehabilitation Sites /Vehicle Assembly Building Area (MLP/VAB), Solid Waste Management Unit (SWMU) 056
5. MW = Monitoring Well

Figure 5-3
Hot Spot 3
Subsurface Obstructions

MLP/VAB (SWMU 056)
NASA Kennedy Space Center, Florida

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Table 5-2
Injection Point Coordinates and Injection Details
Mobile Launcher Platform Rehabilitation Sites / Vehicle Assembly Building Area (MLP/VAB): Hot Spot 3

Injection Point ID	Easting (feet)	Northing (feet)	Injection Top Depth (feet bls)	Injection Bottom Depth (feet bls)	Injection Interval Length (feet)	Provect-IR Mass Injection Rate (lb/feet)	Water Injection Rate (gal/feet)	Provect-IR Mass (lb)	Estimated Mix Water (gal)
IP01	767211.7	1547243.5	4	10	6	71	48	424	288
			10	14	4	157	75	628	302
IP02	767202.1	1547245.0	4	10	6	71	48	424	288
			10	14	4	157	75	628	302
IP03	767192.2	1547246.5	4	10	6	71	48	424	288
			10	14	4	157	75	628	302
IP04	767205.7	1547235.7	4	10	6	71	48	424	288
			10	14	4	157	48	628	192
IP05	767195.7	1547237.1	4	10	6	71	48	424	288
			10	18	8	157	75	1,257	603
IP06	767199.4	1547227.7	4	10	6	71	48	424	288
			10	18	8	157	75	1,257	603
IP07	767202.2	1547232.1	42	52	10	424	204	4,241	2,036
IP08	767195.2	1547201.7	42	52	10	424	204	4,241	2,036
IP09	767150.8	1547220.9	48	52	4	424	204	1,696	814
IP10	767138.3	1547240.1	48	52	4	424	204	1,696	814
IP11	767158.0	1547245.2	48	52	4	424	204	1,696	814
IP12	767144.9	1547266.1	48	52	4	424	204	1,696	814
IP13	767127.2	1547282.8	48	52	4	424	204	1,696	814
IP14	767085.7	1547288.7	48	52	4	424	204	1,696	814
IP15	767072.2	1547311.9	48	52	4	424	204	1,696	814
IP16	767059.7	1547292.1	48	52	4	424	204	1,696	814

Notes:
bls = below land surface
gal = gallons
ID = identification
IP = injection point
Provect-IR = selected amendment
lb = pounds

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6. PERFORMANCE MONITORING

6.1 PROPOSED MONITORING WELL INSTALLATION

Six performance monitoring wells are proposed for installation to evaluate performance of the IM. Prior to performance monitoring well installation and the injection activities, DPT groundwater sampling will be performed at the proposed well locations and depths to confirm groundwater quality and the intended use of the new wells to monitor performance of the IM. The DPT groundwater sampling will also provide baseline data at the locations of the new performance monitoring wells to support the performance evaluation. Six monitoring wells are proposed for monitoring the low-concentration plume (LCP) and to provide groundwater quality data upgradient below and downgradient of the IM treatment area. **Table 6-1** summarizes the rationale for the depth and location of each proposed monitoring well.

Wells will be installed when injection activities are completed to prevent preferential pathways during amendment application. Monitoring wells will be installed using DPT at screen depth intervals corresponding with treatment intervals. Each monitoring well will be constructed of 1-inch diameter, Schedule 40 PVC riser, and 0.010-inch slotted prepacked screen.
Figure 5-1, Figure 5-2, **Figure 6-1,** and **Figure 6-2** show the proposed monitoring well locations, which are temporarily identified as MLPV-MW000A through MLPV-MW000L. At the time of installation, the monitoring well names will be revised to follow site naming conventions and appropriate sequence number. **Figure 6-3** illustrates the typical monitoring well construction details.

6.2 SAMPLING PLANS

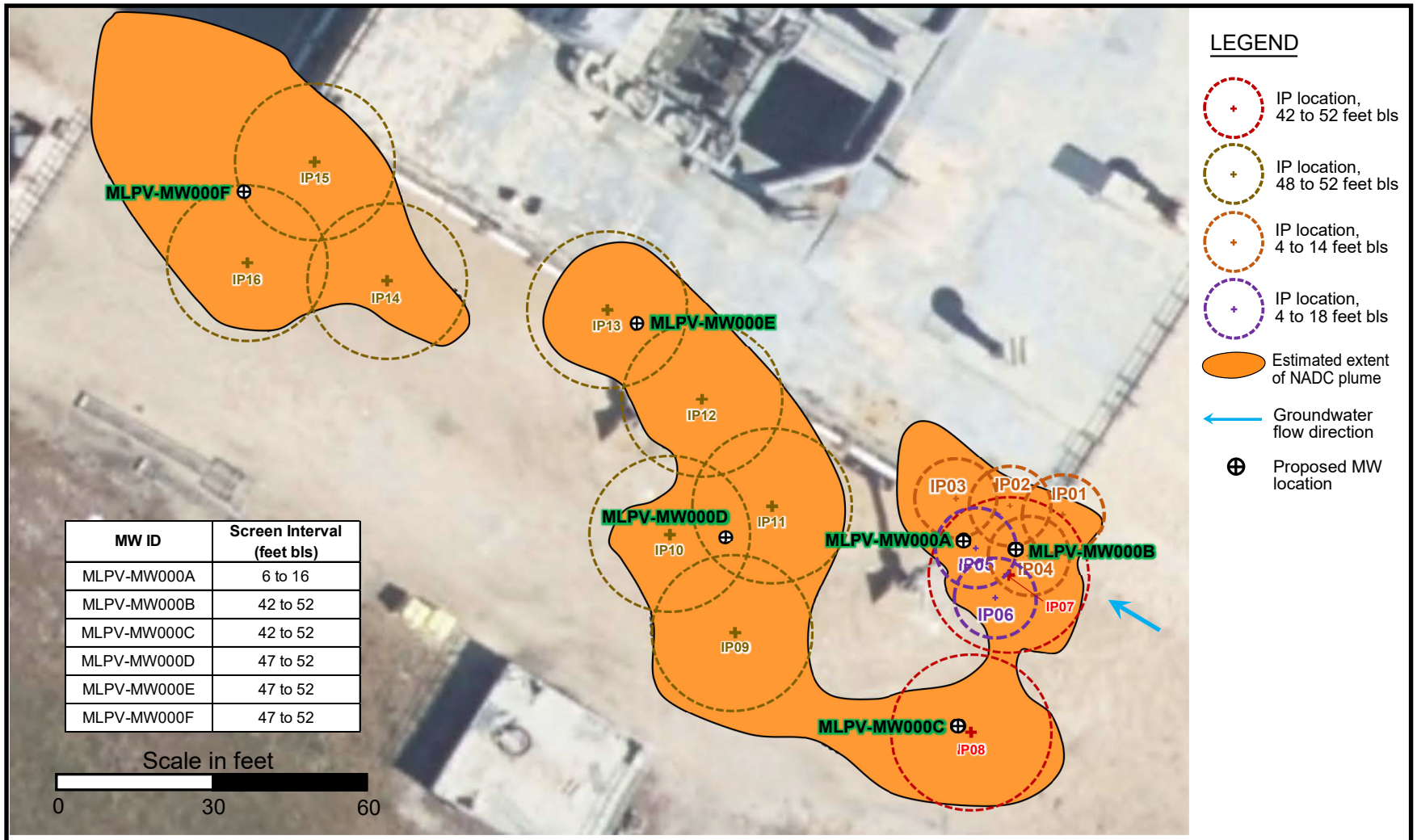
Post-injection performance and UIC monitoring will be performed as summarized below and outlined in **Table 6-2** and **Table 6-3**.

- CVOCs (TCE, cDCE, tDCE, 1,1,-DCE, and VC), ethene, and ethane will be monitored to evaluate progress of biologically mediated reductive dichlorination.
- Methane will be monitored to evaluate the redox conditions of the aquifer and methanogen activity.
- Sulfate and sulfide will be monitored to evaluate the environmental conditions for Dhc and possible influence of sulfate reducing bacteria. As sulfate reduction occurs, sulfide concentrations increase or are precipitated by dissolved iron, when available, as iron sulfides.
- TOC, initially low at this site, will be monitored to evaluate distribution and concentration of electron donors available for dechlorinating organisms.
- UIC parameters will be monitored per the FDEP Provect-IR Acceptance Letter to evaluate changes to water quality in a temporary zone of discharge (ZOD) that includes the treatment area. Monitoring requirements for the ZOD are ammonia, iron, pH, TDS, total recoverable petroleum hydrocarbons, sodium, and sulfate. The UIC Acceptance Letter is provided in **Appendix G**.

- Groundwater parameters of temperature, conductivity, pH, turbidity, dissolved oxygen (DO), and oxidative reduction potential (ORP) will be recorded while sampling.

At the performance monitoring wells, CVOC parameters will be sampled semiannually until concentrations reduce to below their NADCs. At the LCP monitoring wells, CVOC parameters will be sampled biennially until concentrations reduce to below their GCTLs. At the performance monitoring wells, UIC parameters will be sampled until concentrations decrease to background levels or to levels that meet respective groundwater standards. At the LCP monitoring wells, UIC parameters will be sampled once at three locations (MLPV-MW000G, MLPV-MW000H, and MLPV-MW000L) to provide baseline and background UIC data outside of the IM treatment area. Sampling frequency will be evaluated annually and modified as needed.

Two years after IM activities, DPT groundwater sampling is proposed in and around the treatment area to assess the plume behavior and overall ISCR performance. An evaluation of analytical results will determine the need and frequency of additional performance DPT groundwater sampling, as the treatment lifecycle is generally five to ten years.

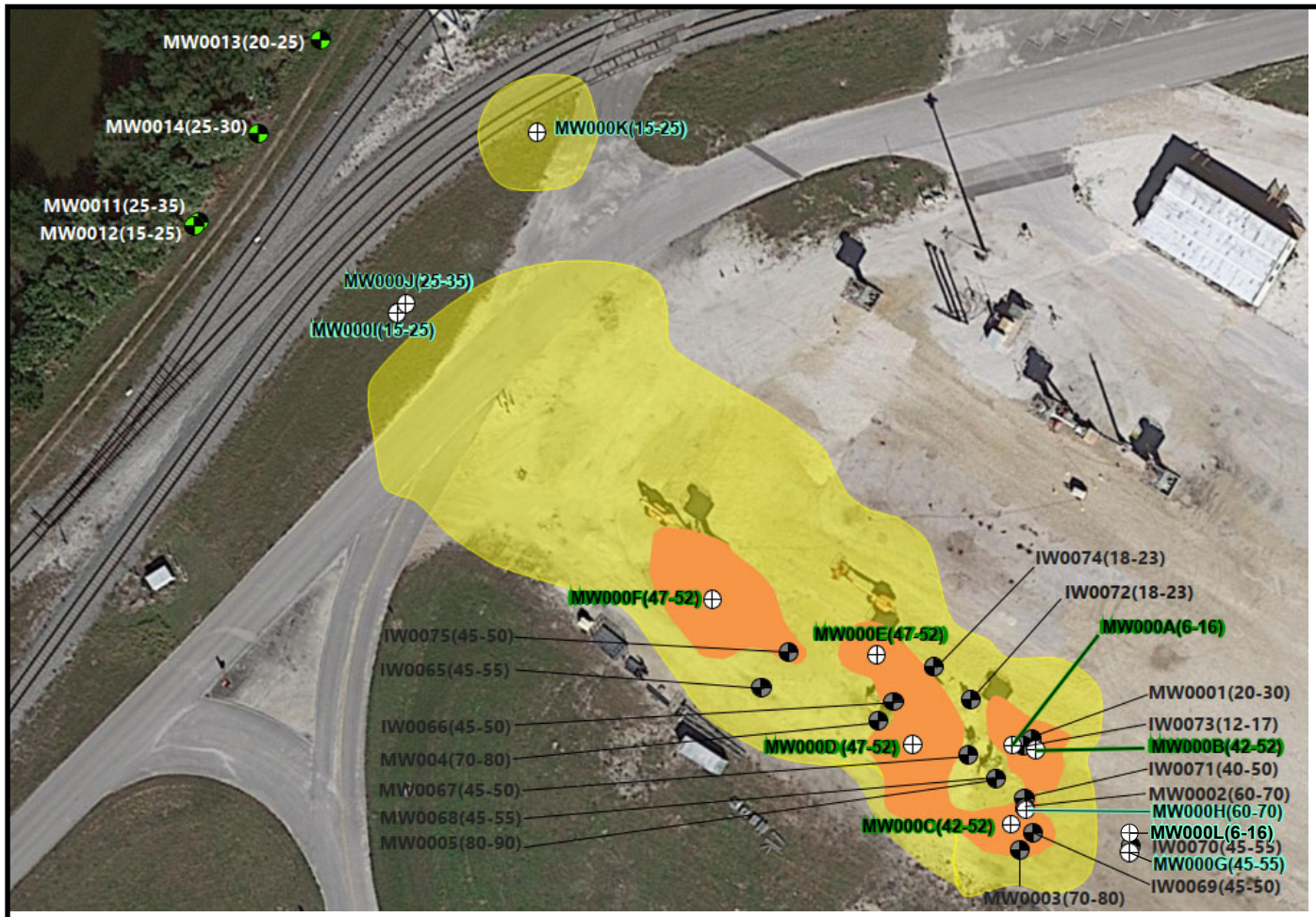


MW ID	Screen Interval (feet bls)
MLPV-MW000A	6 to 16
MLPV-MW000B	42 to 52
MLPV-MW000C	42 to 52
MLPV-MW000D	47 to 52
MLPV-MW000E	47 to 52
MLPV-MW000F	47 to 52

Notes:
1. bls = Below land surface
2. IP = Injection point
3. MLP/VAB = Mobile Launcher Platform Rehabilitation Sites / Vehicle Assembly Building Area (MLP/VAB), Solid Waste Management Unit (SWMU) 056
4. MW = Monitoring well
5. NADC = Natural Attenuation Default Concentrations, listed in Chapter 62-777, Florida Administrative Code, Tables I and V.

FIGURE 6-1
Hot Spot 3
Proposed Monitoring Well Locations

MLP/VAB (SWMU 056)
NASA Kennedy Space Center, Florida



LEGEND

- Estimated extent of GCTL plume
- Estimated extent of NADC plume
- Groundwater flow direction
- Proposed MW location
- Existing MW location
- Abandoned MW location

Low Concentration Plume Monitoring Well

Performance Monitoring Well

MW ID	Screen Interval (feet bls)
MLPV-MW000G	45 to 55
MLPV-MW000H	60 to 70
MLPV-MW000I	15 to 25
MLPV-MW000J	25 to 35
MLPV-MW000K	15 to 25

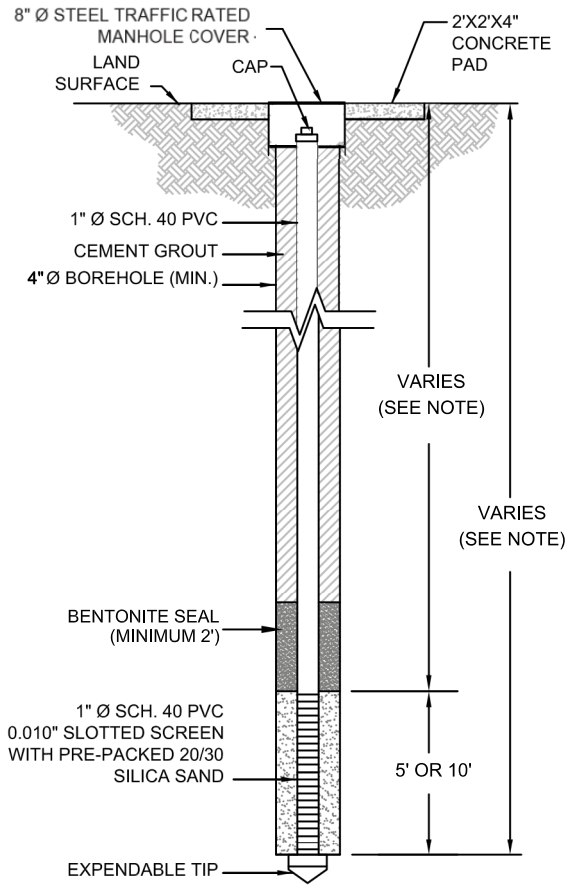
Scale in feet

0 100 200

Notes:
1. bls = Below land surface
2. MLP/VAB = Mobile Launcher Platform Rehabilitation Sites / Vehicle Assembly Building Area (MLP/VAB), Solid Waste Management Unit (SWMU) 056
3. MW = Monitoring well
4. GCTL = Groundwater Cleanup Target Levels, listed in Chapter 62-777, Florida Administrative Code Table I
5. NADC = Natural Attenuation Default Concentrations, listed in Chapter 62-777, Florida Administrative Code, Tables I and V.

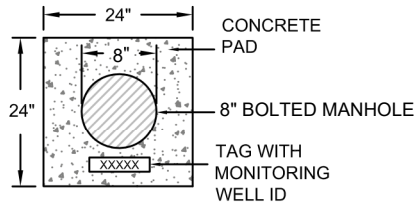
FIGURE 6-2
Hot Spot 3
Proposed Monitoring Well Locations
(Performance and LCP wells)

MLP/VAB (SWMU 056)
NASA Kennedy Space Center, Florida



SONIC MONITORING WELL DETAIL

NOT TO SCALE



MONITORING WELL PLAN VIEW

NOT TO SCALE

Note:
1. PVC = Polyvinyl Chloride
2. SCH = Schedule
3. " = Inches
4. ' = Feet
5. Ø = Diameter
6. See Table 6-1 for monitoring well depths and screen intervals
7. MLP/VAB = Mobile Launcher Platform Rehabilitation Sites / Vehicle Assembly Building Area
8. SWMU = Solid Waste Management Unit

Figure 6-3
Typical Monitoring Well Construction

MLP/VAB (SWMU 056)
NASA Kennedy Space Center, Florida

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Table 6-1
Rationale for Proposed Monitoring Wells
Mobile Launcher Platform Rehabilitation Sites / Vehicle Assembly Building Area (MLP/VAB): Hot Spot 3

Monitoring Well ID	Easting (feet)	Northing (feet)	Screen Interval (feet bls)	Monitoring Objective
MLPV-MW000A	767190.7	1547238.9	6 to 16	ISCR performance in shallow groundwater with greatest CVOC concentrations
MLPV-MW000B	767202.2	1547237.8	42 to 52	ISCR performance in deep groundwater near IP07 and greatest CVOC concentrations in deep groundwater
MLPV-MW000C	767191.5	1547203.5	42 to 52	ISCR performance in deep groundwater near IP08 and separate area of high cDCE and VC concentrations
MLPV-MW000D	767147.8	1547239.8	47 to 52	ISCR performance in deepest groundwater treatment interval near IP10 and IP11 and high cDCE and VC concentrations
MLPV-MW000E	767131.5	1547280.4	47 to 52	ISCR performance in deepest groundwater treatment interval near IP12 and IP13
MLPV-MW000F	767058.5	1547306.6	47 to 52	ISCR performance in deepest groundwater downgradient of treatment transect formed by IP14 to IP16
MLPV-MW000G	767252.0	1547192.0	45 to 55	LCP monitoring upgradient of treatment area (replaces IW0070), and provides background for UIC
MLPV-MW000H	767204.0	1547214.0	60 to 70	LCP monitoring below treatment area (replaces MW0002), and provides background for UIC
MLPV-MW000I	766915.0	1547439.0	15 to 25	LCP Monitoring between the treatment area and Outstanding Florida Water area wells
MLPV-MW000J	766919.0	1547443.0	25 to 35	LCP Monitoring between the treatment area and Outstanding Florida Water area wells
MLPV-MW000K	766980.0	1547520.0	15 to 25	LCP Monitoring between the treatment area and Outstanding Florida Water area wells. Interval based on historical DPT data.
MLPV-MW000L	767252.0	1547195.0	6 to 16	LCP monitoring upgradient of shallow treatment area, and provides background for UIC

Notes:
bls = below land surface
cDCE = cis-1,2-dichloroethene
CVOC = chlorinated volatile organic compound
DPT = Direct Push Technology
ID = identification
IP = injection point
ISCR = in situ chemical reduction
LCP = Low concentration plume
MW = monitoring well
VC = vinyl chloride

"MLPV-" is the prefix used for identifying the site within the Remediation Information System database.

Table 6-2
Performance and UIC Monitoring Plan
Mobile Launcher Platform Rehabilitation Sites / Vehicle Assembly Building Area (MLP/VAB): Hot Spot 3

		Performance Monitoring				UIC Parameters					
Monitoring Well ID	**Screen Interval (feet bls)**	**CVOCs: TCE, cDCE, tDCE, 1,1,-DCE, and VC (8260B)**	**Methane, Ethene, Ethane (RSK-175)**	**Sulfide (SM4500-S)**	**TOC (SW846 9060A)**	**Ammonia (350.1)**	**Iron (6010)**	**TDS (SM2540 C)**	**TRPH (FL-PRO)**	**Sodium (200.7)**	**Sulfate (300.0)**
MLPV-MW000A	6 to 16	Semi-annually until below their NADC	Semi-annually until reach background levels or to levels that meet respective groundwater standards			Semi-annually until reach background levels or to levels that meet respective groundwater standards					
MLPV-MW000B	42 to 52										
MLPV-MW000C	42 to 52										
MLPV-MW000D	47 to 52										
MLPV-MW000E	47 to 52										
MLPV-MW000F	47 to 52										

Notes:
1,1,-DCE = 1,1-dichloroethene
bls = below land surface
cDCE = cis-1,2-dichloroethene
CVOC = chlorinated volatile organic compound
FL-PRO = Florida Petroleum Range Organics
ID = identification
MW = monitoring well
NADC = Natural Attenuation Default Criteria, listed in Chapter 62-777, Florida Administrative Code
TCE = trichloroethylene
tDCE = trans-1,2-dichloroethene
TDS = total dissolved solids
TOC = total organic carbon
TRPH = total recoverable petroleum hydrocarbons
UIC = underground injection control
VC = vinyl chloride
"MLPV-" is the prefix used for identifying the site within the Remediation Information System database.
Sampling frequency will be evaluated annually.

Table 6-3
Low Concentration Plume Monitoring Plan
Mobile Launcher Platform Rehabilitation Sites / Vehicle Assembly Building Area (MLP/VAB): Hot Spot 3

		Low Concentration Plume	UIC Background Parameters					
Monitoring Well ID	**Screen Interval (feet bls)**	**CVOCs: TCE, cDCE, tDCE, 1,1,-DCE, and VC (8260B)**	**Ammonia (350.1)**	**Iron (6010)**	**TDS (SM2540 C)**	**TRPH (FL-PRO)**	**Sodium (200.7)**	**Sulfate (300.0)**
MLPV-MW000G	45 to 55	Biennially until below their GCTL	Semi-annually for one year to collect baseline data set Sampled to provide background for UIC parameters.					
MLPV-MW000H	60 to 70							
MLPV-MW000I	15 to 25		Not analyzed					
MLPV-MW000J	25 to 35							
MLPV-MW000K	15 to 25							
MLPV-MW000L	6 to 16		Semi-annually for one year and for background for UIC parameters.					

Notes:
1,1,-DCE = 1,1-dichloroethene
bls = below land surface
cDCE = cis-1,2-dichloroethene
CVOC = chlorinated volatile organic compound
FL-PRO = Florida Petroleum Range Organics
ID = identification
MW = monitoring well
GCTL = Groundwater Cleanup Target Levels, listed in Chapter 62-777, Florida Administrative Code Table I
TCE = trichloroethylene
tDCE = trans-1,2-dichloroethene
TDS = total dissolved solids
TOC = total organic carbon
TRPH = total recoverable petroleum hydrocarbons
UIC = underground injection control
VC = vinyl chloride
"MLPV-" is the prefix used for identifying the site within the Remediation Information System database.
Sampling frequency will be evaluated annually.

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7. REPORTING

7.1 INTERIM MEASURES IMPLEMENTATION WORK PLAN

Prior to the implementation of the ISCR IM, an IM Implementation Work Plan will be prepared that provides final injection design elements and coordination specifications that are required to complete the IM. The IM Implementation Work Plan will contain, at a minimum, the information required by the KSCRT EE Process, Revision 4 (or latest version available at the time of preparation). The IM Implementation Work Plan will be signed/sealed by the Florida licensed professional engineer in charge of the project and submitted to FDEP.

7.2 INTERIM MEASURES AND PERFORMANCE MONITORING DOCUMENTATION

Injection activities will be documented in the first annual Performance Monitoring Report for the Host Spot 3 ISCR IM. The report will include final injection locations and volumes, monitoring well installation, sampling results from the first event of performance monitoring, and any other items required by the KSCRT EE Process, Revision 4 (or latest version available at the time of preparation). The ISCR IM activities will also be presented to the KSCRT as a CCR ADP.

The Annual performance monitoring report for the Hot Spot 3 ISCR IM will document semiannual performance monitoring activities, results, recommendations, conclusions, and any other items required by the KSCRT EE Process, Revision 4 (or latest version available at the time of preparation). The Annual Performance Monitoring Report for Hot Spot 3 will be signed/sealed by the Florida licensed professional engineer in charge of the project. Performance monitoring activities will be presented to the KSCRT as an Annual Performance Monitoring ADP.

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8. SCHEDULE AND COST

The approximate timeline for primary tasks associated with the ISCR IM is as estimated below:

- 50 working days for Implementation Work Plan preparation, Health and Safety Plan updates, procurement of subcontractors, site plan submittal and approval, dig permit submittal and approval, utility locate, and any additional permitting;
- 2 working days for mobilization and setup;
- 10 working days for injection activities;
- 6 working days for monitoring well installation and survey; and
- 75 working days for preparation of CCR and presentation of the CCR ADP to the KSCRT (depending on KSCRT schedule).

The general timeline identified may include overlap of elements identified above to reduce the implementation timeline, as appropriate.

8.1 CLEANUP TIMEFRAME

ISCR is an in situ treatment technology that does not require ongoing operation and maintenance. The treatment timeframe for this IM is estimated as the time duration when emplaced Provect-IR is maintaining conditions for ISCR of CVOCs until groundwater treatment objectives are achieved. The emplaced Provect-IR is expected to maintain ISCR of CVOCs for five to ten years.

8.2 COSTING

The capital cost for the ISCR IM, including monitoring well installation, semiannual monitoring well sampling, one biennial DPT performance monitoring sampling event to assess ISCR performance and reporting, are provided in **Table 8-1**. While significant reduction occurs within the first two years, the remediation lifecycle is anticipated to last five to ten years. The estimated capital cost for the IM with five years of monitoring is approximately $680,300.

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Table 8-1
Estimated Costs to Implement ISCR IMWP
Mobile Launcher Platform Rehabilitation Sites / Vehicle Assembly Building Area (MLP/VAB): Hot Spot 3

Item	Description	Quantity	Unit	Unit Cost	Total Cost	Estimate Basis
Capital Costs						
Site Preparation						
Site Preparation and Mobilization	Miscellaneous site preparation	1	EACH	$ 4,500	$ 4,500	Engineering Estimate
GPR Survey	Ground penetrating radar (GPR) survey of site	1	EACH	$ 1,500	$ 1,500	Engineering Estimate
Injection Point Locations and GPR Survey Oversight	Mark injection point locations and oversight of GPR survey to clear/revise injection point locations	1	EACH	$ 1,600	$ 1,600	Engineering Estimate
				Subtotal	$ 7,600	
ISCR Injection						
Provect-IR ISCR Amendment	Purchase ~15 Super Sacks of IR amendment	29,625	LB	$ 2.40	$ 71,100	Provectus email 10/2022
Shipping - ISCR Amendment	Shipping for IR amendment	1	EACH	$ 15,000	$ 15,000	Engineering Estimate
Mobilization/Demobilization	Mob/demob of ISCR injection equipment plus setup and breakdown	1	EACH	$ 8,000	$ 8,000	Estimate from Cascade quote (9/2022), TX site
Injection Services	Inject IR per work plan at 16 injection points, contractor labor, and injection equipment	10	DAY	$ 4,150	$ 41,500	Estimate from Cascade quote (9/2022), TX site
Per Diem	Per diem for injection services contractor	11	DAY	$ 650	$ 7,150	Estimate from Cascade quote (9/2022), TX site
Fork Lift Rental	Forklift for unloading Super Sacks and staging for mixing	10	DAY	$ 250	$ 2,500	Estimate from Cascade quote (9/2022), TX site
Reporting and HASP - Injection Contractor		1	EACH	$ 1,500	$ 1,500	Estimate from Cascade quote (9/2022), TX site
Remediation Management/Oversight	Oversight and management of ISCR injection implementation	12	DAY	$ 2,000	$ 24,000	Engineering Estimate
				Subtotal	$ 170,750	
Post ISCR Injection						
DPT groundwater sampling to confirm MW locations	Using fixed laboratory, estimated 3 to 4 days for twelve proposed well locations	4	DAY	$ 4,500	$ 18,000	
Monitoring Well Installation - DPT	Installation, development, and surveying of twelve monitoring wells using DPT (includes installation, surveying, and oversight), estimated 5 days	5	DAY	$ 4,700	$ 23,500	Engineering Estimate, Environmental Drilling Services Estimate (10/2022)
Initial Groundwater Sampling	Collection and analysis of groundwater samples from twelve newly installed monitoring wells for select CVOCs (TCE, cDCE, tDCE, 1,1,-DCE, and VC); methane, ethene, ethane, sulfide, TOC, ammonia, iron, TDS, TRPH, sodium, and sulfate.	1	EACH	$ 7,950	$ 7,950	Engineering Estimate
				Subtotal	$ 49,450	
Engineering Design, Management, and Reporting Costs						
Project Engineering/Management Support	Project coordination, health and safety, meetings, telephone conferences, progress reports, administrative support, permits	120	HOUR	$ 150	$ 18,000	Engineering Estimate
Implementation Work Plan	Implementation Work Plan per NASA Engineering Evaluation process	1	EACH	$ 30,000	$ 30,000	Engineering Estimate
Advance Data Package (ADP)	ADP preparation and presentation of CCR	1	EACH	$ 15,000	$ 15,000	Engineering Estimate
				Subtotal	$ 63,000	
				Total Capital Cost	**$ 290,800**	
Post-Implementation Costs						
Semi-annual Performance and LCP Monitoring and UIC Sampling	Collection and analysis of groundwater samples from six newly installed monitoring wells for select CVOCs (TCE, cDCE, tDCE, 1,1,-DCE, and VC); methane, ethene, ethane, sulfide, TOC, ammonia, iron, TDS, TRPH, sodium, and sulfate.	2	EVENT	$ 7,950	$ 15,900	Engineering Estimate
Biennial Performance Monitoring DPT groundwater sampling	Sampling to assess performance of ISCR, 2 years after injections.	1	EVENT	$ 60,000	$ 60,000	Previous DPT Event Expense
Reporting (Annual Report)/Data Evaluation	Document results of implementation and semi-annual performance monitoring (Annual Interim Measures Report)	1	EACH	$ 35,000	$ 35,000	Engineering Estimate
ADP	ADP preparation and presentation of results of implementation (Annual Interim Measures Report)	1	EACH	$ 15,000	$ 15,000	Engineering Estimate
				Subtotal	$ 125,900	
				Total Post-Implementation Annual Cost	**$ 65,900**	
				Total Post-Implementation Biennial Cost	**$ 191,800**	
				Total Remediation Cost (Capital and 3 Years of Monitoring)	**$ 548,500**	
				Total Remediation Cost (Capital and 5 Years of Monitoring)	**$ 680,300**	

Notes:
1-1-DCE = 1,1-dichloroethene
ADP = Advance Data Package
CCR = Construction Completion Report
cDCE = cis-1,2-dichloroethene
CVOC = chlorinated volatile organic compound
GPR = Ground Penetrating Radar
HASP = Health and Safety Plan
IMWP = Interim Measures Work Plan
ISCR = in situ chemical reduction
LB = pound
TCE = trichloroethene
tDCE = trans-1,2-dichloroethene
TDS = total dissolved solids
TOC = total organic carbon
TRPH = total recoverable petroleum hydrocarbons
UIC = underground injection control
VC = vinyl chloride

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NASA. 2016c. *MLP/VAB Area, SWMU No. 056, 2016 Corrective Measures Implementation Progress Report (Revision 0).* Prepared by Geosyntec Consultants Inc., Titusville, Florida.

NASA. 2017. *MLP/VAB Area, SWMU No. 056, Hot Spot 3 Bioremediation Implementation Work Plan (Revision 0).* Prepared by Geosyntec Consultants Inc., Titusville, Florida.

NASA. 2018a. *MLP/VAB Area, SWMU No. 056, Hot Spot 3 Bioremediation Construction Completion Report (Revision 0).* Prepared by Geosyntec Consultants Inc., Titusville, Florida.

NASA. 2018b. *MLP/VAB Area, SWMU No. 056, Hot Spot 3 Bioremediation Annual Interim Measure Report (Revision 0).* Prepared by Geosyntec Consultants Inc., Titusville, Florida.

NASA. 2019. *MLP/VAB Area, SWMU No. 056, CMI and IM Annual Report: Biosparge and Air Sparge System O&M, Hot Spot 3 Bioremediation IM, and Interim Groundwater Monitoring, Advanced Data Package (Revision 0).* Prepared by Geosyntec Consultants Inc., Titusville, Florida.

NASA. 2022. *MLP/VAB Area, SWMU No. 056, CMI and IM Annual Status Report: Summary of Biosparge System Operation and Maintenance, and Interim Groundwater Monitoring (Revision 0).* Prepared by AECOM Technical Services, Inc., Orlando, Florida.

Provectus Environmental Products, Inc. 2017. *Provect-IR® Handling and Application Guidelines.* December 2017.

APPENDIX A

KSCRT MEETING MINUTES: SEPTEMBER 2021

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DAY 3

2109-M10 – Randy Sillan/AECOM

Mobile Launch Platform Rehabilitation (MLP) Sites and VAB Area Hot Spot #3 (SWMU 056), September 2021

Goal: The goal is to present 2021 direct push technology (DPT) groundwater sampling results from the Hot Spot 3 area and gain Team concurrence of the path forward. Field efforts summarized in the ADP include sampling for chlorinated volatile organic compound (CVOC) analysis. The objective of the ADP is to present current site conditions that support additional interim measures.

Discussion: Taking advantage of a lull in construction activities at the MLP, 188 DPT groundwater samples were collected at 62 locations and analyzed for CVOCs to evaluate current site conditions. A subset of samples was also analyzed for parameters useful in evaluating bioremediation. CVOC results confirm that the 2017 emulsified vegetable oil injections and bioaugmentation interim measure (IM) has decreased CVOC mass and shrunken the plume footprint. A small area with elevated trichloroethene (TCE) concentrations indicate a source is likely still present. The geochemical parameters indicate that aquifer conditions may be limiting enhanced reductive dechlorination. The recommended path forward is to utilize in situ chemical reduction (ISCR) by emplacing a product that enhances biotic and abiotic reduction of CVOCs for a long period (5 or more years), and maintains optimal conditions by limiting methanogenesis and managing sulfate reduction and sulfide accumulation. Preparation of an IM Work Plan is the next step.

FDEP requested clarification regarding the footprint and depths of the 2017 IM and conceptual treatment area for additional treatment. AECOM stated that concentrations above NADC are in similar locations now as prior to the 2017 IM, but the CVOC concentrations are lower compared to 2017. Since the groundwater flow is toward an Outstanding Florida Water, FDEP asked if a consideration had been given to expanding the existing air sparge system, which might be more quickly implemented since there is an infrastructure in place. NASA described the difficulties with accessibility and construction in the adjacent crawlerway and the highly compacted ground around the MLP. FDEP noted that the underground injection

control component of the proposed ISCR IM may require public notice.

The Team reached consensus to proceed with an IM Work Plan to implement ISCR to treat key CVOCs (TCE, cis-1,2-dichloroethene [cDCE], and VC) exceeding their respective NADC (TCE greater than 300 ug/L, cDCE greater than 700 ug/L, and VC greater than 100 ug/L) **(2109-D35).**

Results: Decision Item 2109-D35

2109-M11 Jennifer Joyal/AECOM

KSC Center-Wide Per- and Polyfluoroalkyl Substances (PFAS) Investigation, Areas of Potential Concern (AOPC), September 2021

As a general note, NASA stated that the confirmation sampling that was performed or is planned at these AOPCs is for purposes of determining the presence or absence of PFAS. If there are detections, then the location will move into site assessment (SA) and at that time the extents of the PFAS will be determined. If media were not sampled prior, the SA is where that would get picked up.

Center-wide surface water sampling was conducted within the Industrial Area and other regional areas. The regional results will be presented at a future meeting.

AOPC 1 is the former Fire and Rescue Building at the Shuttle Landing Facility (SLF). It was used for emergency vehicle parking during landings, former fire pump testing, and former aqueous film-forming foam (AFFF) storage according to interviews. Phase III CS will include groundwater and soil sampling at this location. FDEP requested that a surface water sample be collected from the ditch by the AOPC on the east side of the landing strip. NASA inquired if a sample should also be collected for the swale north of Sharkey Road? FDEP concurred. The Phase III sampling results will be presented to the Team.

AOPC 2 is the former Contractor Support Building #7 north of the VAB area. According to interviews, this location was a former storage area for AFFF materials. A groundwater sample collected from this area during the Phase I CS revealed PFOA and PFOS

September 2021 Decision Items Rev 2		
Decision No.	**Minutes Reference**	**Decision**
2109-D26	2109-M09	**KSC Center-Wide Per- and Polyfluoroalkyl Substances (PRL 237) Locations of Concern, September 2021:** The Team reached consensus to proceed with site assessment activities under SWMU #116, Fire Station #1 Area (formerly known as Fire Station #4; includes PRL #237 LOC 19); site assessment activities are under contract.
2109-D27	2109-M09	**KSC Center-Wide Per- and Polyfluoroalkyl Substances (PRL 237) Locations of Concern, September 2021:** The Team reached consensus to proceed with site assessment activities under SWMU #117, Sewage Treatment Plant #1 and Sludge Disposal Area (includes PRL #237 LOC 20 and PFAS impacts at SWMU #067 [POL Area, M6-0894]).
2109-D28	2109-M09	**KSC Center-Wide Per- and Polyfluoroalkyl Substances (PRL 237) Locations of Concern, September 2021:** Team consensus was reached for no further action for LOC 22.
2109-D29	2109-M09	**KSC Center-Wide Per- and Polyfluoroalkyl Substances (PRL 237) Locations of Concern, September 2021:** Team consensus reached to proceed with site assessment activities under SWMU #099, Visitors Center Maintenance Area.
2109-D30	2109-M09	**KSC Center-Wide Per- and Polyfluoroalkyl Substances (PRL 237) Locations of Concern, September 2021:** Team consensus was reached to proceed with site assessment activities under SWMU #120, Former Treatment Plant #11 and Percolation Pond.
2109-D31	2109-M09	**KSC Center-Wide Per- and Polyfluoroalkyl Substances (PRL 237) Locations of Concern, September 2021:** Team consensus was reached for no further action for LOC 26 with further surface water assessment proceeding as part of LOC 31.
2109-D32	2109-M09	**KSC Center-Wide Per- and Polyfluoroalkyl Substances (PRL 237) Locations of Concern, September 2021:** Team consensus was reached to proceed with site assessment activities under SWMU #118, KARS Park II Area (2109-D33).
2109-D33	2109-M09	**KSC Center-Wide Per- and Polyfluoroalkyl Substances (PRL 237) Locations of Concern, September 2021:** Team consensus was reached to proceed with site assessment activities under SWMU #014, Base Support Building (includes PRL #237 AOPC 12 and LOC 32).
2109-D34	2109-M09	**KSC Center-Wide Per- and Polyfluoroalkyl Substances (PRL 237) Locations of Concern, September 2021**: Team consensus was reached to proceed with site assessment activities under SWMU #003, Ransom Road Landfill.
2109-D35	2109-M10	**Mobile Launch Platform Rehabilitation (MLP) Sites and VAB Area Hot Spot #3 (SWMU 056), September 2021:** The Team reached consensus to proceed with an IM Work Plan to implement ISCR to treat key CVOCs (TCE, cDCE, and VC) exceeding their respective NADC (TCE greater than 300 ug/L, cDCE greater than 700 ug/L, and VC greater than 100 ug/L).
2109-D36	2109-M11	**KSC Center-Wide Per- and Polyfluoroalkyl Substances (PFAS) Investigation, Areas of Potential Concern (AOPC), September 2021:** Team consensus reached to proceed with site assessment activities at AOPC 2 based upon the Phase I CS results. A SWMU name and number will be assigned.

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APPENDIX B

HOT SPOT 3 PERFORMANCE MONITORING ADP DATED SEPTEMBER 17, 2021

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AECOM
150 North Orange Avenue, Suite 200
Orlando, Florida 32801
www.aecom.com

September 17, 2021

Ms. Anne Chrest
Remediation Project Manager
National Aeronautics and Space Administration
Mail Code SI-E2
Building K6-1547 (Logistics Facility)
John F. Kennedy Space Center
Kennedy Space Center, FL 32899-0001

Subject: **Mobile Launch Platform (MLP) Rehabilitation Sites and the Vehicle Assembly Building (VAB) Area, (Solid Waste Management Unit [SWMU] 056), Hot Spot 3 (HS3) Performance Monitoring Advanced Data Package (ADP)**
September 2021 Kennedy Space Center Remediation Team (KSCRT) Meeting

Reference: **Indefinite Delivery Indefinite Quantity (IDIQ) Contract 80KSC019D0010**

Dear Ms. Chrest:

AECOM Technical Services, Inc. (AECOM) is pleased to provide Kennedy Space Center (KSC), National Aeronautics and Space Administration (NASA), with the ADP for the MLP/VAB Area (SWMU 056). The purpose of the ADP is to present direct push technology (DPT) groundwater sampling activities performed at the Hot Spot 3 area in March and April 2021.

Field efforts summarized in the ADP include 188 DPT groundwater samples collected at 62 locations for chlorinated volatile organic compound (CVOC) analysis. The objective of the ADP is to present current site conditions that support additional interim measures.

In summary, remediation progress from former Emulsified Vegetable Oil injections has decreased CVOC mass and plume footprint. Elevated concentrations in select areas indicate a source is likely still present, however geochemical parameters indicate limiting enhanced reductive dichlorination conditions. AECOM recommends creating optimal conditions for long-term CVOCs degradation that treats plumes and mass flux from the source with in situ chemical reduction (ISCR) by (i) emplacing a product that enhances biotic and abiotic reduction of CVOCs for a long period (5 or more years), and (ii) maintains optimal conditions by limiting methanogenesis and managing sulfate reduction and sulfide accumulation. The following consensus statement will be presented to the KSCRT: Proceed with an IMWP to implement ISCR to treat key CVOCs (TCE, cDCE, and VC) exceeding their respective NADC (TCE greater than 300 ug/L, cDCE greater than 700 ug/L, and VC greater than 100 ug/L).

Should you require additional information, please contact Linnea King Clark at linnea.king@aecom.com or via phone at 407.456.1535.

Sincerely,

AECOM Technical Services, Inc.

Linnea King Clark
Task Order Manager

Jennifer Joyal, PE
Program Manager

Enclosure

Cc: FDEP
Richard Smith, HGL
Mark Speranza, Tetra Tech

Hot Spot 3 Performance Monitoring

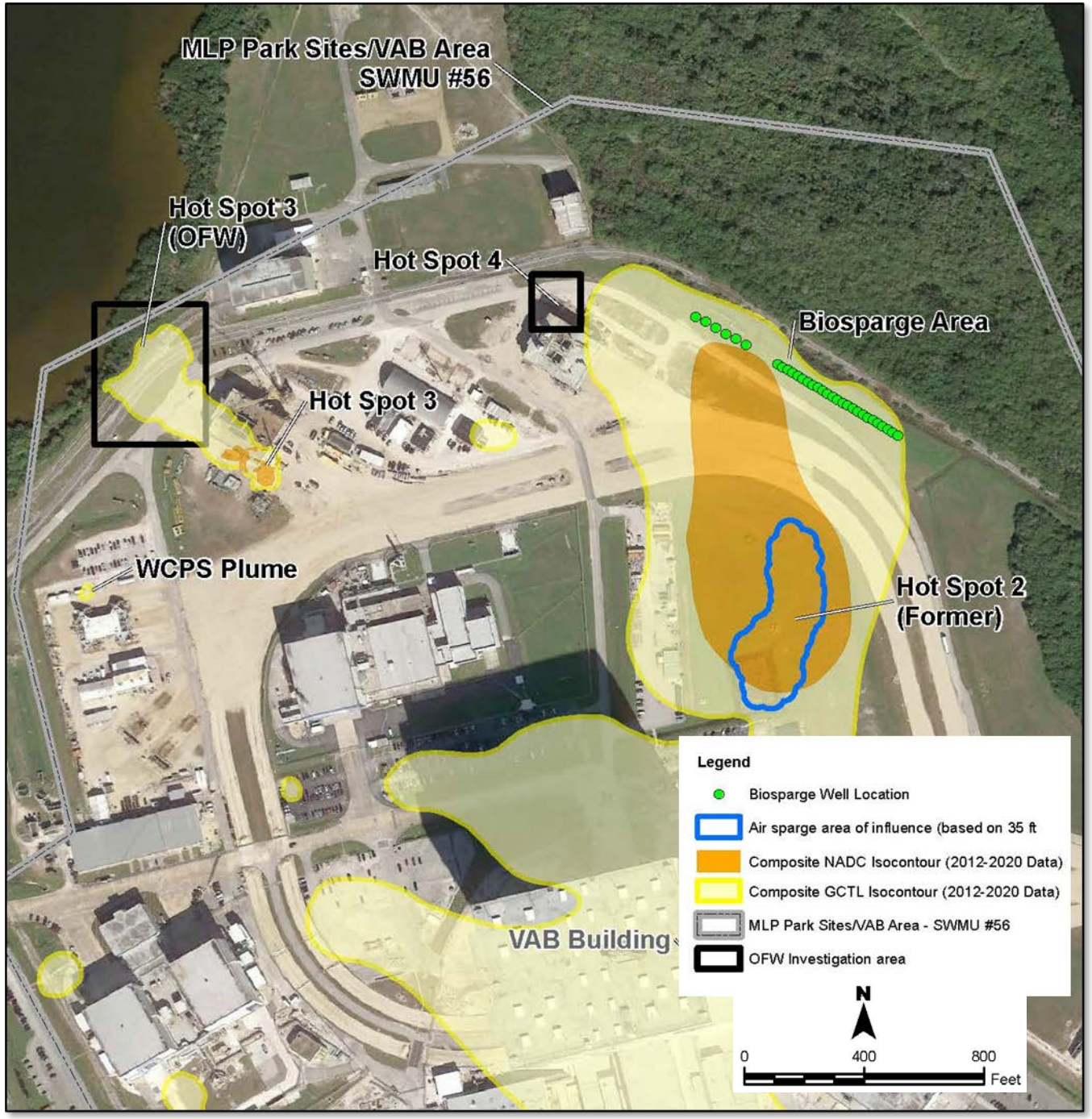
Mobile Launch Platform Rehabilitation Sites and Vehicle Assembly Building Area (MLP/VAB)

Solid Waste Management Unit (SWMU) 056

September 17, 2021

Outline

- Brief Hot Spot 3 (HS3) Background
- 2021 DPT Groundwater Sampling and Results
- Conclusion
- Team Consensus



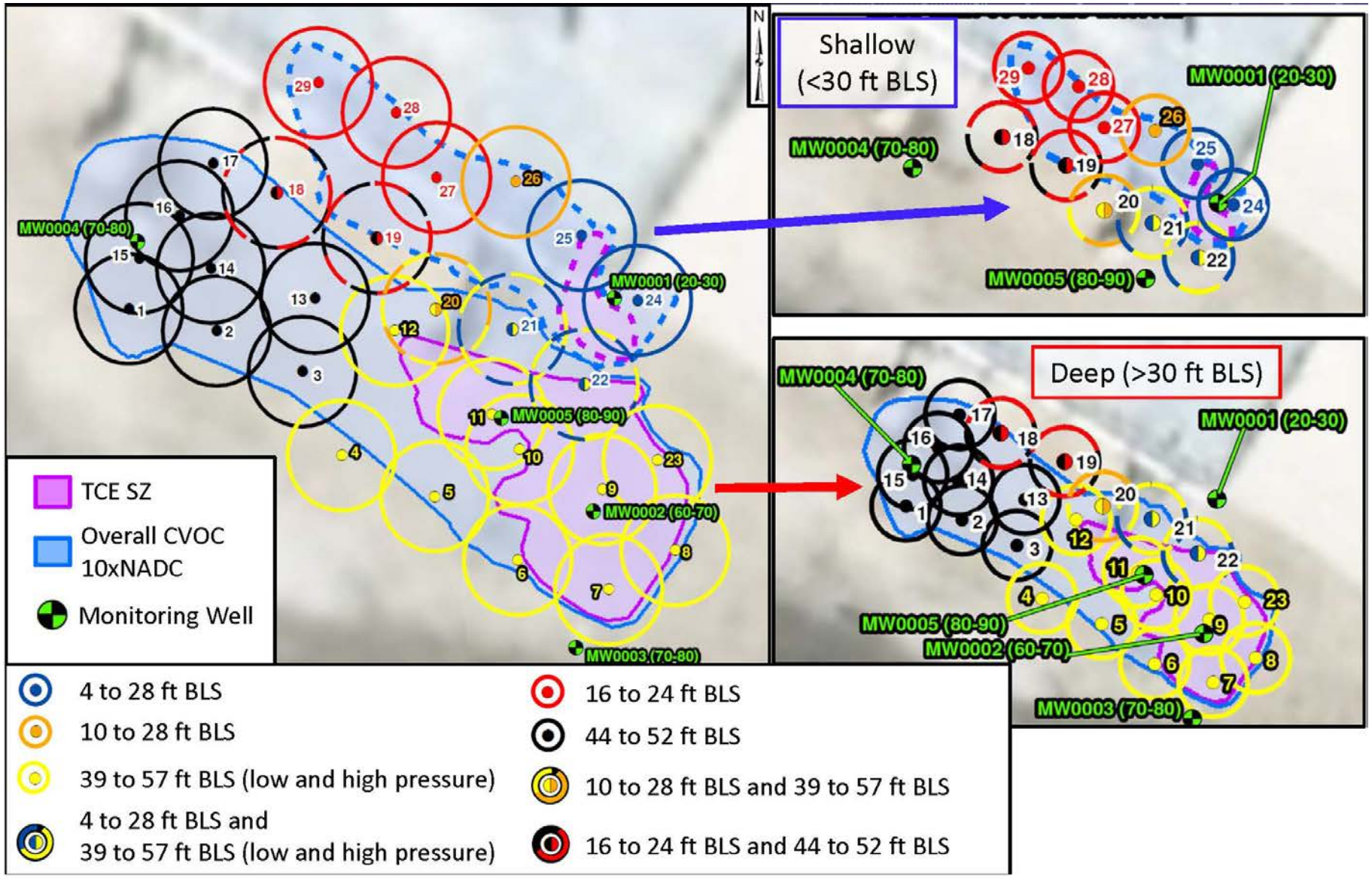
Brief HS3 Background

- **2012 - 2014** – VAB Reassessment identified chlorinated volatile organic compounds (CVOCs) greater than 10 times the Natural Attenuation Default Concentrations (10xNADCs)
- **2015** – Site characterization delineated CVOCs (Groundwater Cleanup Target Levels [GCTL], NADC, 10xNADC])
- **2016** – Remedial Alternative Evaluation selected bioremediation (CVOCs >10xNADCs)
- **2016 - 2017** – Interim Measures Work Plan (IMWP) and Implementation WP
  - Baseline direct-push technology (DPT) groundwater sampling
  - Monitoring well (MW) installation
  - Biostimulation (SRS-SD) and bioaugmentation (KB-1)
- **2017 (Jul/Aug)** – IM Implementation
  - 29 DPT injection locations
  - 174,300 gallons of emulsified vegetable oil (EVO) solution and 43 liters of KB-1
  - 9 MWs installed after injections

SRS-SD Formulation

Ingredient	Percent	Description
Food Grade U.S. Grown Soybean Oil	60%	Locally sourced soybean oil.
Food Grade Soluble Substrate	5.5%	Rapidly biodegradable soluble substrate
Proprietary Food Grade Nutrients	<1%	Proprietary organic and inorganic nutrients such as yeast extract, nitrogen and phosphorus.
Proprietary Food Grade Emulsifiers, Preservatives and other Organics	7.5%	Proprietary nonionic emulsifier and other organics
Vitamin B_{12}	<1%	250 µg/L of Vitamin B_{12}

Brief HS3 Background – 2017 Bioremediation IM



Brief HS3 Background

- **2018 (Feb & Aug)** – IM performance based on MW samples
  - 80 to 99% decrease of CVOCs based on concentrations at MWs
  - Distribution of total organic carbon (TOC) indicated design radius of influence (ROI) of 8 ft was achieved
- **2018 (Sept)** – 2 MWs added at downgradient edge
- **2019 (Feb/Mar)** – IM performance monitoring (MWs and DPT), 18 months
  - DPT – 87 groundwater samples from 19 locations
  - ~80 to 100% mass reduction in shallow intervals (~94% reduction in deep)
  - Minimal change from month 12 and conditions in some areas favored continued bioremediation
- **2019 (Apr)** – Area leased to commercial partner restricting access
  - MWs were abandoned in lease area
- **2020** – Lease was terminated and site access reinstated
- **2021 (Mar/Apr)** – DPT groundwater sampling to evaluate current site conditions

2021 DPT Groundwater Sampling

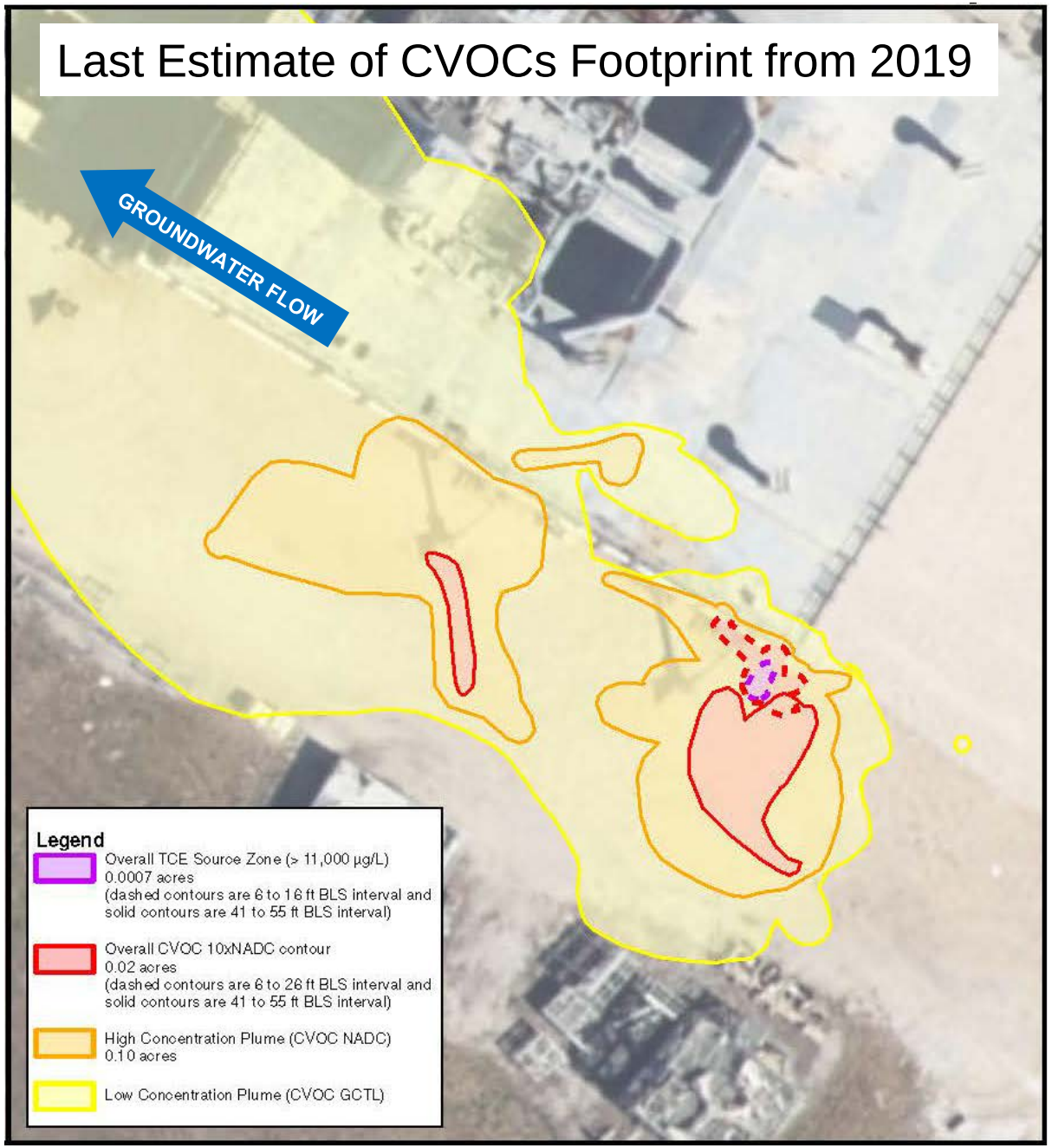
Objective – Evaluate current site conditions in the previously treated area and the need for bioremediation interim measures

Plan

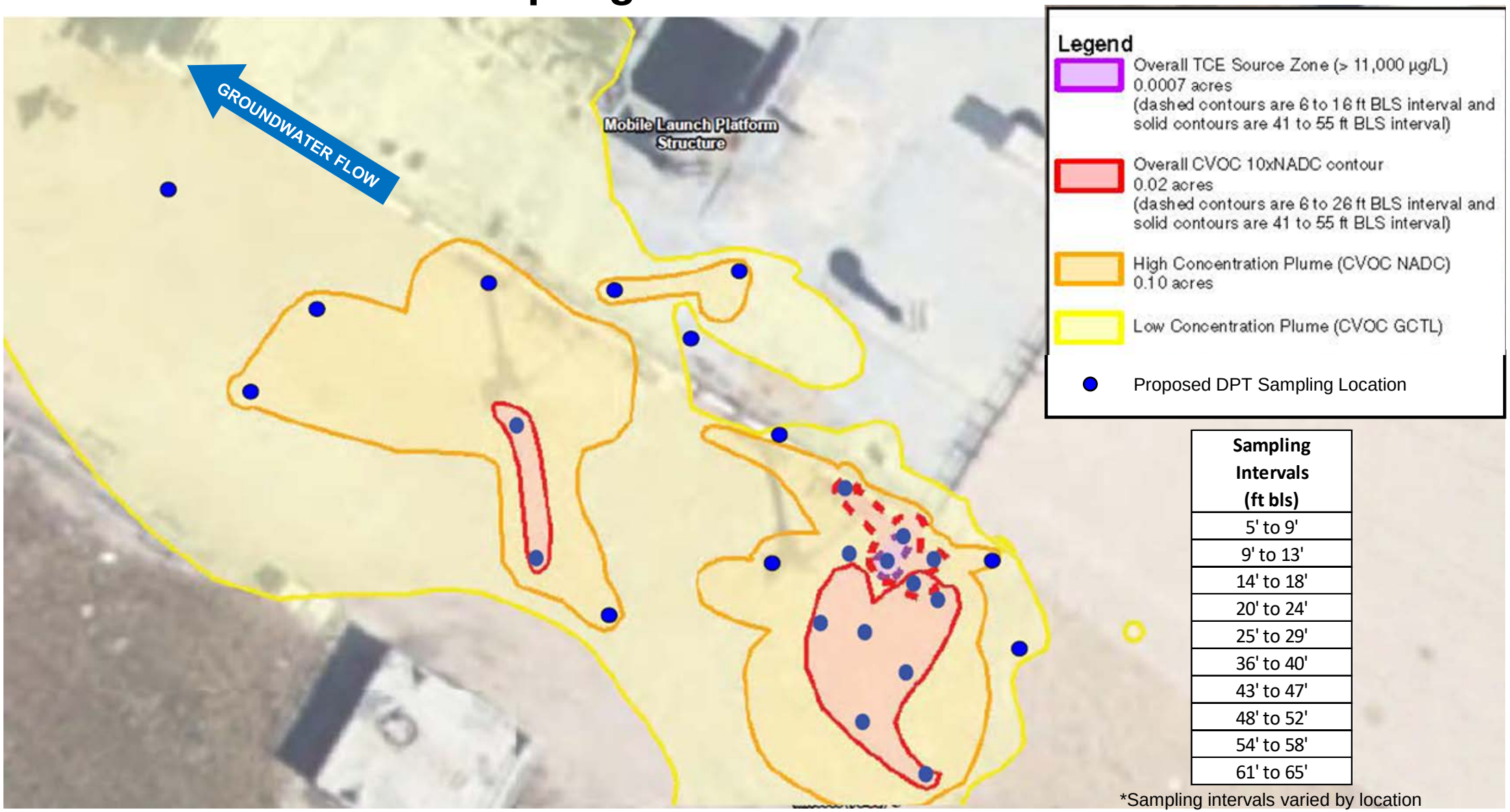
- Collect samples at locations with existing data (2019 DPT and MWs)
- Up to 26 DPT locations and 50 samples
- Modify based on mobile lab results

Actual

- April 1 - 16, 2021 (12 days)
- 188 samples from 62 locations (CVOCs)
- 43 samples analyzed for sulfate (SO_4^{2-}), sulfide (S^{2-}), TOC, ethane, ethene, and methane



2021 DPT Groundwater Sampling Plan

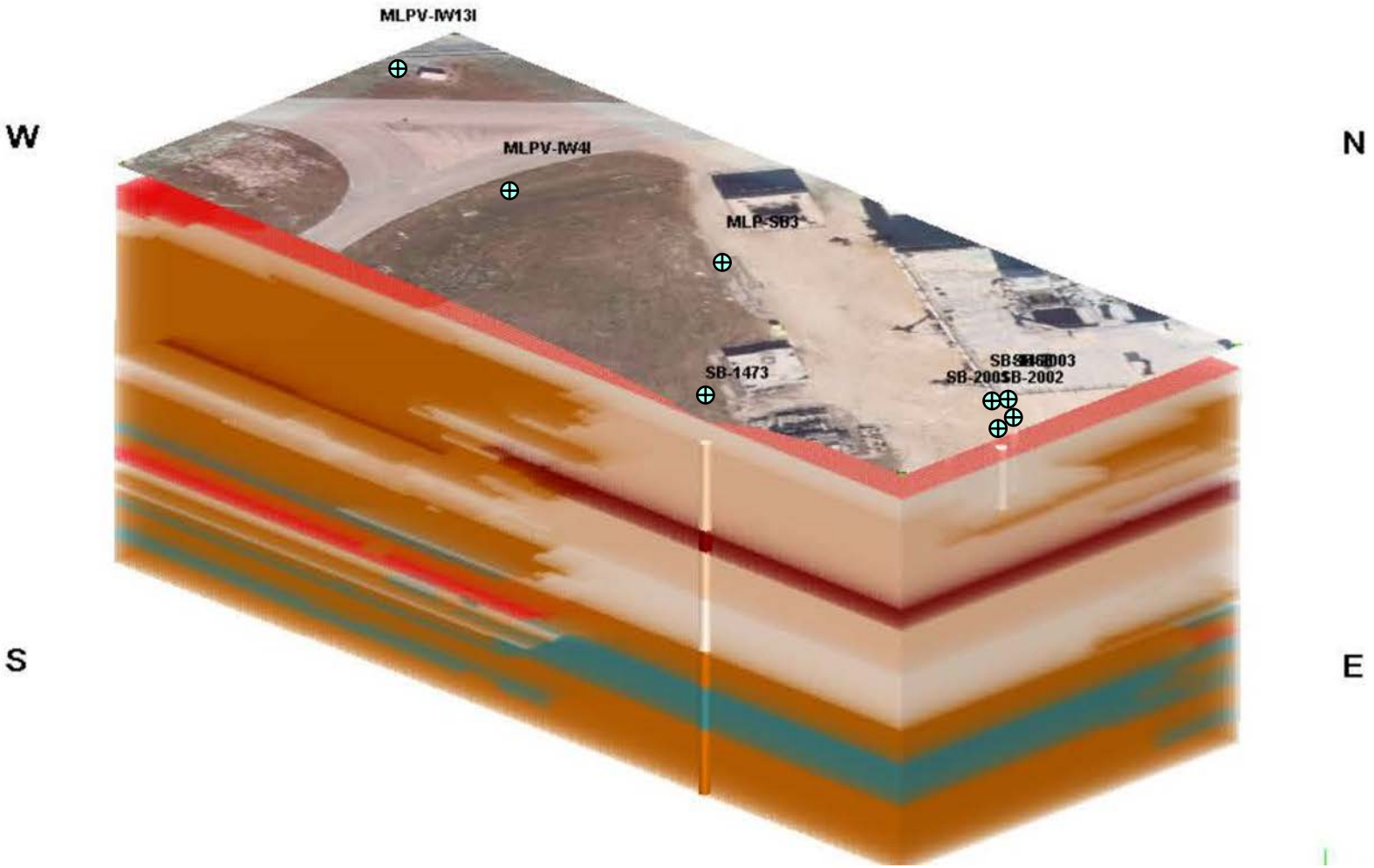


Sampling Intervals (ft bls)
5' to 9'
9' to 13'
14' to 18'
20' to 24'
25' to 29'
36' to 40'
43' to 47'
48' to 52'
54' to 58'
61' to 65'

*Sampling intervals varied by location

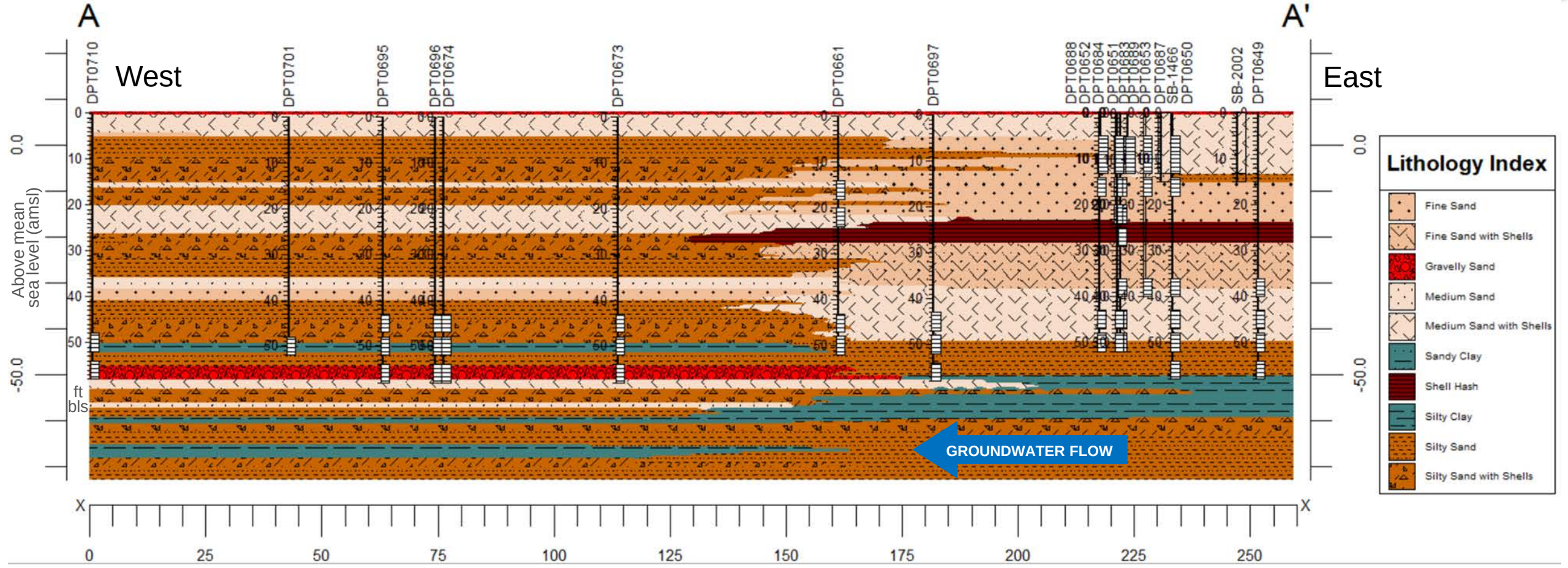
Lithology

- The site lithology model was revised
  - 3D lithology model created from geologic descriptions in 8 historical borings: MLPV-IW4I, MLP-SB3, MLPV-IW13I, SB-1466, SB-1473, SB-2001, SB-2002, and SB-2003
  - 2D profiles created from slices through the 3D model



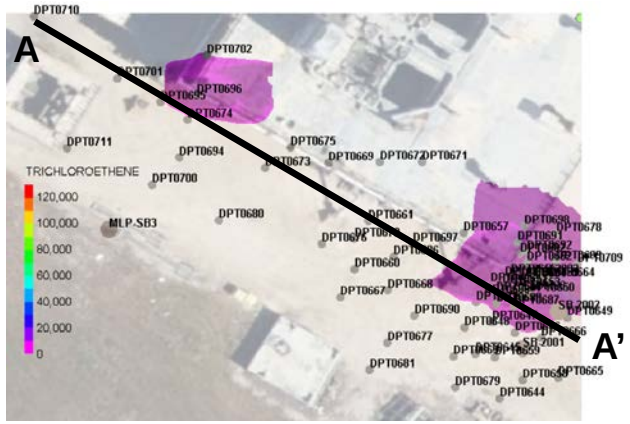
Lithology – Cross Section A-A’

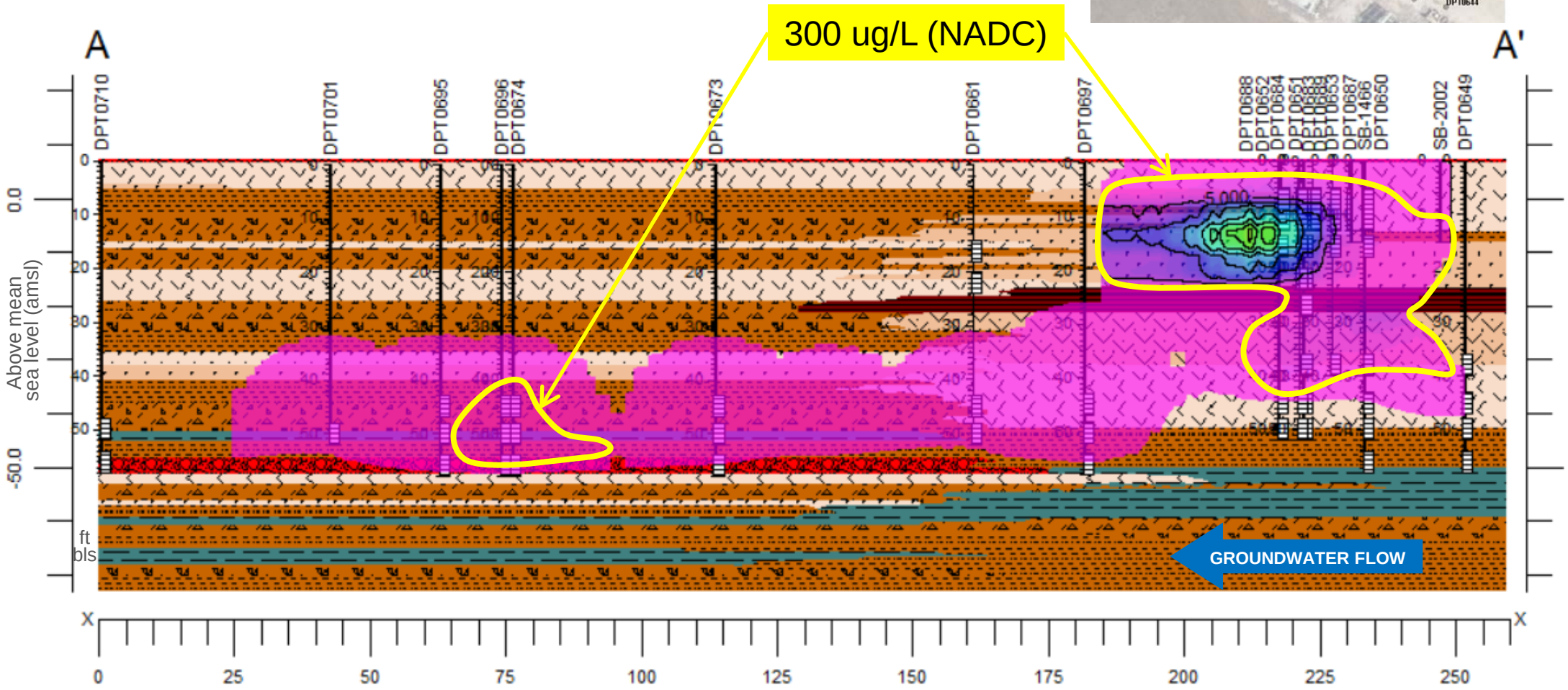
- East side is primarily well sorted fine to medium sand with shells
- Towards west, the silt content increases
- Clayey soil becomes more common at 60 ft bls

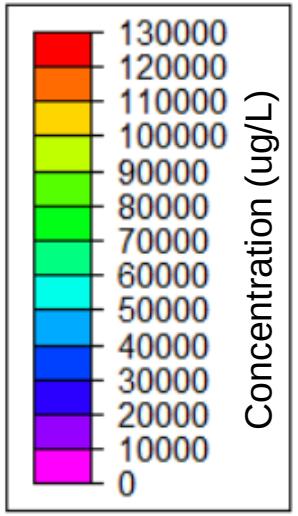


DPT Assessment Results – TCE (>3 ug/L)

- 11 samples >300 micrograms per liter (ug/L)
- Max=129,000 ug/L at DPT0683 between 9 – 13 ft bls



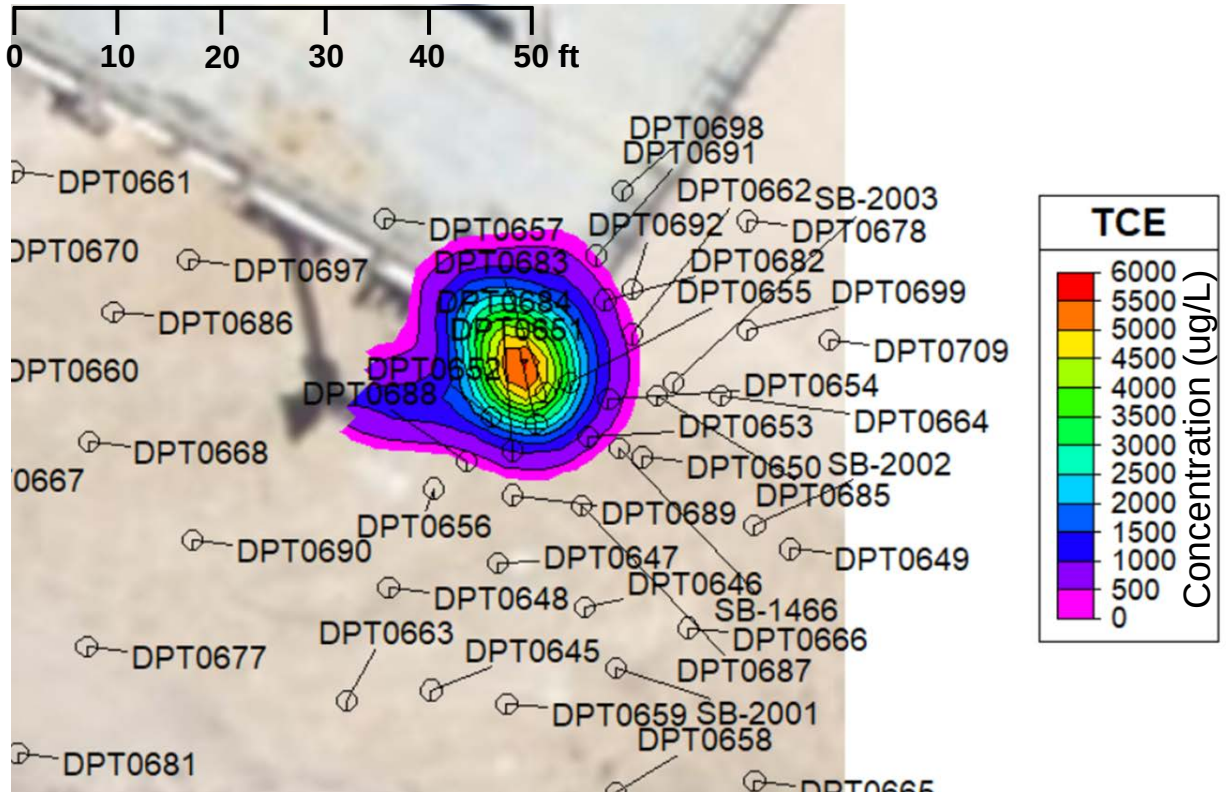




Note: Reporting Limits are included in the interpolated plume extents for all 3D models

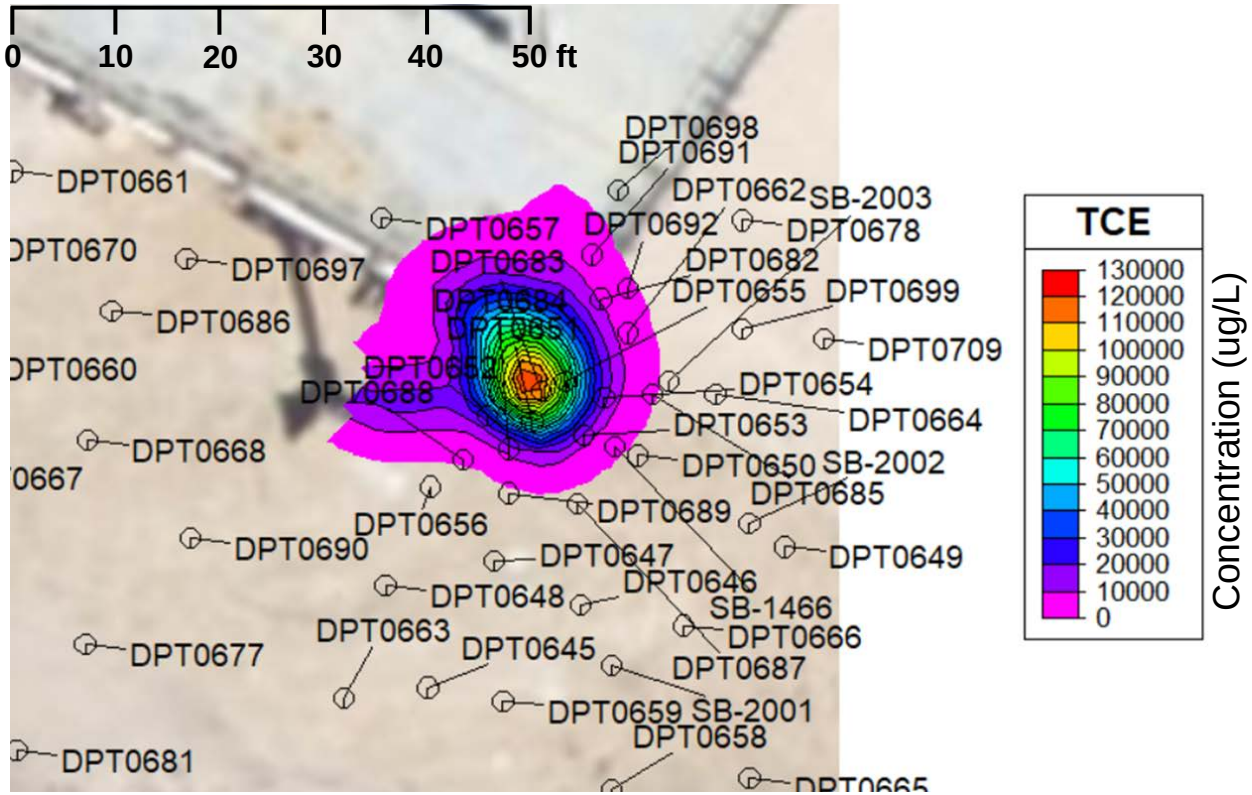
DPT Assessment Results – TCE (>300 ug/L) Plan View

7 ft bls (0 ft amsl)



(fine sand and silty sand)

11 ft bls (-4 ft amsl)

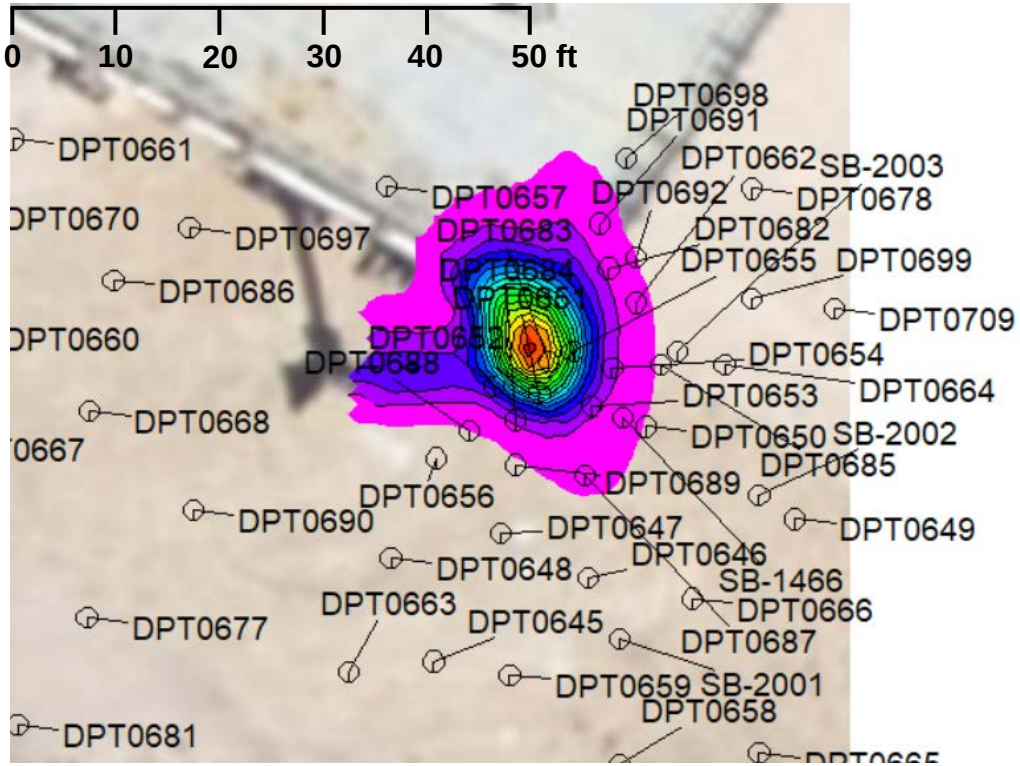


(fine sand and silty sand)

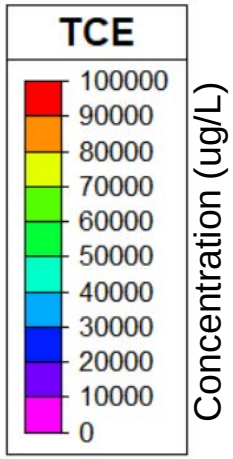
Note: Plan views of plumes are 2D slices through the 3D model of the CVOC concentrations

DPT Assessment Results – TCE (>300 ug/L) Plan View

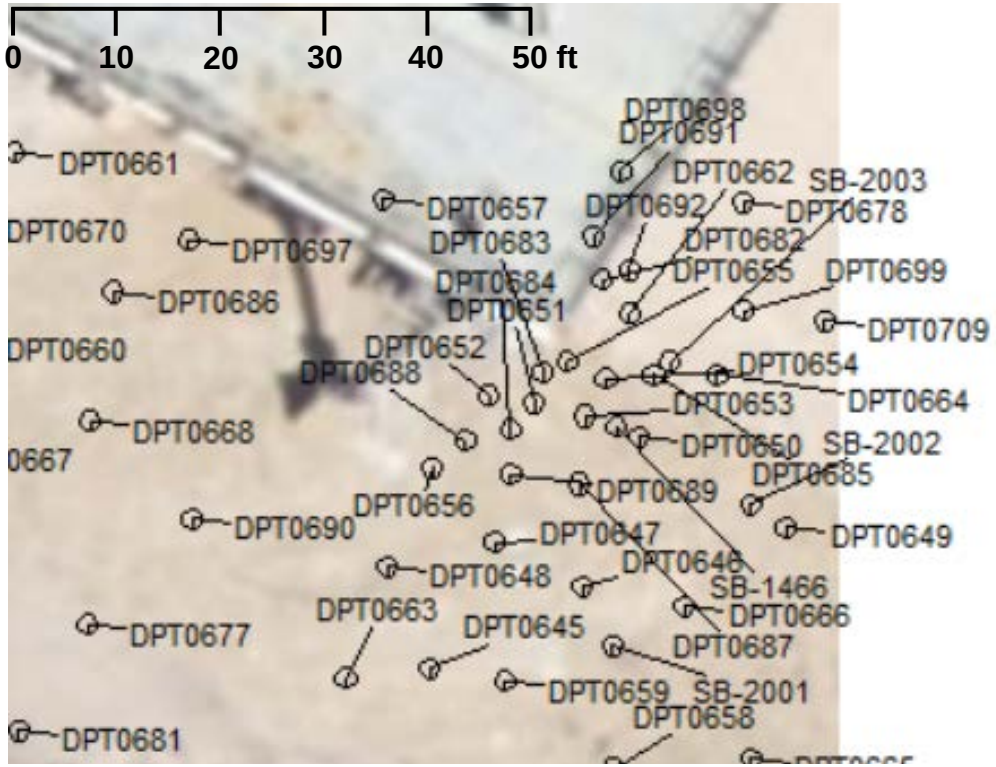
16 ft bls (-9 ft amsl)



(fine sand and silty sand)



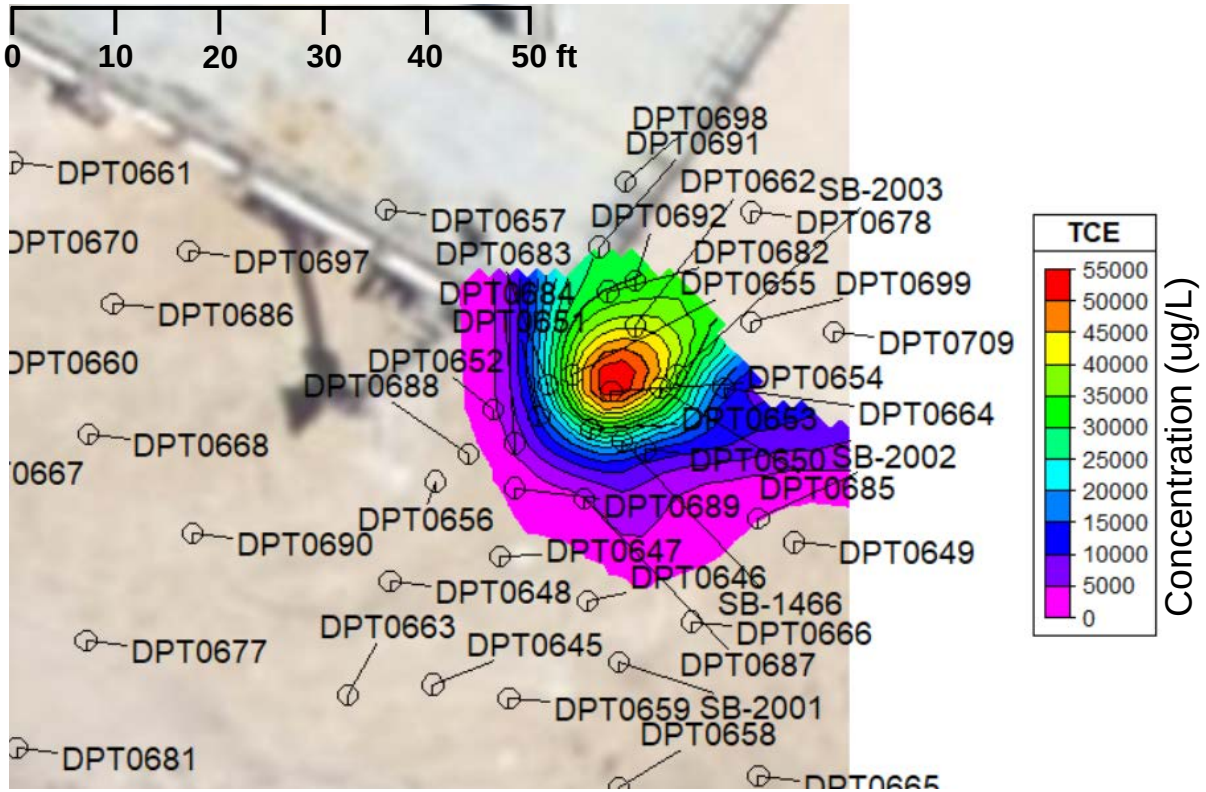
22 to 38 ft bls (-15 to -31 ft amsl)



(fine sand, shell hash, fine sand with shells)

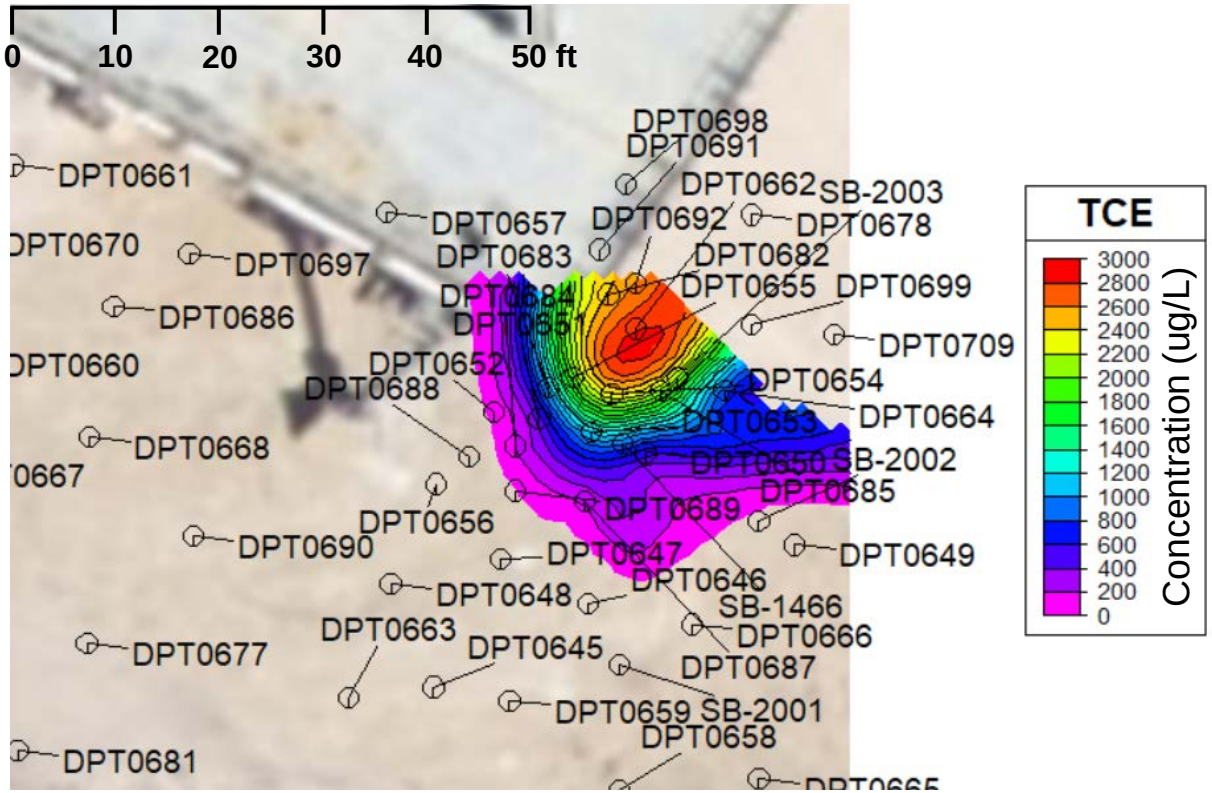
DPT Assessment Results – TCE (>300 ug/L) Plan View

45 ft bls (-38 ft amsl)



(medium sand with shells)

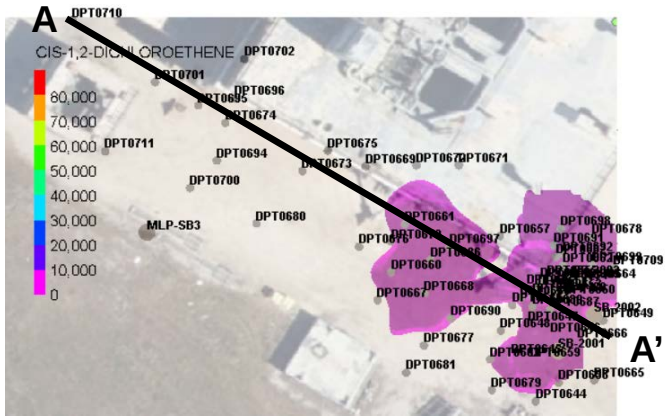
50 ft bls (-43 ft amsl)

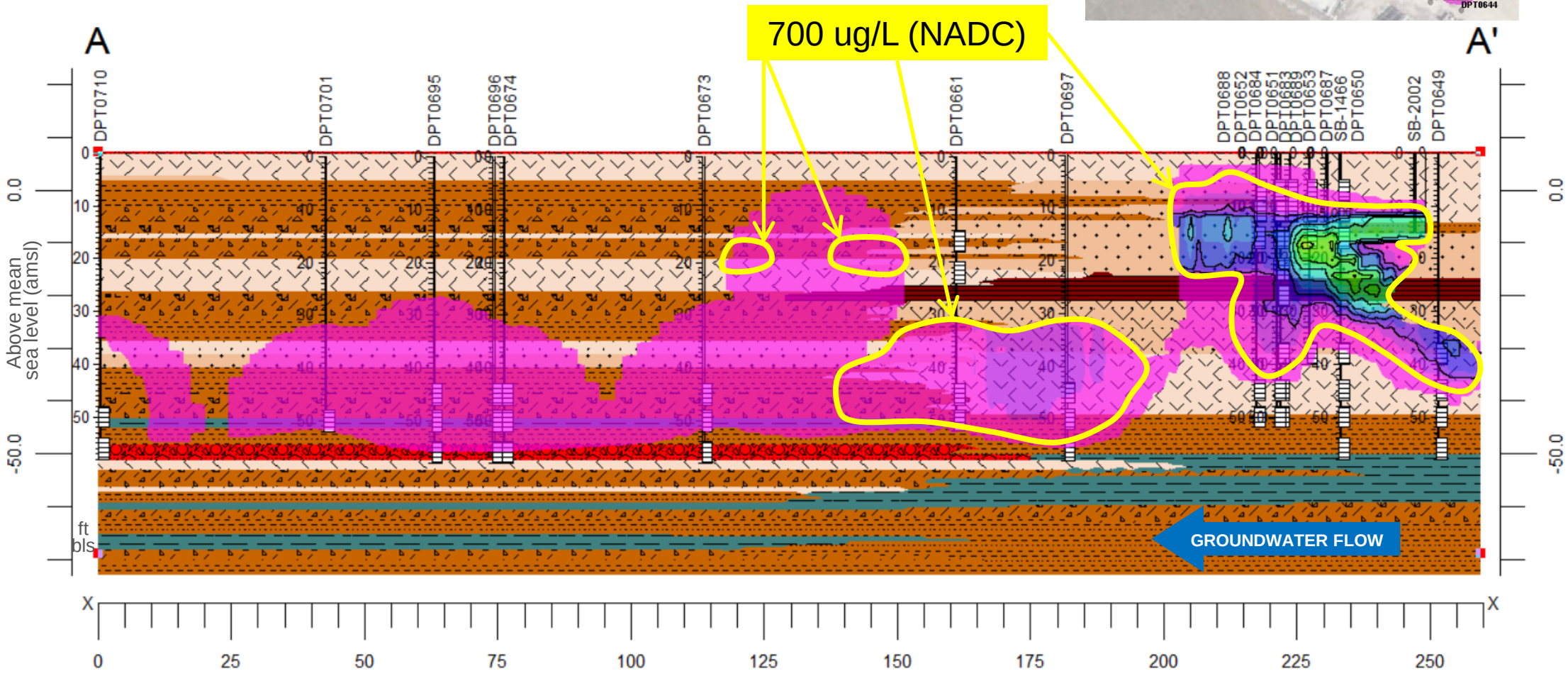


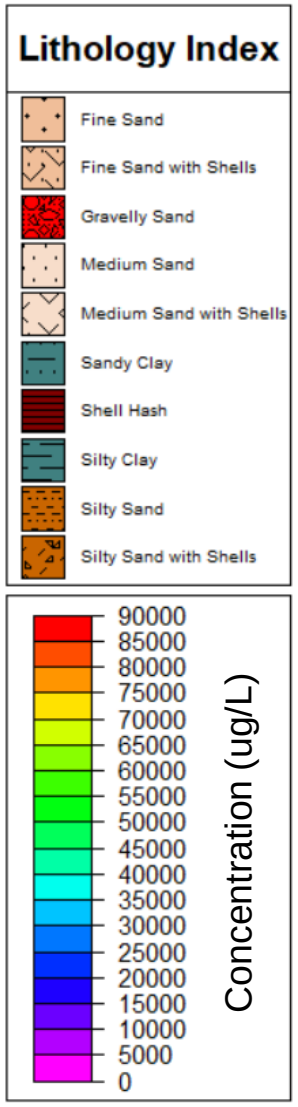
(silty sand)

DPT Assessment Results – cDCE (>70 ug/L)

- 24 samples >700 ug/L
- Max=88,000 ug/L at DPT0653 between 14-18 ft bls

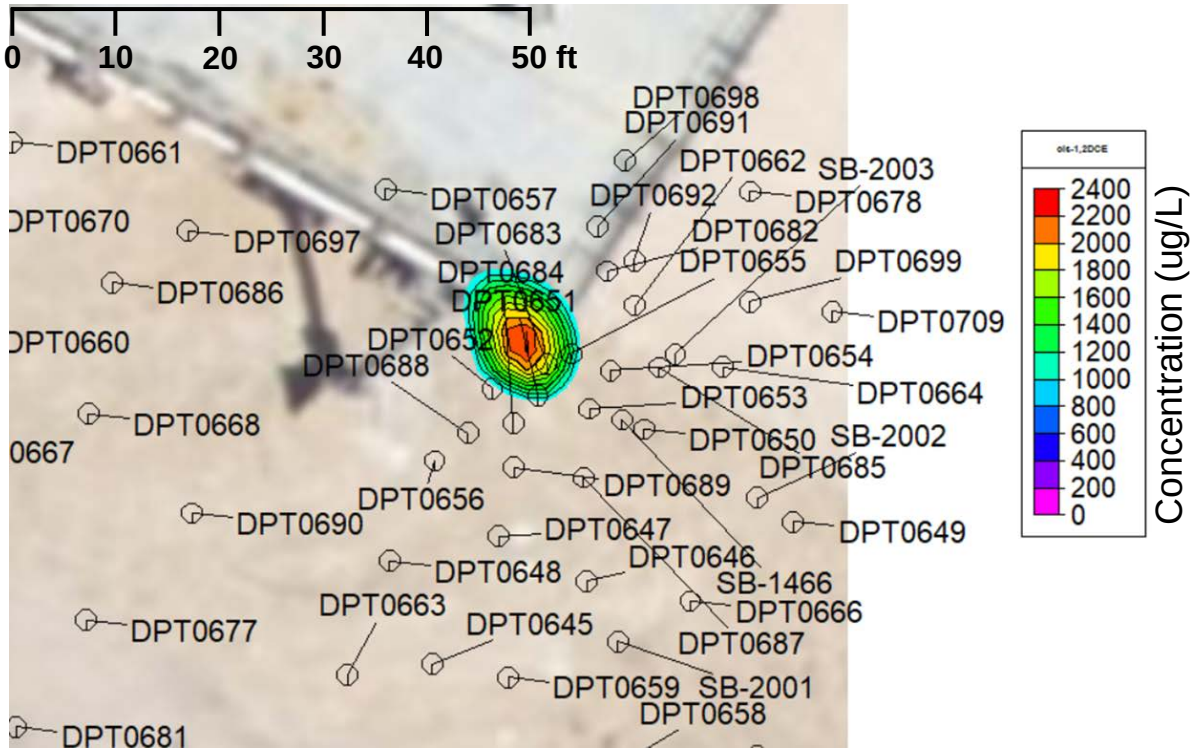






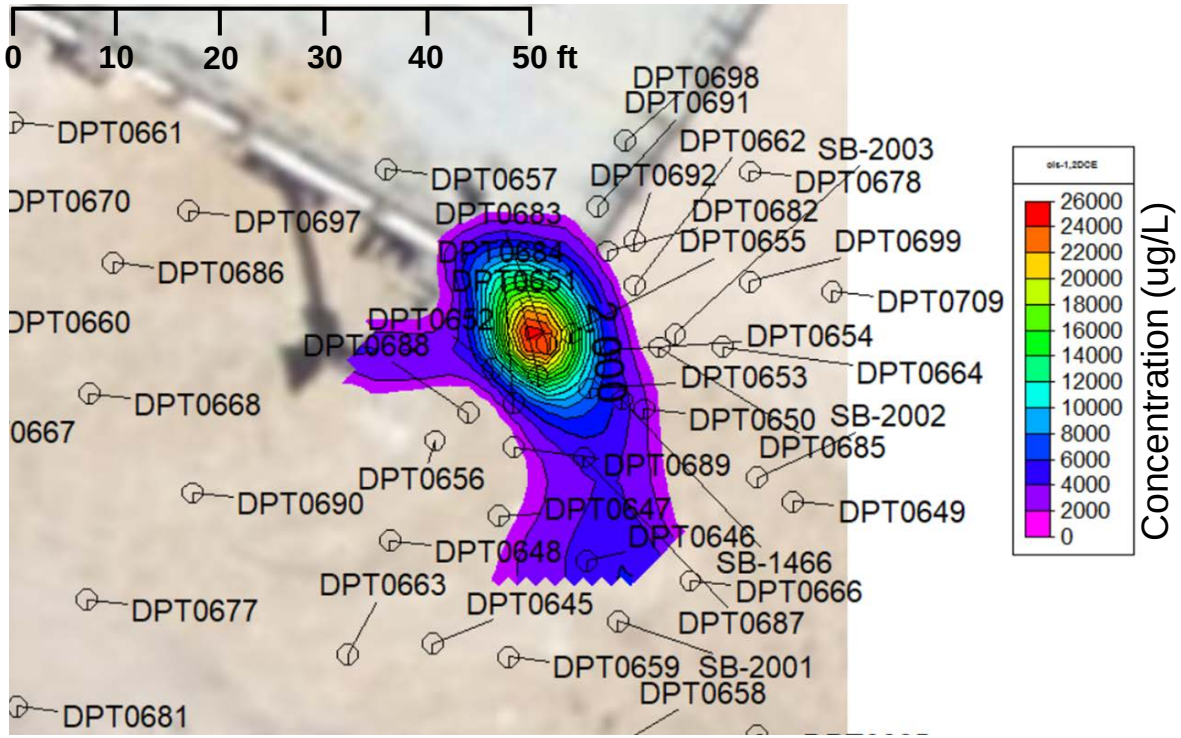
DPT Assessment Results – cDCE (>700 ug/L) Plan View

7 ft bls (0 ft amsl)



(fine sand and silty sand)

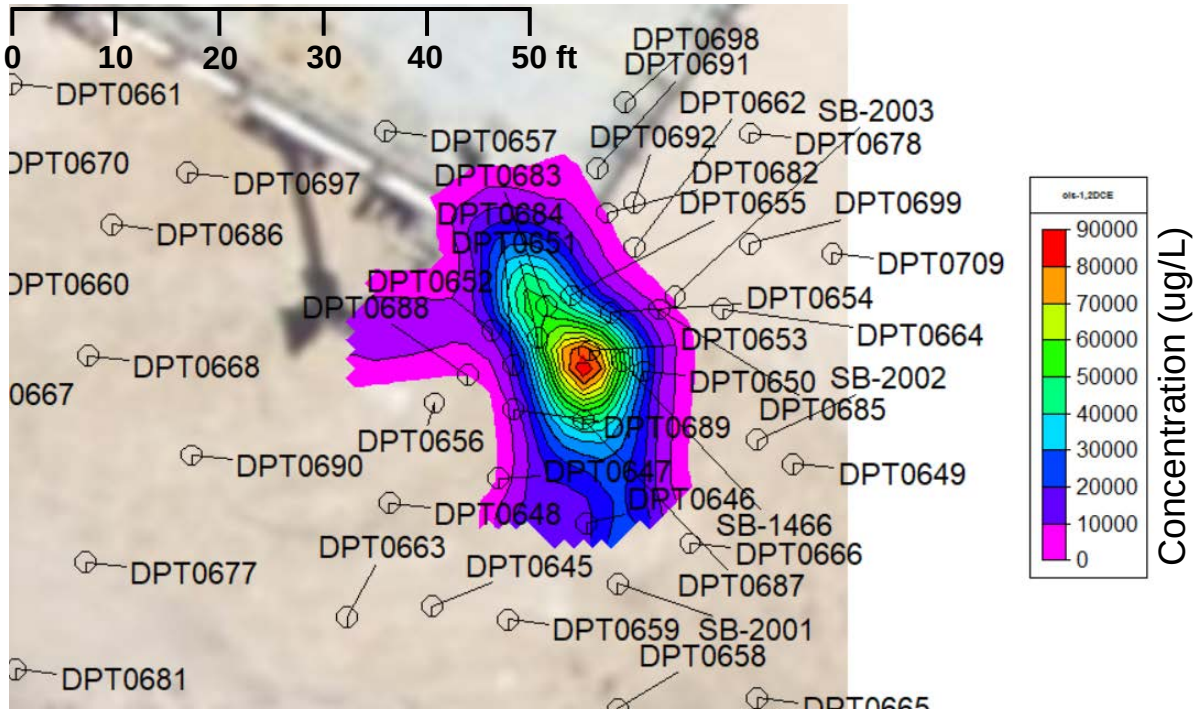
11 ft bls (-4 ft amsl)



(fine sand and silty sand)

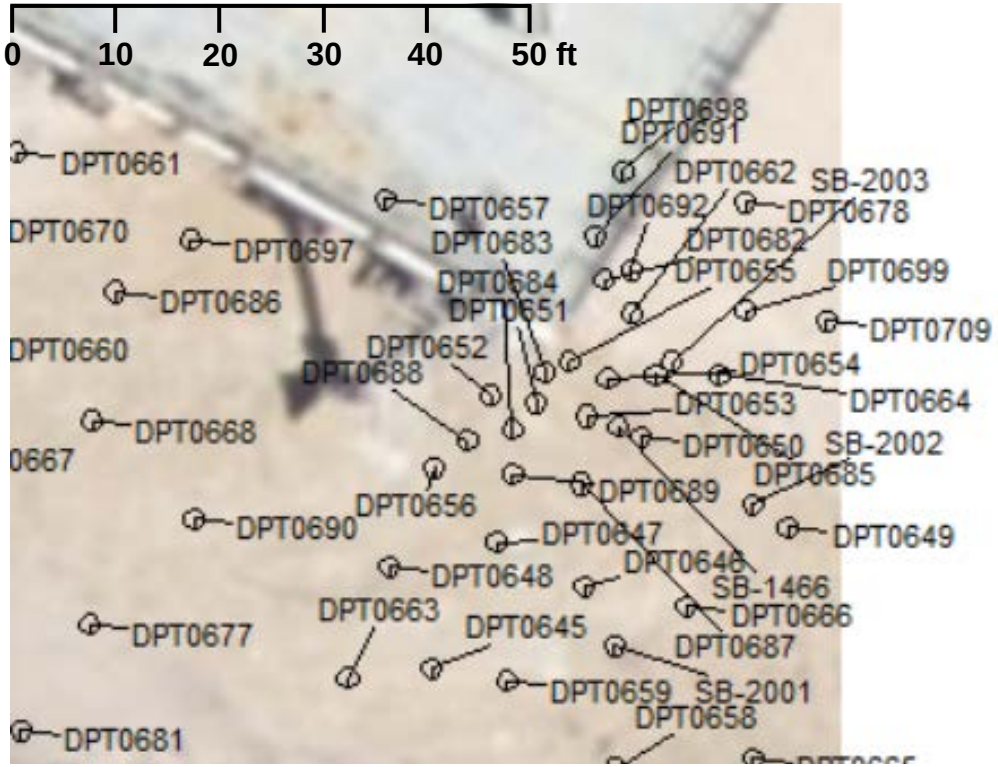
DPT Assessment Results – cDCE (>700 ug/L) Plan View

16 ft bls (-9 ft amsl)



(fine sand and silty sand)

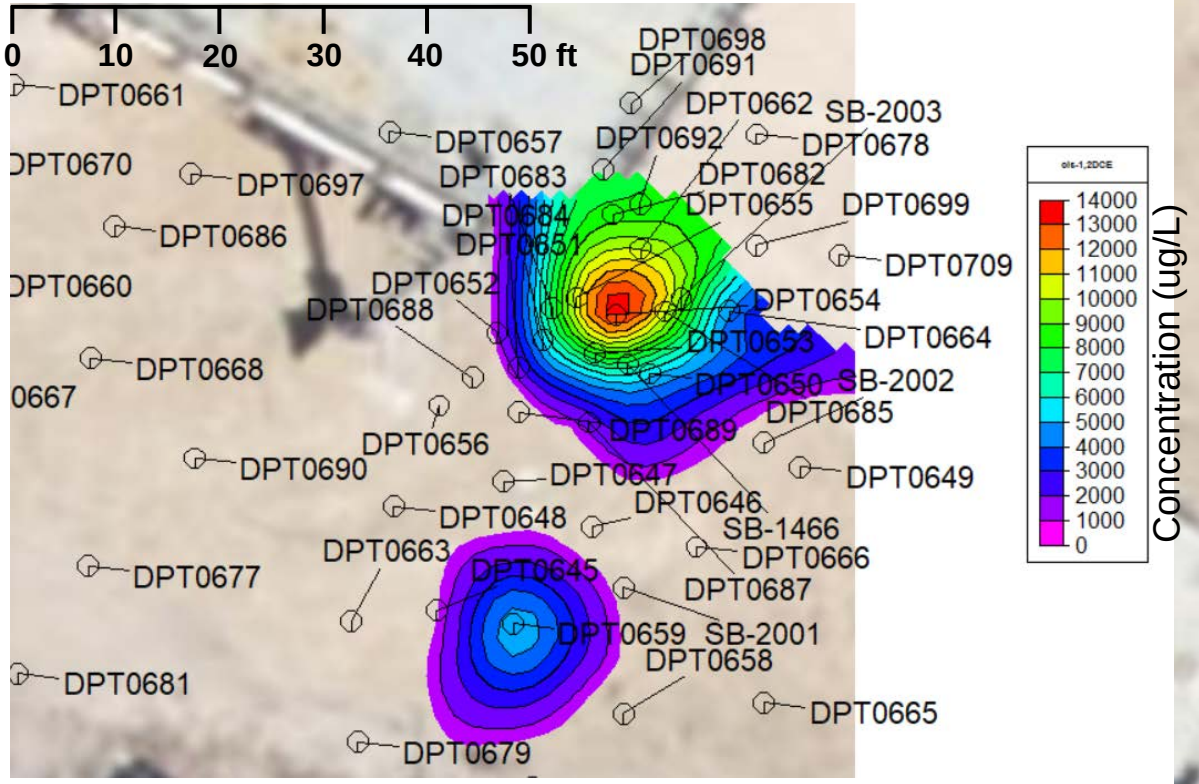
22 to 38 ft bls (-15 to -31 ft amsl)



(fine sand, shell hash, fine sand with shells)

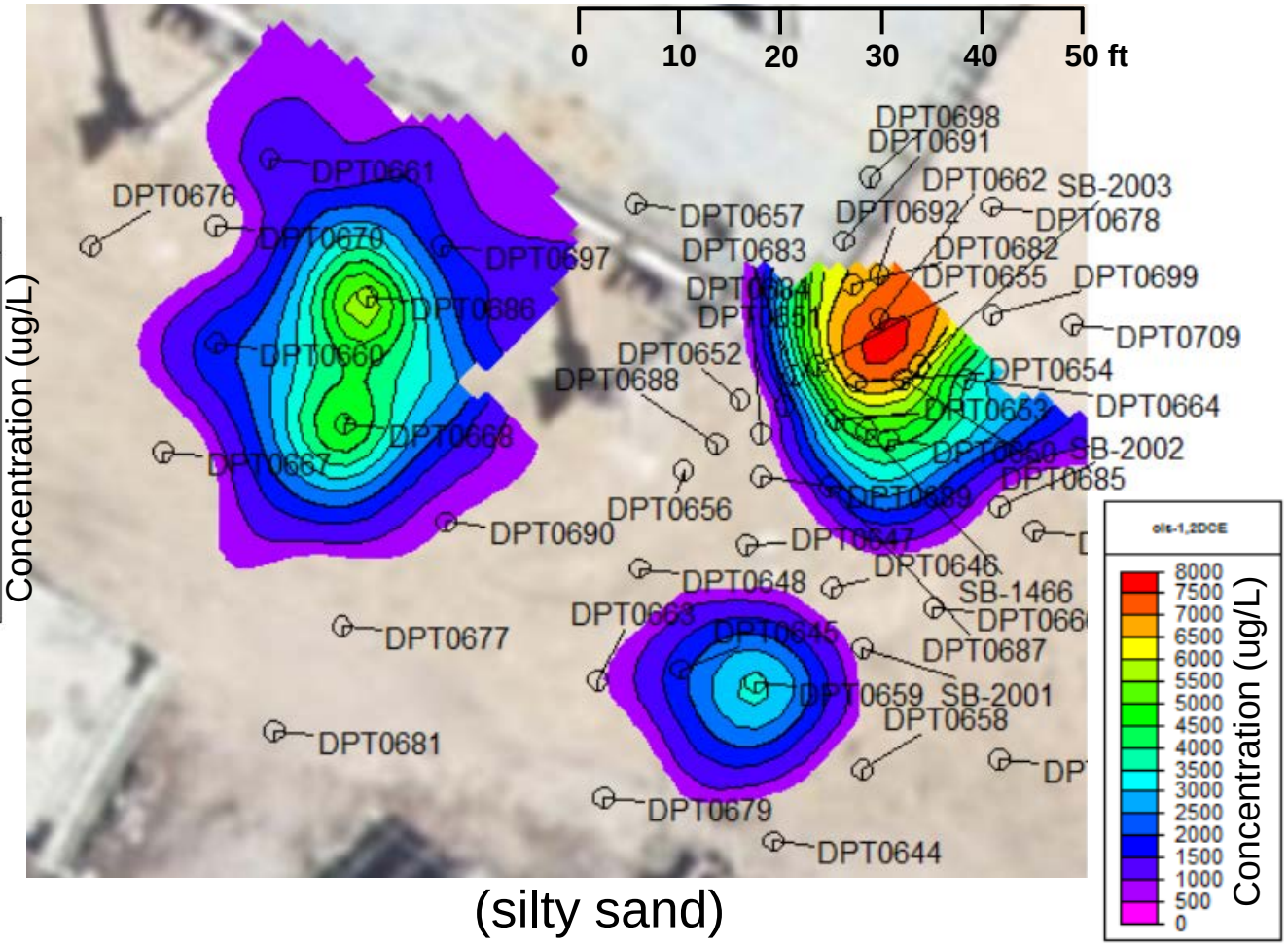
DPT Assessment Results – cDCE (>700 ug/L) Plan View

45 ft bls (-38 ft amsl)



(medium sand with shells)

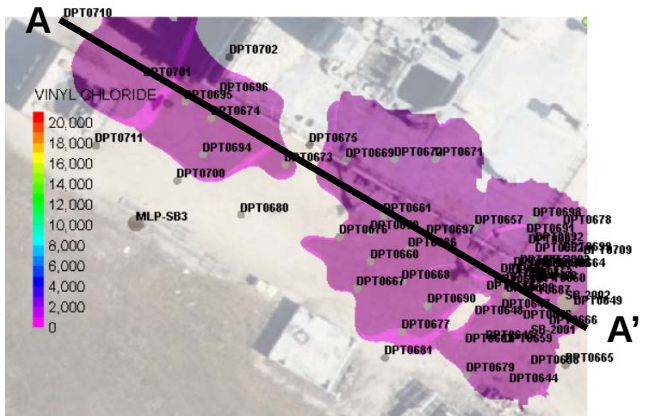
50 ft bls (-43 ft amsl)

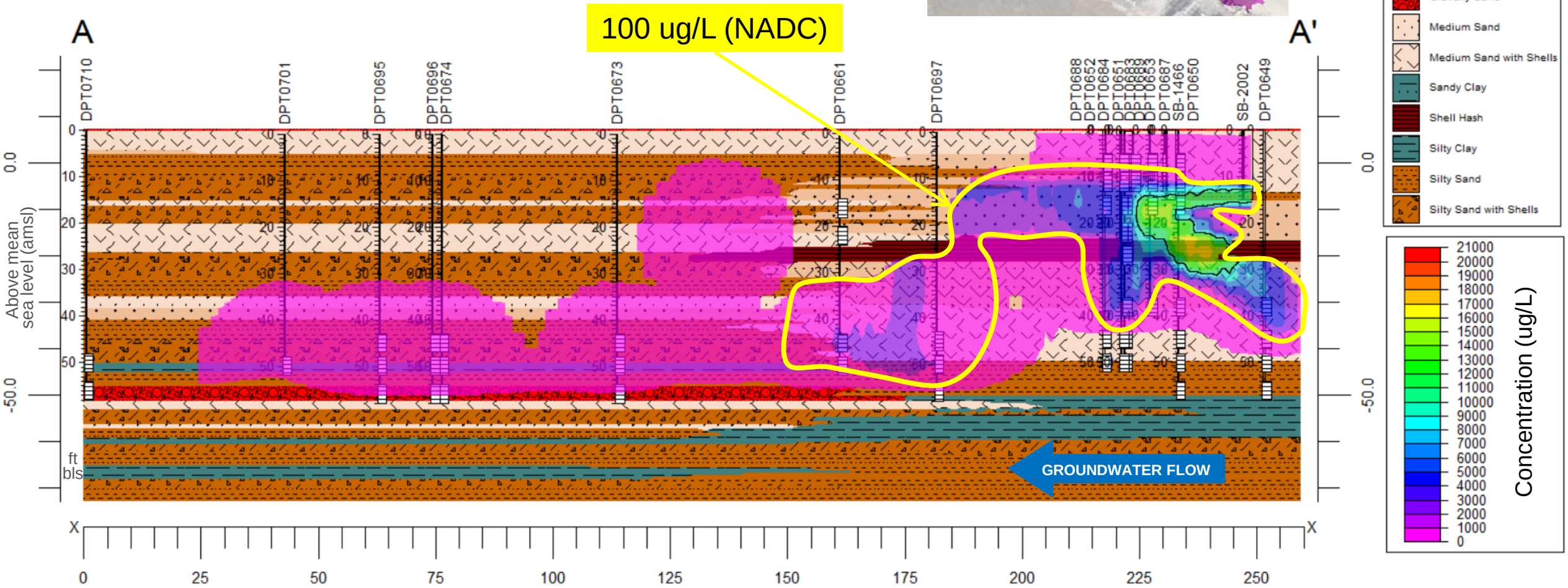


(silty sand)

DPT Assessment Results – VC (>1 ug/L)

- 45 samples >100 ug/L
- Max=21,000 ug/L at DPT0653 between 14-18 ft bls

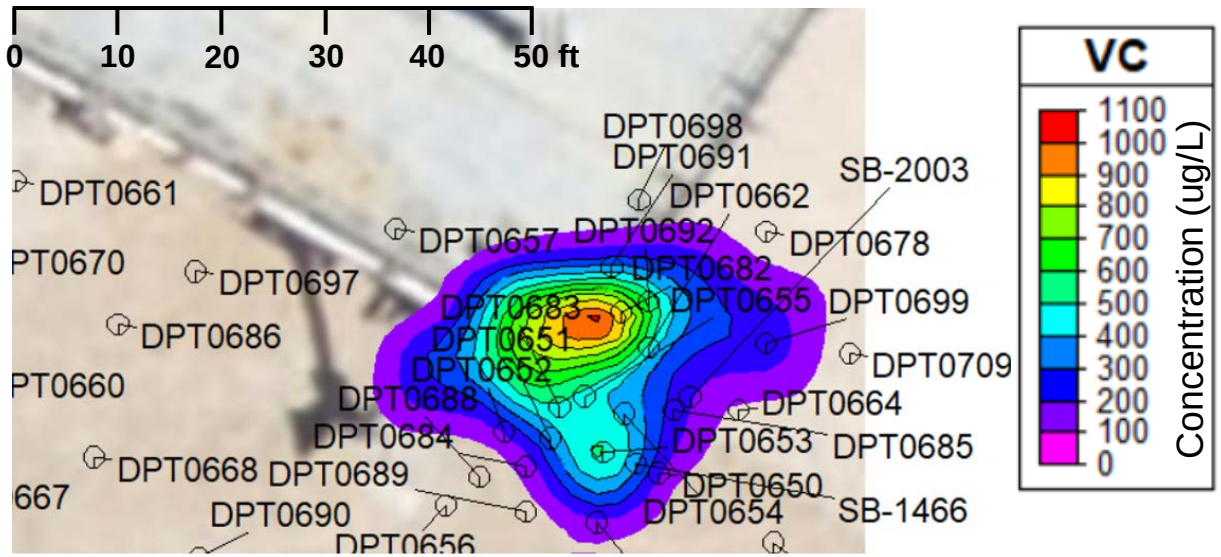




aecom.com

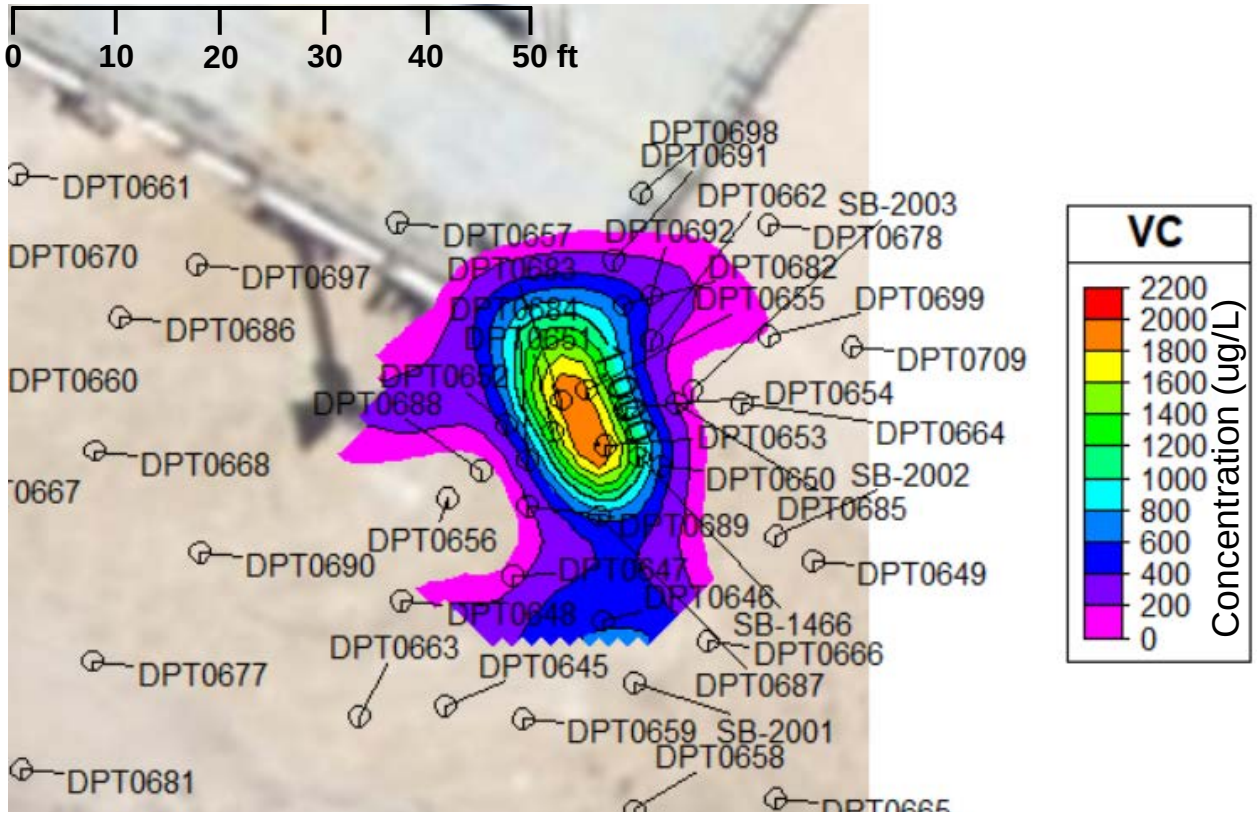
DPT Assessment Results – VC (>100 ug/L) Plan View

7 ft bls (0 ft amsl)



(fine sand and silty sand)

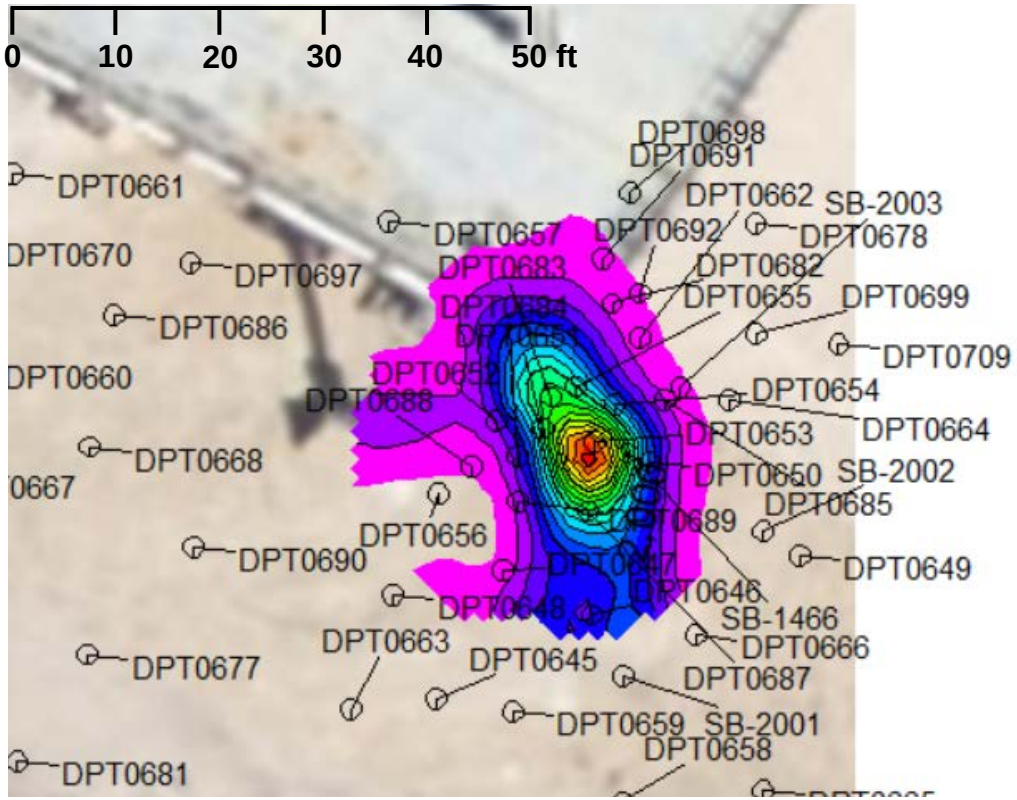
11 ft bls (-4 ft amsl)



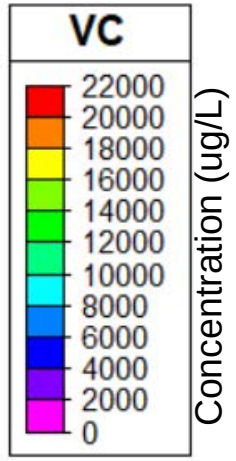
(fine sand and silty sand)

DPT Assessment Results – VC (>100 ug/L) Plan View

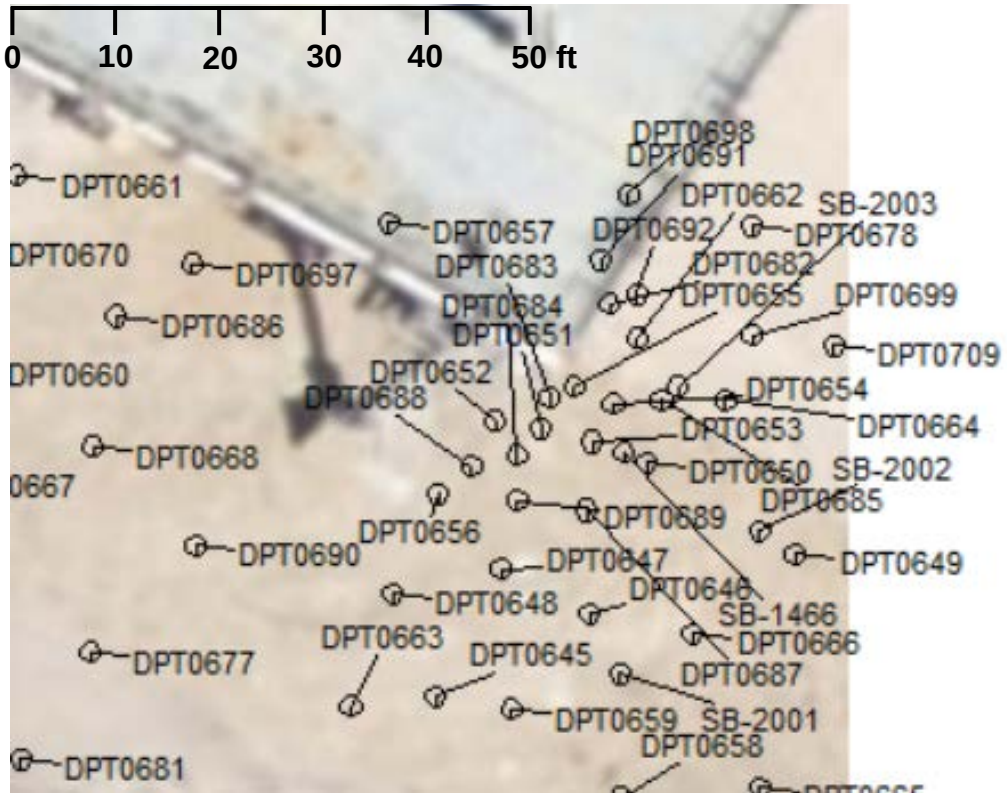
16 ft bls (-9 ft amsl)



(fine sand and silty sand)



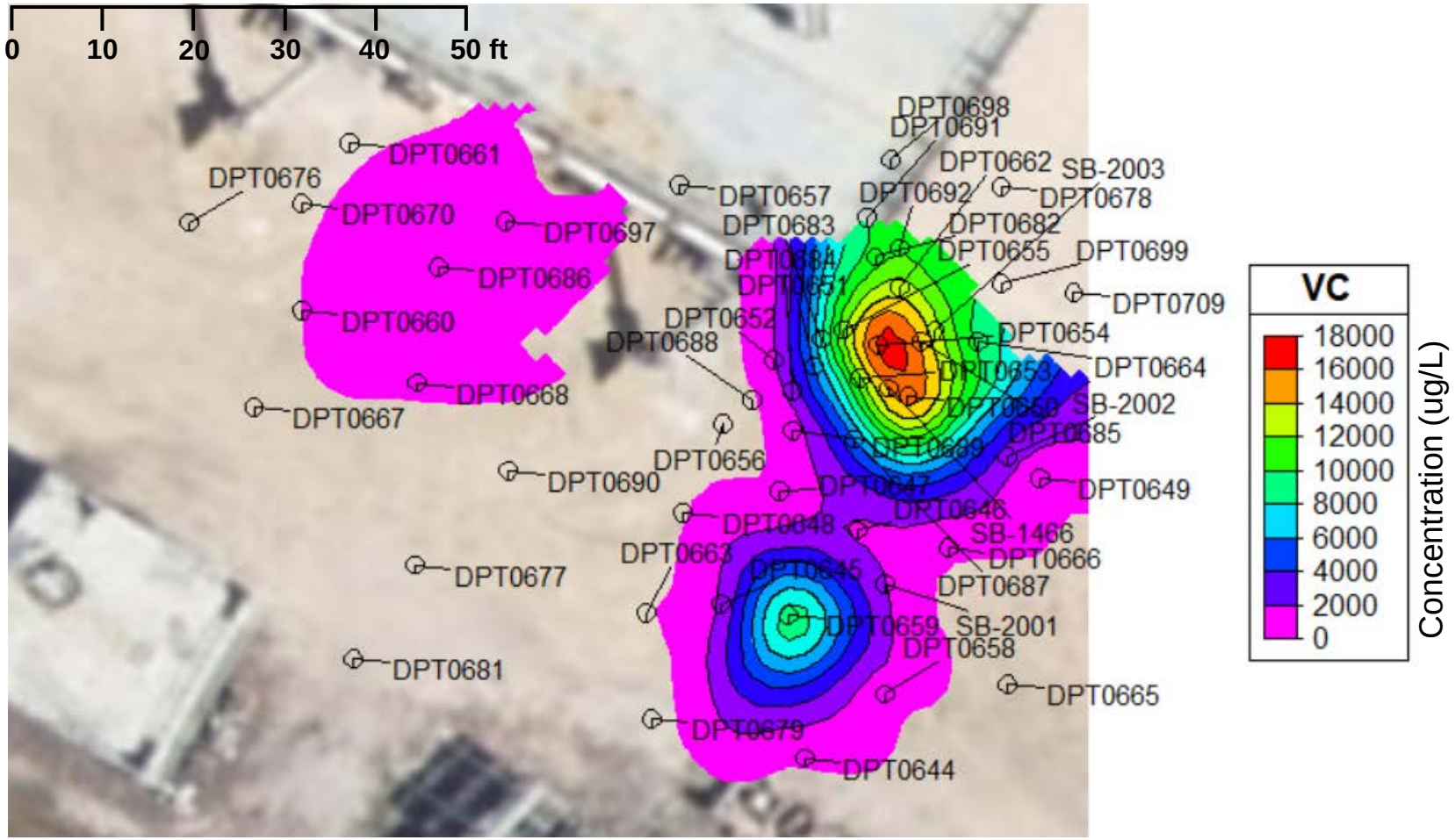
22 to 38 ft bls (-15 to -31 ft amsl)



(fine sand, shell hash, fine sand with shells)

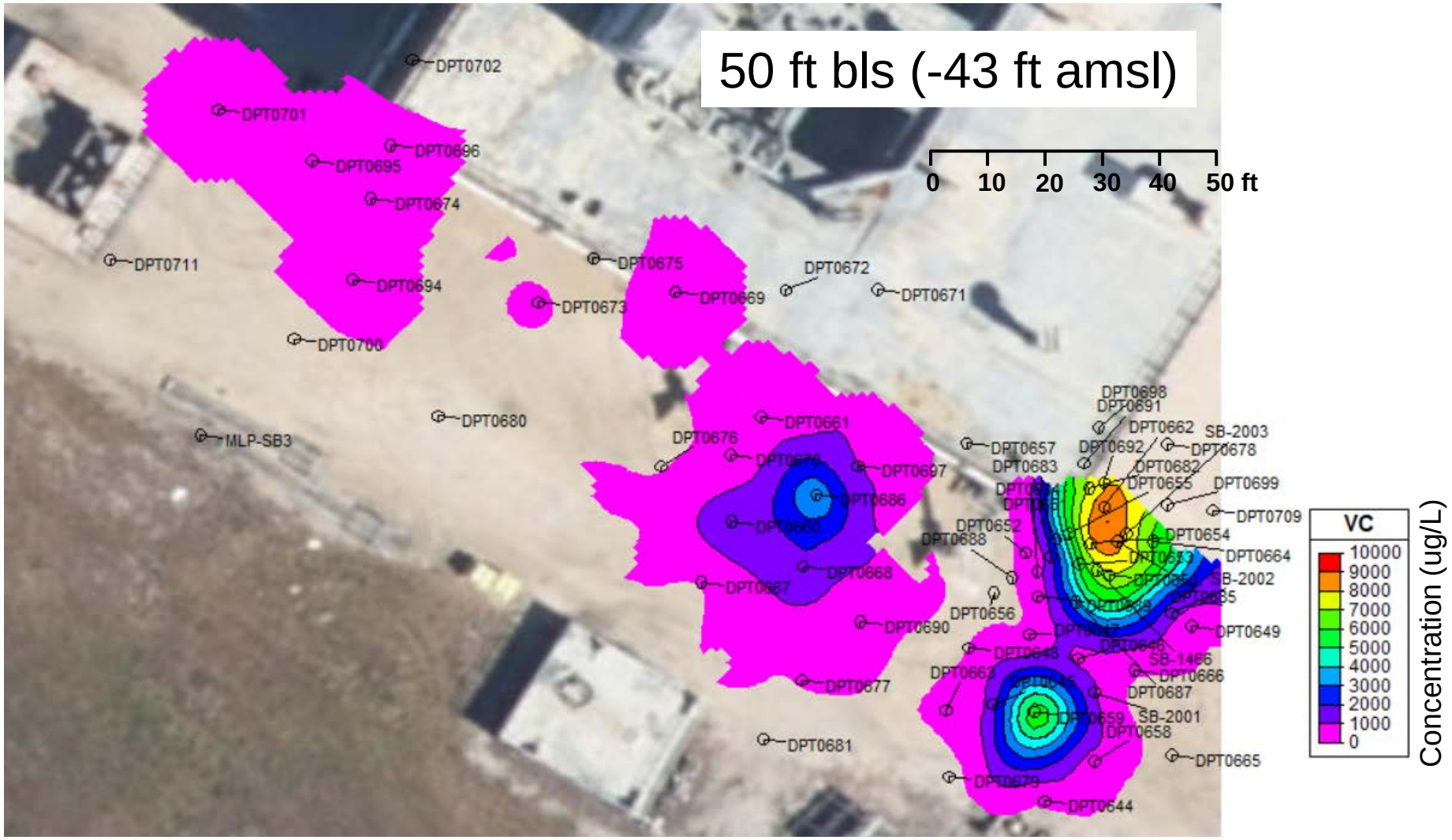
DPT Assessment Results – VC (>100 ug/L) Plan View

45 ft bls (-38 ft amsl)



(medium sand with shells)

DPT Assessment Results – VC (>100 ug/L) Plan View



(silty sand)

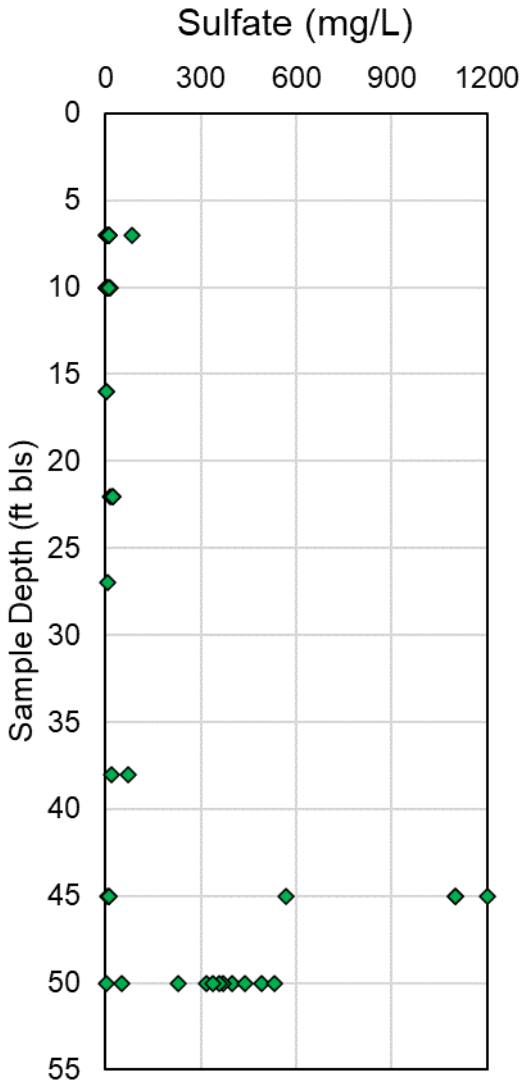
DPT Sampling Summary

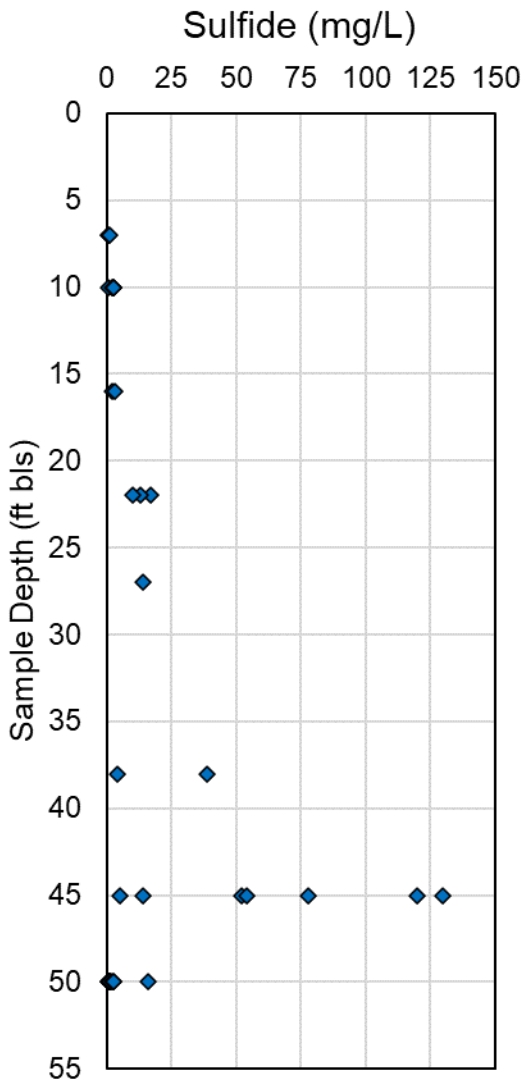
- Dissolved CVOCs plumes were delineated to NADCs (GCTLs at some locations)
- Shallow Interval (above 28 ft bls; 2017 treatment depth was 4 to 28 ft bls)
  - Has maximum CVOC concentrations (TCE=129,000 ug/L, cDCE= 88,000 ug/L, VC=21,000 ug/L)
  - Center of plumes (and likely TCE source) is still near SE corner of platform
  - Potential treatment areas (NADC plumes) vary by CVOC:
    - TCE: ~30 ft diameter and consistent to 28 ft bls
    - cDCE: area expands (~10 to ~30 ft diameter) with depth and to the south
    - VC: ~20x30 ft
- Deep Interval (below 40 ft bls; 2017 treatment depth was 39 to 57 ft bls)
  - CVOC concentrations generally decrease with depth and are less than shallow groundwater
  - Center of plumes and treatment areas (NADC plumes) vary by CVOC:
    - TCE: ~25x40 ft with center (max concentrations) ~10 ft east of center in shallow groundwater
    - cDCE: coincides with TCE plus 2 other areas south and downgradient (lower concentrations)
    - VC: similar to cDCE (3 areas) with larger downgradient areas

DPT Sampling Summary

Geochemistry (sulfate/sulfide)

- Sulfate
  - <1 to 1,200 milligrams per liter (mg/L)
  - Average of ~200 mg/L
  - Highest concentrations below 40 ft bls
- Sulfide
  - <1 to 130 mg/L
  - Average of ~16 mg/L
  - Highest concentrations below 40 ft bls
- Sulfate concentrations are high and sulfate reducers are competing for electron donor (TOC) with *Dhc* and other microbes that support enhanced reductive dechlorination (ERD)
- Sulfide concentrations are high (not typical) indicating limited natural iron to precipitate sulfide and the potential inhibition of microbial activity and ERD

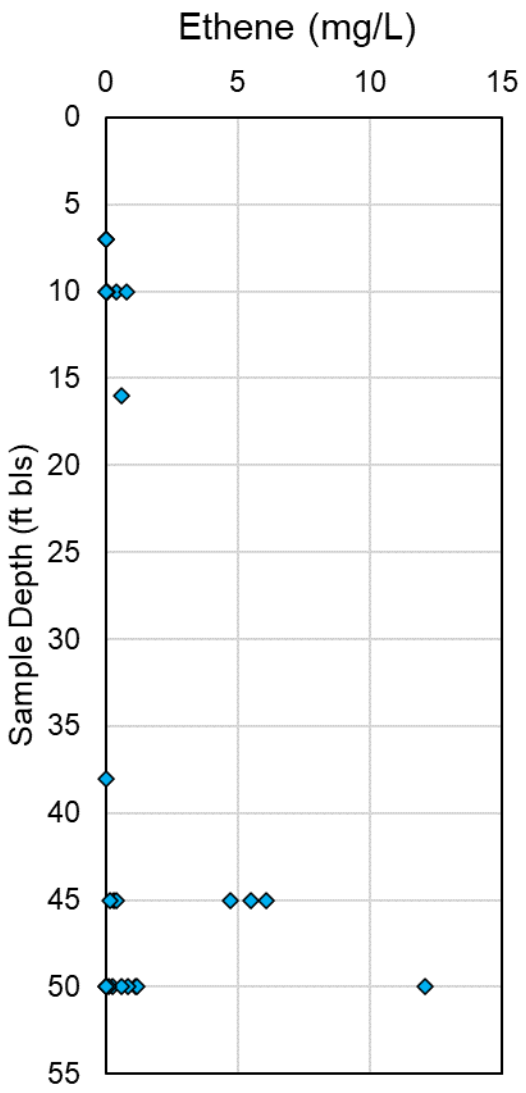


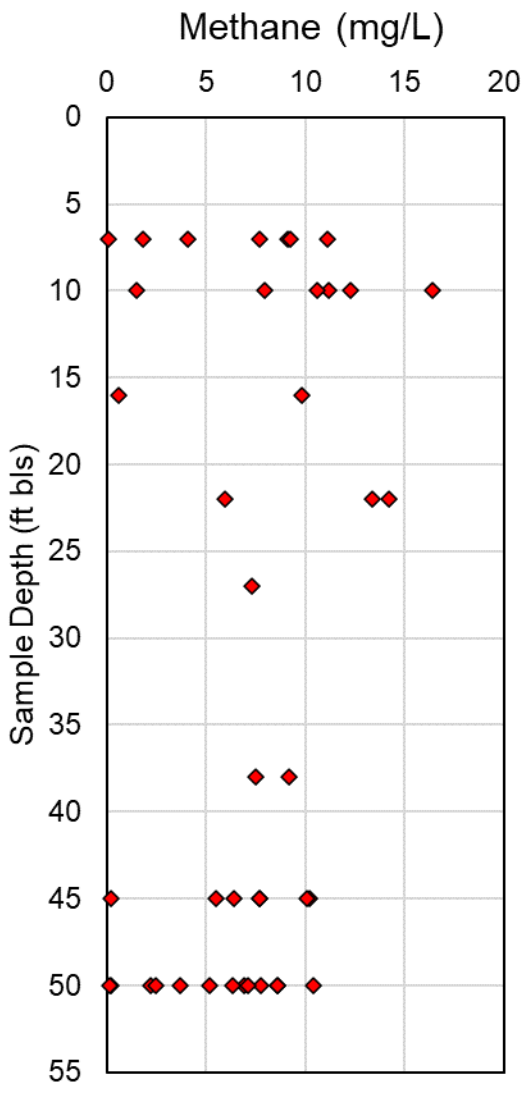


DPT Assessment Summary

Geochemistry

- TOC
  - 1.5 to 2,800 mg/L (max at 45 ft bls)
  - Average of ~120 mg/L
  - Can support ERD but not optimal
- Ethene
  - <1 to 12 mg/L (max at 50 ft bls)
  - Average of ~1.4 mg/L
  - Indicates complete ERD in shallow (5 to 18 ft bls) and deep (38 to 52 ft bls) groundwater
- Methane
  - <1 to 16 mg/L (max at 10 ft bls)
  - Average of ~7 mg/L
  - Indicates methanogenesis activity is high (good redox for ERD) and methanogens are competing for electron donor (inefficient use of TOC)
  - Potential for unsafe condition in confined space





Conclusion

Remediation Progress

- EVO injection decreased CVOC mass and plume footprints (source likely still present)
- Redox and pH are appropriate for ongoing ERD but TOC is depleted and not optimal
- High sulfate and low natural iron to control sulfide likely limits ERD and optimal use of TOC
- High methane indicates non-optimal use of TOC by methanogens that limit ERD

Recommendations

- Create optimal conditions for long-term CVOCs degradation that treats plumes and mass flux from the source

Remediation Strategy/Approach

- Promote in situ chemical reduction (ISCR) by emplacing a product that:
  - Enhances biotic and abiotic reduction of CVOCs for a long period (5 or more years)
  - Maintains optimal conditions by limiting methanogenesis and managing sulfate reduction and sulfide accumulation

Conclusion and Team Consensus

Recommended Remedial Approach

- Optimal ISCR approach uses a slow-release hydrogen substrate and micro- or nano-scale zero valent iron (ZVI)
- High-pressure injection of the product (likely a high viscosity slurry) is typically performed with direct-push, special injection tooling, and high-pressure pumps (>300 psi) to create lateral hydraulic fractures to distribute the remedial product at specified depth intervals
- Process is self-buffering because of ZVI
- Oxidation of ZVI provides iron to limit sulfide accumulation (formation/precipitation of iron sulfides can expand treatment volume)
- Potential products to be evaluated (availability, costs, and injection vendor experience)
  - Provect-IR is a solid that is mixed with water and injected as a slurry. Includes slow-release solid organic hydrogen donors, ZVI, oxygen scavengers, and red yeast rice (RYR) extract to limit methanogenesis
  - PeroxyChem EHC and EHC Plus are similar to Provect-IR but do not include the methanogenesis inhibitor (EHC Plus adds powdered activated carbon to add adsorption to the degradation processes)

Team Consensus

- Proceed with an IMWP to implement ISCR to treat key CVOCs (TCE, cDCE, and VC) exceeding their respective NADC.

  (TCE > 300 ug/L, cDCE >700 ug/L, and VC >100 ug/L)

MLP/VAB (SWMU 056)
HS3 Performance Monitoring

Spider diagrams and table of DPT groundwater sampling results are attached.

AECOM
150 North Orange Avenue
Orlando, FL 32801
aecom.com

Project name:
KSCRT Meeting Support

Project ref:
MLP/VAB HS3 IMWP ADP

To:
Ryan O'Meara
Kennedy Space Center, Florida

From:
Randy Sillan, PhD, PE
Linnea King Clark

Date:
February 2, 2023

Memo

Subject: Response to Comments on Hot Spot 3 Interim Measures Work Plan; Mobile Launch Platform Rehabilitation Sites / Vehicle Assembly Building Area (MLP/VAB), SWMU 056

AECOM's responses to comments provided by HydroGeoLogic and Tetra Tech from their review of the MLP/VAB, SWMU 056, Hot Spot 3 Interim Measures Work Plan (IMWP) are provided here.

Responses to HydroGeoLogic Comments

1. Comment: Slide 3 – Suggest noting that KB-1 contains Dehalococcoides.

   Response: Dehalococcoides was added to the slide.

2. Comment: Slide 4 – The bullet states -~80 to 100% mass reduction in shallow intervals (~94% reduction in deep). Please clarify if this mass reduction is only in the dissolved phase or overall mass reduction in the subsurface and how this mass reduction was estimated. Also, the next bullet states -minimal change from month 12 and conditions in some areas favored continued bioremediation. Please clarify if this minimal change is with regards to TCE concentration or the bioremediation process.

   Response: The mass reduction estimates were based on changes in dissolved concentrations at performance monitoring wells and presented in the 2018 CMI and IM Annual Report (Geosyntec 2019). In addition, the report concluded that minimal changes in CVOC concentrations were observed between Month 12 and 18 at the performance monitoring wells. Text was added to the bullets on slide 4.

3. Comment: Slide 5 – Suggest adding any site-specific K values, if available, in the Lithology Index table to indicate associated permeability.

   Response: Hydraulic conductivity values for the subsurface from 30 to 50 ft bls were reported in the 2007 RFI to range from 9 to 24 ft/d (average of 16.3 ft/d). This estimate of K was added to slide 5. Estimates of hydraulic conductivity specific to Hot Spot 3 and other depths and lithology are not available.

4. Comment: Slide 6 – Please clarify whether the 2021 DPT samples were obtained from an area previously treated with SRS-SD and KB-1. If so, please include comparison to baseline data. Slide 4 states approximately 80% to 100% mass reduction in shallow interval after amendment injection. If the 2021 samples were from a previously treated area, then the TCE detection of 129,000 µg/L would indicate substantial dissolution of TCE from non-aqueous or adsorbed phases into aqueous phase, and also would

raise concerns about the reliability of using groundwater data to estimate baseline and post-treatment mass.

Response: The objective of the 2021 DPT groundwater sampling event was to delineate the NADC plumes and identify the treatment volumes for the IMWP. AECOM recognizes that previous estimates of mass reduction were based on changes in concentrations in groundwater and did not account for initial TCE mass sorbed to soil or present as NAPL. Thus, estimates of mass reduction as a percentage of a pre-treatment or baseline mass are not planned because of the significant uncertainty associated with estimating the baseline mass.

5. Comment: Slide 13 – Were any iron data collected to confirm aqueous concentrations?

   Response: Dissolved or total iron was not analyzed during the 2021 DPT groundwater sampling event.

6. Comment: Slide 13 – If field parameters were recorded during DPT sampling, please discuss the pH and ORP results, since these parameters can provide insight into the microbial activity.

   Response: Groundwater field parameters were not measured during the 2021 DPT groundwater sampling event.

7. Comment: Slide 14 – HGL agrees with the recommended remedial approach of enhancing both biotic and abiotic reduction (ISCR) through the use of slow-release hydrogen substrate and ZVI. HGL recognizes that oxidation of ZVI will result in iron (II) sulfide precipitation. Please clarify if any consideration was given to the effects of iron (II) sulfide precipitation on the permeability of subsurface porous media and any positive or negative factors to ISCR performance.

   Response: Precipitation of iron sulfide is expected to primarily occur on mineral (soil grain) surfaces and can expand the surface area where CVOCs are degraded by abiotic reduction via beta-elimination and hydrogenolysis. Significant permeability reduction from the precipitation of iron sulfide on mineral grain surfaces has not been observed at other sites and is not expected for the proposed ISCR application that injects and distributes ZVI within the porous matrix. Concerns with permeability reduction have been historically limited to designs where permeable reactive barriers primarily consist of ZVI (limited sand).

8. Comment: Slides 16 through 19 – Please specify the injection point spacings. The diagrams and associated estimated overlaps on the RODs are a nice visual illustration and noting the injection point spacing for each interval will complete the picture.

   Response: Text was added to slide 17 stating the recommended injection point spacing for the shallow interval (4 to 10 ft bls) is 10 feet as discussed in Section 5.1 of the IMWP. To limit the number of injection points, this spacing is maintained for the shallow treatment interval (4 to 18 ft bls). For the deep treatment interval (42 to 52 ft bls), the injection point spacing varies and depends on the estimated radius of distribution (ROD) and the estimated areal extent of the NADC plumes.

9. Comment: Slides 21 and 22 – Suggest incorporating collection of saturated matrix samples during baseline and post-injection events to reduce uncertainty associated with estimates of TCE and degradation product masses.

   Response: Because of the significant uncertainty in estimating the mass of CVOCs in the subsurface with a limited number of soil borings, soil samples will not be collected and analyzed. Remediation performance will be evaluated by reductions in CVOCs concentrations.

10. Comment: Slide 22 – Suggest noting that field parameters also will be recorded during well sampling.

    Response: A note was added to slide 22 and 25 stating field parameters will be collected during monitoring well sampling.

11. Comment: Slide 24 – In top bullet, please change “historic” to “historical”.

    Response: Changed accordingly.

12. Comment: Slide 25 – It appears that only two background samples for zone of discharge (ZOD) parameters will be collected, and only one of the background samples will be obtained from the same interval as the planned injections. There appear to be no background ZOD wells screened across the shallow injection interval. This approach will provide a small dataset for interpretation of post-injection ZOD parameter data for the treatment zones. Suggest collecting more background ZOD parameter data to allow for more robust comparisons of post-treatment conditions to background conditions.

    Response: One upgradient monitoring well, MLPV-MW000L, has been added for collecting background data in the shallow injection interval from 6 to 16 feet below land surface. This addition was also applied to Section 6.0 of the text, and respective Figure 6-2 and Table 6-1, Table 6-3, and Table 8-1.

13. Comment: Slide 28 -HGL agrees with the consensus statement.

14. General Comment: HGL agrees with consensus statement and general approach to in situ chemical reduction outlined in the presentation.

Responses to Tetra Tech Comments

0. Comment: Section 5.2/Slide 16 – How were the radii of distribution calculated?

   Response: The estimated radii of distribution discussed in Section 5.1 were provided by Provectus and based on their experience and recommended dosing rates and slurry strengths for Provect-IR in similar soil types and application depths.

1. Comment: Slide 16/Table 5-1 – The estimated radius of distribution for the 42 to 52 feet bls injections is 15 feet. Based on Slide 5 (lithology), a small clay layer is present at approximately 50 feet bls on the western portion of the site. Is this clay layer expected to have any impact on the radius of distribution for IP14, IP15, and IP16 (injection points on western portion of the site into the 48 to 52 feet bls interval)?

   Response: Note that the spatial interpretation of lithology is uncertain and based on data from historical soil borings that are located near but not in the proposed treatment areas. The clay layer is not expected to affect the radius of distribution (ROD) in the silty sands above and below the clay. The ROD in the clay may be less and would depend on the thickness of the clay layer, which may be less than 2 feet. However, limited distribution in the clay layer is not expected to affect treatment performance, which will be controlled by the distribution of Provect-IR in the dominant groundwater migration pathways (i.e. the permeable sandy matrices).

2. Comment: Section 5.2/Slide 19 – Was a more conservative approach of adding injection points in the areas west of IP08 from 48 to 52 feet bls and northwest of IP16 from 48 to 52 feet bls considered? Approximately three additional injection locations would not significantly increase the current capital cost as equipment for the injections is already mobilized and would result in distribution of Provect-IR over nearly the entire NADC plume based on the estimated radius of distribution.

   Response: Additional injection points were considered. As discussed in Section 5.2, the locations of IP08 and IP14 to IP16 are expected to create treatment transects that support reduction of VC in downgradient groundwater as clean groundwater migrates from the Provect-IR treatment areas and conditions for ISCR of VCpropagate downgradient from the Provect-IR treatment areas. Thus, additional injection points for these lowerconcentration, downgradient areas are not expected to be needed to achieve remediation objectives.

3. Comment: Figure 5-2/Slide 19 – The locations of injection points and monitoring wells on Figure 5-2 do not match the image on Slide 19 for the 43 to 47 feet bls interval. Please revise for consistency.

   Response: Figure 5-2 has been revised.

4. Comment: Section 5.3/Slide 20 – The slide includes injection pressures of 100 to 200 psi and the text indicates pressures up to 500 psi in the deeper zones; these seem high for this formation. During injection, will the pressure be gradually increased to limit fracturing and short-circuiting? Were injection pressures used for previous remedial actions consulted (recognizing the differences in injected materials)?

Response: Injection pressure will be gradually increased and closely monitored along with injection rate to limit fracturing and short-circuiting. An injection procedure similar to the current plan was implemented during the 2017 injection event when a positive displacement pump was used to inject the SRS-SD solution into lower permeability formations at pressures that ranged from 100 to 250 psi. Thus, estimated injection pressures in the IMWP have been previously implemented at the Site.

5. Comment: Section 5.3, paragraph 3, first sentence – Does this mean that no utility clearance, such as ground penetrating radar (GPR) will be performed?

   Response: That is correct. A figure illustrating the injection point locations relative to known subsurface obstructions is presented as Figure 5-3. These obstruction locations are approximate based on a previous GPR survey. Injection point locations will be adjusted in the field as needed.

6. Comment: Section 5.3, paragraph 3, last sentence – Specific potential paths for daylighting (such as abandoned monitoring wells) should be noted here.

   Response: Noted. Language referencing abandoned monitoring wells as potential pathways has been added.

7. Comment: Section 5.3 – A figure showing the proposed injection points and monitoring wells with the existing subsurface information (similar to Slide 32 of the presentation) would be useful.

   Response: Figure 5-3 has been added to show the injection and monitoring well locations in relation to existing subsurface obstructions.

8. Comment: Section 6/Table 8.1/Slide 21 – "Following significant reduction at performance MWs (~2+ years), perform DPT GW sampling to assess plume and overall ISCR performance" is stated on Slide 21. However, there is no mention of DPT sampling to assess performance of ISCR in Section 6. Additionally, consider calculating costs in Table 8-1 for the lifecycle of the project including the duration of semi-annual monitoring well sampling and follow-up DPT event(s). Section 8.2 indicates that one year of monitoring well sampling is included.

   Response: DPT performance groundwater sampling was added to Section 6 and Table 8.1. Section 8.2 was updated accordingly. Since the lifecycle of the project can vary from 5 to ten years, the estimated capital cost with five years of groundwater monitoring is included.

9. Comment: Slide 22 – Include evaluation of field parameters (pH, ORP, DO) in the baseline and monitoring well sampling to evaluate the radius of distribution of the Provect-IR. Are the monitoring wells and follow-up DPTs appropriately located to make this evaluation?

   Response: Reference to documenting required groundwater parameters (temperature, conductivity, pH, turbidity, dissolved oxygen (DO), and oxidation-reduction potential (ORP)) has been added to slide 22. Monitoring wells are positioned within the treatment area and corresponding treatment intervals to provide relevant groundwater chemistry data.

10. Comment: Slide 25 – Are LCP monitoring wells G and H far enough from injection locations to provide UIC background? They will not be installed or sampled until after the injections.

    Response: The proposed location for LCP wells MW000G (45-55 ft bls) and MW000L (6-16 ft bls) are near abandoned well IW0070 (45-55 ft bls) and shallow 2019 DPT groundwater samples that were non-detect indicating the new LCP wells are upgradient of the plume and can be expected to provide UIC background data. The proposed location for LCP well MW000H (60-70 ft bls) is near abandoned well MW0002 (60-70 ft bls), which was non-detect in 2018 (last sample). The objectives for MW000H are to provide water quality data under the plume to confirm the vertical extent and provide additional UIC background data.

11. Comment: Slide 27 – The NPDES and SWPPP are ruled out in the IMWP; they can be removed from this list.

    Response: NPDES and SWPPP were removed from the list.

12. Comment: Section 8.1 – The estimated/expected timeframe for reduction to occur following the injections is not mentioned in Section 8.1. Slide 21 of the ADP states to approximately 2+ years for significant reduction. Consider adding similar statement to this section.

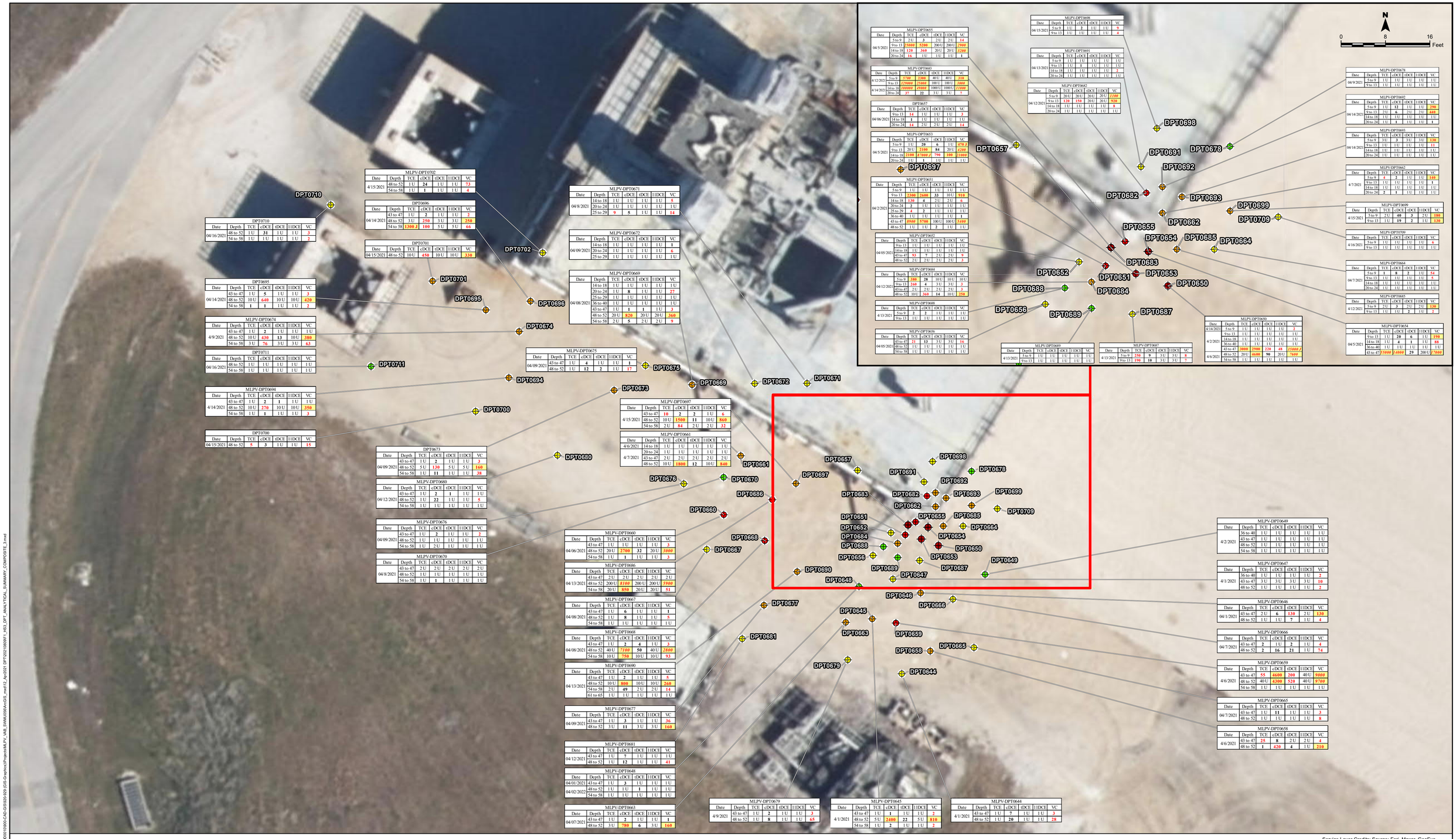
    Response: Reference to remediation duration has been added to Section 8.2. Since the lifecycle of the project can vary from 5 to ten years, the estimated capital cost with five years of groundwater monitoring is included.

13. Comment: Slides 9 and 10 – Suggest revising tags for DPT0651, DPT0652, and DPT0684. It is difficult to read results because of overlapping tags.

    Response: The labels for the specified DPT locations were revised on slides 9 and 10 to remove overlapping.

14. Comment: Please consider adding slides numbers to the PowerPoint presentation.

    Response: Page numbers were added.



MLPV-DPT0710						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/16/2021	48 to 52	1 U	**31**	1 U	1 U	**3**
	54 to 58	1 U	1 U	1 U	1 U	**2**

MLPV-DPT0702						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/15/2021	48 to 52	1 U	**24**	1 U	1 U	**73**
	54 to 58	1 U	**1**	1 U	1 U	**4**

DPT0696						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/14/2021	43 to 47	1 U	**2**	1 U	1 U	**2**
	48 to 52	1 U	**250**	3 U	3 U	**250**
	54 to 58	**1300 J**	**100**	5 U	5 U	**66**

DPT0701						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/15/2021	48 to 52	10 U	**450**	10 U	10 U	**330**

MLPV-DPT0671						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/8/2021	14 to 18	1 U	1 U	1 U	1 U	**5**
	20 to 24	1 U	1 U	1 U	1 U	1 U
	25 to 29	**9**	**5**	1 U	1 U	**14**

MLPV-DPT0672						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/09/2021	14 to 18	1 U	1 U	1 U	1 U	**1**
	20 to 24	1 U	1 U	1 U	1 U	**6**
	25 to 29	1 U	1 U	1 U	1 U	1 U

MLPV-DPT0695						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/14/2021	43 to 47	1 U	**5**	1 U	1 U	**3**
	48 to 52	10 U	**640**	10 U	10 U	**420**
	54 to 58	**1**	**1**	1 U	1 U	**2**

MLPV-DPT0669						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/08/2021	14 to 18	1 U	1 U	1 U	1 U	1 U
	20 to 24	1 U	**8**	1 U	1 U	**27**
	25 to 29	1 U	1 U	1 U	1 U	1 U
	36 to 40	1 U	1 U	1 U	1 U	1 U
	43 to 47	1 U	**1**	**1**	1 U	**3**
	48 to 52	20 U	**820**	20 U	20 U	**360**
	54 to 58	2 U	**5**	2 U	2 U	**9**

MLPV-DPT0674						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/9/2021	43 to 47	1 U	**2**	1 U	1 U	1 U
	48 to 52	10 U	**430**	**13**	10 U	**380**
	54 to 58	3 U	**76**	3 U	3 U	**63**

MLPV-DPT0675						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/09/2021	43 to 47	1 U	**4**	1 U	1 U	**1**
	48 to 52	1 U	**12**	**2**	1 U	**17**

DPT0711						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/16/2021	48 to 52	1 U	1 U	1 U	1 U	1 U
	54 to 58	1 U	1 U	1 U	1 U	1 U

MLPV-DPT0694						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/14/2021	43 to 47	1 U	**2**	1 U	1 U	1 U
	48 to 52	10 U	**270**	10 U	10 U	**350**
	54 to 58	1 U	**1**	1 U	1 U	**3**

DPT0700						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/15/2021	48 to 52	**5**	**3**	1 U	1 U	**15**

MLPV-DPT0697						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/15/2021	43 to 47	**10**	**2**	**2**	1 U	**6**
	48 to 52	10 U	**1500**	**11**	10 U	**860**
	54 to 58	2 U	**84**	2 U	2 U	**32**

MLPV-DPT0661						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/6/2021	14 to 18	1 U	1 U	1 U	1 U	1 U
	20 to 24	1 U	1 U	1 U	1 U	1 U
4/7/2021	43 to 47	2 U	2 U	2 U	2 U	2 U
	48 to 52	10 U	**1800**	**12**	10 U	**840**

DPT0673						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/09/2021	43 to 47	1 U	**2**	1 U	1 U	**3**
	48 to 52	5 U	**130**	5 U	5 U	**160**
	54 to 58	1 U	**11**	1 U	1 U	**38**

MLPV-DPT0680						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/12/2021	43 to 47	1 U	**2**	**1**	1 U	1 U
	48 to 52	1 U	**22**	1 U	1 U	**5**
	54 to 58	1 U	1 U	1 U	1 U	1 U

MLPV-DPT0676						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/09/2021	43 to 47	1 U	**2**	1 U	1 U	**2**
	48 to 52	1 U	1 U	1 U	1 U	1 U
	54 to 58	1 U	2 U	1 U	1 U	1 U

MLPV-DPT0670						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/8/2021	43 to 47	2 U	2 U	2 U	2 U	2 U
	48 to 52	1 U	1 U	1 U	1 U	1 U
	54 to 58	1 U	**1**	1 U	1 U	1 U

MLPV-DPT0660						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/06/2021	43 to 47	1 U	1 U	1 U	1 U	**3**
	48 to 52	20 U	**2700**	**32**	20 U	***1000***
	54 to 58	1 U	**1**	1 U	1 U	**3**

MLPV-DPT0686						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/13/2021	43 to 47	2 U	2 U	2 U	2 U	2 U
	48 to 52	200 U	***8100***	200 U	200 U	***5900***
	54 to 58	20 U	**850**	20 U	20 U	**51**

MLPV-DPT0667						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/08/2021	43 to 47	1 U	**6**	1 U	1 U	**1**
	48 to 52	1 U	**8**	1 U	1 U	**5**
	54 to 58	1 U	1 U	1 U	1 U	1 U

MLPV-DPT0668						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/08/2021	43 to 47	1 U	**2**	**4**	1 U	**3**
	48 to 52	40 U	***7100***	**50**	40 U	***2800***
	54 to 58	10 U	**750**	10 U	10 U	**93**

MLPV-DPT0690						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/13/2021	43 to 47	1 U	**2**	1 U	1 U	**5**
	48 to 52	10 U	**800**	10 U	10 U	**260**
	54 to 58	2 U	**49**	2 U	2 U	**14**
	61 to 65	1 U	1 U	1 U	1 U	1 U

MLPV-DPT0677						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/09/2021	43 to 47	1 U	**3**	1 U	1 U	**36**
	48 to 52	3 U	**11**	3 U	3 U	**160**

MLPV-DPT0681						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/12/2021	43 to 47	1 U	**7**	1 U	1 U	1 U
	48 to 52	1 U	**12**	1 U	1 U	**41**

MLPV-DPT0648						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/01/2021	43 to 47	1 U	**3**	1 U	1 U	1 U
04/02/2021	48 to 52	1 U	1 U	**1**	1 U	1 U
	54 to 58	1 U	1 U	1 U	1 U	1 U

MLPV-DPT0663						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/07/2021	43 to 47	1 U	**2**	1 U	1 U	**1**
	48 to 52	3 U	**780**	**6**	3 U	**160**

MLPV-DPT0679						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/9/2021	43 to 47	1 U	**2**	1 U	1 U	**3**
	48 to 52	1 U	**8**	1 U	1 U	**65**

MLPV-DPT0645						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/1/2021	43 to 47	1 U	**1**	1 U	1 U	**2**
	48 to 52	5 U	**2400**	**22**	5 U	**810**
	54 to 58	1 U	**2**	1 U	1 U	**2**

MLPV-DPT0644						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/1/2021	43 to 47	1 U	**7**	1 U	1 U	**3**
	48 to 52	1 U	**20**	1 U	1 U	**28**

MLPV-DPT0655						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/5/2021	5 to 9	2 U	**20**	2 U	2 U	**14**
	9 to 13	**2500**	**5200**	200 U	200 U	***7900***
	14 to 18	**170**	**360**	20 U	20 U	***1200***
	20 to 24	**16**	1 U	1 U	1 U	**1**

MLPV-DPT0663						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/12/2021	5 to 9	**5700**	**2300**	40 U	40 U	**310**
	9 to 13	***125000***	***15000***	100 U	100 U	***5400***
4/14/2021	14 to 18	***100000***	***19000***	1000 U	1000 U	***11000***
	20 to 24	**37**	**22**	3 U	3 U	**7**

DPT0657						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/06/2021	9 to 13	**14**	1 U	1 U	1 U	**3**
	14 to 18	**1**	1 U	1 U	1 U	1 U
	20 to 24	**14**	2 U	2 U	2 U	**14**

MLPV-DPT0653						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/5/2021	5 to 9	1 U	**20**	**6**	1 U	**470 J**
	9 to 13	20 U	**2100**	**84**	20 U	***4200***
	14 to 18	***2100***	***17000 J***	**790**	**100**	***21000***
	20 to 24	1 U	**1**	1 U	1 U	1 U

MLPV-DPT0651						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/2/2021	5 to 9	1 U	1 U	1 U	1 U	1 U
	9 to 13	**2300**	**2600**	**33**	10 U	**910**
	14 to 18	**130**	**4**	2 U	2 U	**6**
	20 to 24	**2**	1 U	1 U	1 U	1 U
	23 to 29	**4**	**2**	1 U	1 U	1 U
	36 to 40	1 U	1 U	1 U	1 U	**1**
	43 to 47	***8900***	***5700***	100 U	100 U	***5400***
	48 to 52	1 U	1 U	**2**	1 U	1 U

MLPV-DPT0652						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/05/2021	9 to 13	1 U	1 U	1 U	1 U	**9**
	14 to 18	1 U	1 U	1 U	1 U	1 U
	43 to 47	**93**	**7**	2 U	2 U	**9**
	48 to 52	2 U	2 U	2 U	2 U	**3**

MLPV-DPT0684						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/12/2021	5 to 9	**380**	**28**	10 U	10 U	10 U
	9 to 13	**260**	**4**	3 U	3 U	**3**
	43 to 47	2 U	2 U	2 U	2 U	**3**
	48 to 52	10 U	**360**	**14**	10 U	**250**

MLPV-DPT0688						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/13/2021	5 to 9	**2**	**2**	1 U	1 U	1 U
	9 to 13	1 U	1 U	1 U	1 U	1 U

MLPV-DPT0656						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/05/2021	43 to 47	**21**	**13**	3 U	3 U	**16**
	48 to 52	1 U	1 U	1 U	1 U	1 U
	54 to 58	1 U	1 U	1 U	1 U	1 U

MLPV-DPT0698						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/15/2021	5 to 9	1 U	**2**	1 U	1 U	**9**
	9 to 13	1 U	1 U	1 U	1 U	**4**

MLPV-DPT0691						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/13/2021	5 to 9	1 U	1 U	1 U	1 U	1 U
	9 to 13	1 U	**1**	1 U	1 U	1 U
	14 to 18	1 U	1 U	1 U	1 U	**2**
	20 to 24	1 U	1 U	1 U	1 U	1 U

MLPV-DPT0682						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/12/2021	5 to 9	20 U	20 U	20 U	20 U	***1100***
	9 to 13	**120**	**150**	20 U	20 U	**920**
	14 to 18	1 U	1 U	1 U	1 U	**8**
	20 to 24	1 U	1 U	1 U	1 U	1 U

MLPV-DPT0689						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/13/2021	5 to 9	1 U	1 U	1 U	1 U	1 U
	9 to 13	1 U	1 U	1 U	1 U	1 U

MLPV-DPT0687						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/13/2021	5 to 9	**250**	**9**	3 U	3 U	**8**
	9 to 13	**190**	**10**	3 U	3 U	**7**

MLPV-DPT0650						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/14/2021	5 to 9	1 U	1 U	1 U	1 U	**2**
	9 to 13	1 U	1 U	1 U	1 U	1 U
	14 to 18	1 U	1 U	1 U	1 U	1 U
	20 to 24	1 U	1 U	1 U	1 U	1 U
4/2/2021	5 to 9	1 U	**20**	**6**	1 U	**190**
	14 to 18	1 U	**4**	**1**	1 U	**88**
	36 to 40	1 U	1 U	1 U	1 U	1 U
	43 to 47	**3000**	**2900**	**220**	**48**	***15000 J***
	48 to 52	20 U	**4600**	**90**	20 U	***7600***
4/6/2021	54 to 58	1 U	1 U	1 U	1 U	1 U

MLPV-DPT0678						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/9/2021	5 to 9	1 U	1 U	1 U	1 U	1 U
	9 to 13	1 U	1 U	1 U	1 U	1 U

MLPV-DPT0692						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/14/2021	5 to 9	1 U	**12**	1 U	1 U	**250**
	9 to 13	2 U	**6**	2 U	2 U	**440**
	14 to 18	1 U	1 U	1 U	1 U	1 U
	20 to 24	1 U	**1**	1 U	1 U	**1**

MLPV-DPT0693						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/14/2021	5 to 9	3 U	**3**	3 U	3 U	**120**
	9 to 13	1 U	1 U	1 U	1 U	**11**
	14 to 18	1 U	1 U	1 U	1 U	1 U
	20 to 24	1 U	1 U	1 U	1 U	1 U

MLPV-DPT0662						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/7/2021	5 to 9	**4**	**2**	1 U	1 U	**140**
	9 to 13	1 U	1 U	1 U	1 U	**1**
	14 to 18	1 U	1 U	1 U	1 U	1 U
	20 to 24	**2**	**1**	1 U	1 U	1 U

MLPV-DPT0699						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/15/2021	3 to 9	2 U	**40**	**3**	2 U	**180**
	9 to 13	1 U	**19**	**2**	1 U	**130**

MLPV-DPT0709						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/16/2021	5 to 9	1 U	1 U	1 U	1 U	**6**
	9 to 13	1 U	1 U	1 U	1 U	1 U

MLPV-DPT0664						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/7/2021	5 to 9	**1**	**8**	**2**	1 U	**54**
	9 to 13	1 U	1 U	1 U	1 U	**6**
	14 to 18	1 U	1 U	1 U	1 U	1 U
	20 to 24	1 U	1 U	1 U	1 U	1 U

MLPV-DPT0685						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/12/2021	5 to 9	1 U	**3**	2 U	2 U	**130**
	9 to 13	1 U	1 U	**2**	1 U	**2**

MLPV-DPT0654						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/5/2021	9 to 13	1 U	**20**	**6**	1 U	**190**
	14 to 18	1 U	**4**	**1**	1 U	**88**
	36 to 40	1 U	1 U	1 U	1 U	1 U
	43 to 47	***5400***	***1400***	**29**	200 U	***7600***

MLPV-DPT0649						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/2/2021	36 to 40	1 U	1 U	1 U	1 U	1 U
	43 to 47	1 U	1 U	1 U	1 U	1 U
	48 to 52	1 U	1 U	1 U	1 U	1 U
	54 to 58	1 U	1 U	1 U	1 U	1 U

MLPV-DPT0647						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/1/2021	36 to 40	1 U	1 U	1 U	1 U	**2**
	43 to 47	3 U	3 U	3 U	3 U	**10**
	48 to 52	1 U	1 U	1 U	1 U	**2**

MLPV-DPT0646						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/1/2021	43 to 47	2 U	**6**	**130**	2 U	**130**
	48 to 52	1 U	1 U	**7**	1 U	**4**

MLPV-DPT0666						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/7/2021	43 to 47	**2**	1 U	**2**	1 U	**4**
	48 to 52	**2**	**16**	**21**	1 U	**74**

MLPV-DPT0659						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/6/2021	43 to 47	**55**	**4600**	**200**	40 U	***9000***
	48 to 52	40 U	**4300**	**520**	40 U	***9700***
	54 to 58	1 U	1 U	1 U	1 U	1 U

MLPV-DPT0665						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/7/2021	43 to 47	1 U	**11**	1 U	1 U	**3**
	48 to 52	1 U	1 U	1 U	1 U	**8**

MLPV-DPT0658						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/6/2021	43 to 47	**25**	**8**	2 U	2 U	**4**
	48 to 52	**1**	**420**	**4**	1 U	**210**

Legend

- DPT sampling location
- Monitoring well location (screen interval (ft bls)) (most recent VC concentration (µg/L))
- 1 µg/L VC isopleth (dashed where inferred)
- 100 µg/L VC isopleth (dashed where inferred)
- 1,000 µg/L VC isopleth

Symbology Color Coding

- CVOC concentration less than or equal to GCTLs
- CVOC concentration greater than GCTLs
- CVOC concentration greater than NADCs and less than or equal to 10xNADC
- CVOC concentration greater than 10xNADC
- CVOC concentration greater than 100xNADC
- CVOC detection limit greater than GCTLs
- Sample not collected at this interval

Notes:
- Concentrations are in micrograms per Liter (µg/L)
- U = Indicates that the analyte was undetected
- I = Indicates the analyte was detected but below the reporting limit; therefore, an estimated value
- Q = Results from run #2
- **Bold** indicates a detected value
- **Red bold font** indicates an exceedance of FDEP GCTLs
- **Highlighted Red bold font** indicates an exceedance of FDEP NADCs
- ***Highlighted Red italic font*** indicates an exceedance of FDEP 10xNADCs
- bls = below land surface
- GCTL = Groundwater Cleanup Target Levels as provided in 62-777, F.A.C.
- NADC = Natural Attenuation Default Concentration as provided in 62-777, F.A.C.
- MLP/VAB indicates Mobile Launch Platform (Stormwater Waste Managment Unit 056)
- Aerial Source: FDOT 2018

Abbreviation	Analyte	GCTL	NADC
TCE	Trichloroethene	3	300
cDCE	1,1-Dichloroethene	70	700
11DCE	cis-1,2-Dichloroethene	7	70
tDCE	trans--Dichloroethene	100	1000
VC	Vinyl Chloride	1	100

Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

N
0 15 30 Feet

FIGURE 1
Hot Spot 3 DPT Sampling Locations
2021

Hot Spot 3
MLP/VAB (SWMU 056)
NASA Kennedy Space Center, Florida

Date Saved: 8/10/2021
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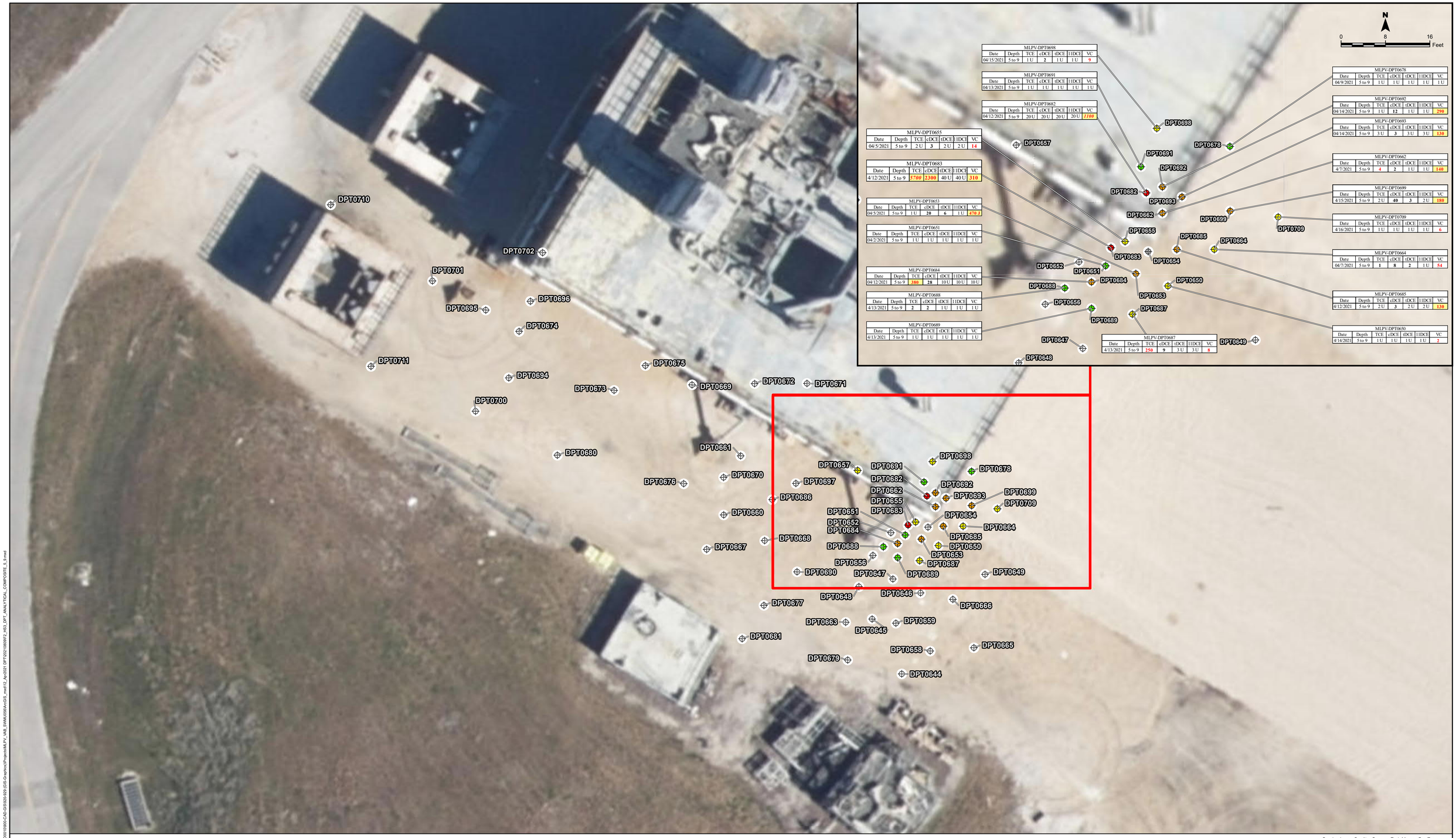

Legend

- DPT sampling location
- Monitoring well location (screen interval (ft bls)) (most recent VC concentration (µg/L))
- 1 µg/L VC isopleth (dashed where inferred)
- 100 µg/L VC isopleth (dashed where inferred)
- 1,000 µg/L VC isopleth

Symbology Color Coding

- CVOC concentration less than or equal to GCTLs
- CVOC concentration greater than GCTLs
- CVOC concentration greater than NADCs and less than or equal to 10xNADC
- CVOC concentration greater than 10xNADC
- CVOC concentration greater than 100xNADC
- CVOC detection limit greater than GCTLs
- Sample not collected at this interval

Notes:
- Concentrations are in micrograms per Liter (µg/L)
- U = Indicates that the analyte was undetected
- I = Indicates the analyte was detected but below the reporting limit; therefore, an estimated value
- Q = Results from run #2
- **Bold** indicates a detected value
- **Red bold font** indicates an exceedance of FDEP GCTLs
- **Highlighted Red bold font** indicates an exceedance of FDEP NADCs
- ***Highlighted Red italic font*** indicates an exceedance of FDEP 10xNADCs
- bls = below land surface
- GCTL = Groundwater Cleanup Target Levels as provided in 62-777, F.A.C.
- NADC = Natural Attenuation Default Concentration as provided in 62-777, F.A.C.
- MLP/VAB indicates Mobile Launch Platform/Vehicle Assembly Building
- Aerial Source: FDOT 2018

Abbreviation	Analyte	GCTL	NADC
TCE	Trichloroethene	3	300
cDCE	cis-1,2-Dichloroethene	70	700
tDCE	trans--Dichloroethene	100	1000
VC	Vinyl Chloride	1	100

Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

N
0 15 30 Feet

FIGURE 2
Hot Spot 3 DPT Sampling Locations (5 to 9 ft bls) Composite 2021

Hot Spot 3
MLP/VAB (SWMU 056)
NASA Kennedy Space Center, Florida

Date Saved: 8/10/2021
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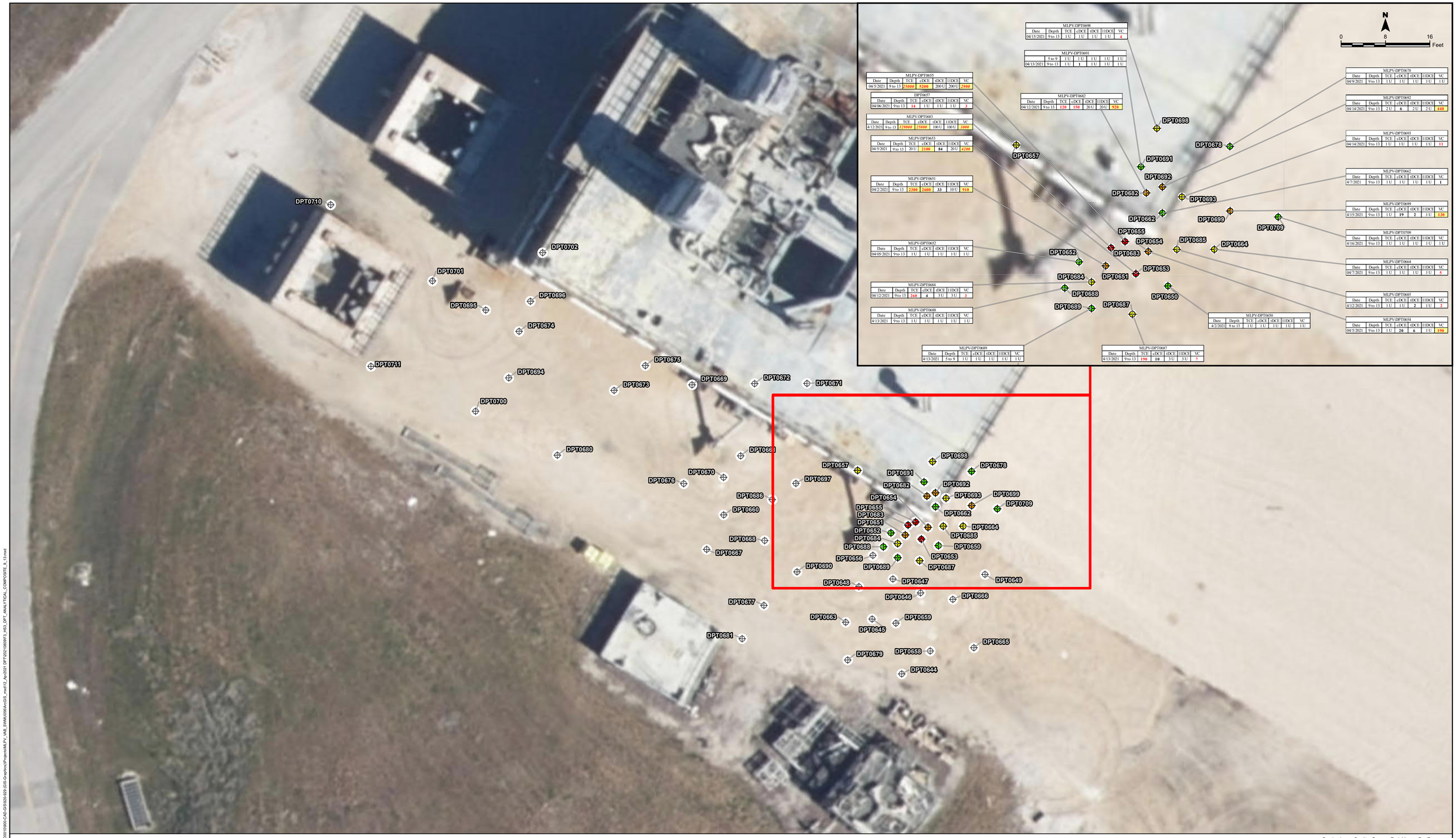

Legend

- DPT sampling location
- Monitoring well location (screen interval (ft bls)) (most recent VC concentration (µg/L))
- 1 µg/L VC isopleth (dashed where inferred)
- 100 µg/L VC isopleth (dashed where inferred)
- 1,000 µg/L VC isopleth

Symbology Color Coding

- CVOC concentration less than or equal to GCTLs
- CVOC concentration greater than GCTLs
- CVOC concentration greater than NADCs and less than or equal to 10xNADC
- CVOC concentration greater than 10xNADC
- CVOC concentration greater than 100xNADC
- CVOC detection limit greater than GCTLs
- Sample not collected at this interval

Notes:
- Concentrations are in micrograms per Liter (µg/L)
- U = Indicates that the analyte was undetected
- I = Indicates the analyte was detected but below the reporting limit; therefore, an estimated value
- Q = Results from run #2
- **Bold** indicates a detected value
- **Red bold font** indicates an exceedance of FDEP GCTLs
- **Highlighted Red bold font** indicates an exceedance of FDEP NADCs
- ***Highlighted Red italic font*** indicates an exceedance of FDEP 10xNADCs
- bls = below land surface
- GCTL = Groundwater Cleanup Target Levels as provided in 62-777, F.A.C.
- NADC = Natural Attenuation Default Concentration as provided in 62-777, F.A.C.
- MLP/VAB indicates Mobile Launch Platform/Vehicle Assembly Building
- Aerial Source: FDOT 2018

Abbreviation	Analyte	GCTL	NADC
TCE	Trichloroethene	3	300
cDCE	1,1-Dichloroethene	70	700
11DCE	cis-1,2-Dichloroethene	7	70
tDCE	trans--Dichloroethene	100	1000
VC	Vinyl Chloride	1	100

Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

FIGURE 3
Hot Spot 3 DPT Sampling Locations (9 to 13 ft bls) Composite 2021

Hot Spot 3
MLP/VAB (SWMU 056)
NASA Kennedy Space Center, Florida

Date Saved: 8/8/2021
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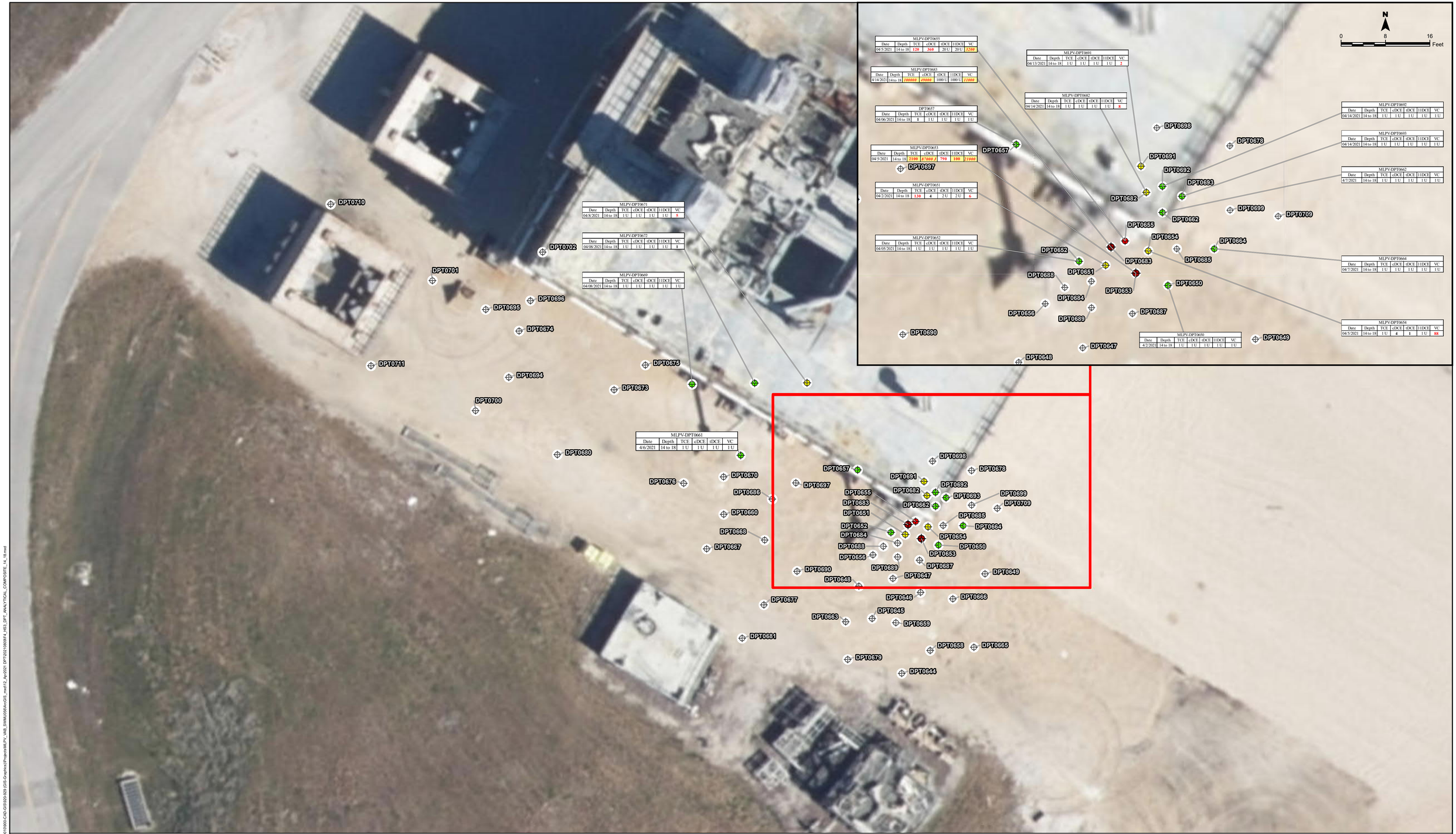


Legend

- DPT sampling location
- Monitoring well location (screen interval (ft bls)) (most recent VC concentration (µg/L))
- 1 µg/L VC isopleth (dashed where inferred)
- 100 µg/L VC isopleth (dashed where inferred)
- 1,000 µg/L VC isopleth

Symbology Color Coding

- CVOC concentration less than or equal to GCTLs
- CVOC concentration greater than GCTLs
- CVOC concentration greater than NADCs and less than or equal to 10xNADC
- CVOC concentration greater than 10xNADC
- CVOC concentration greater than 100xNADC
- CVOC detection limit greater than GCTLs
- Sample not collected at this interval

Notes:
- Concentrations are in micrograms per Liter (µg/L)
- U = Indicates that the analyte was undetected
- I = Indicates the analyte was detected but below the reporting limit; therefore, an estimated value
- Q = Results from run #2
- **Bold** indicates a detected value
- **Red bold font** indicates an exceedance of FDEP GCTLs
- **Highlighted Red bold font** indicates an exceedance of FDEP NADCs
- ***Highlighted Red italic font*** indicates an exceedance of FDEP 10xNADCs
- bls = below land surface
- GCTL = Groundwater Cleanup Target Levels as provided in 62-777, F.A.C.
- NADC = Natural Attenuation Default Concentration as provided in 62-777, F.A.C.
- MLP/VAB indicates Mobile Launch Platform/Vehicle Assembly Building
- Aerial Source: FDOT 2018

Abbreviation	Analyte	GCTL	NADC
TCE	Trichloroethene	3	300
cDCE	1,1-Dichloroethene	70	700
11DCE	cis-1,2-Dichloroethene	7	70
tDCE	trans-Dichloroethene	100	1000
VC	Vinyl Chloride	1	100

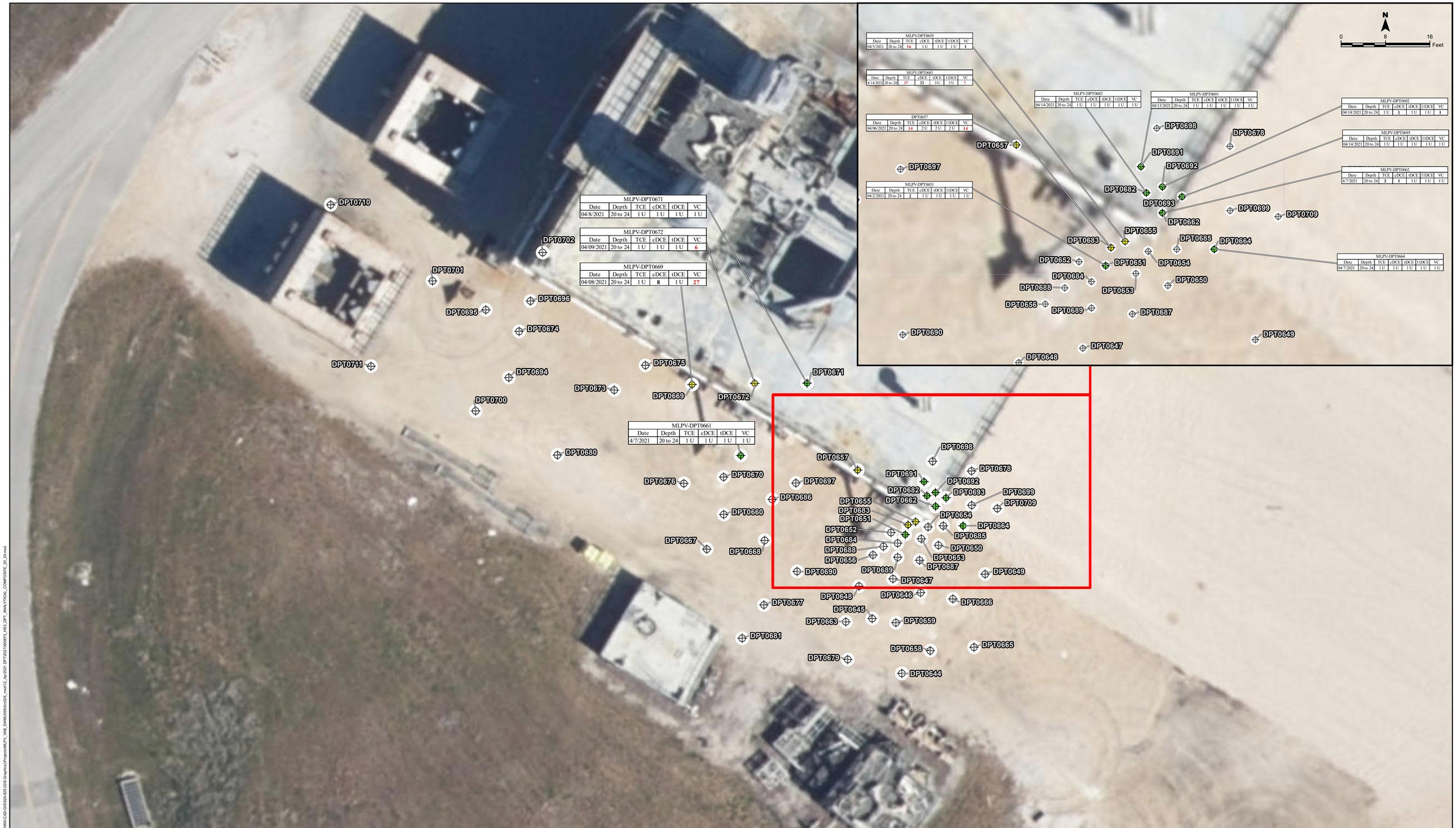
Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

N
0 15 30 Feet

FIGURE 4
Hot Spot 3 DPT Sampling Locations (14 to 18 ft bls) Composite 2021

Hot Spot 3
MLP/VAB (SWMU 056)
NASA Kennedy Space Center, Florida

Date Saved: 8/6/2021
Document Path: P:\DCS\Projects\ENV\NASA\IDIQ 80KSC0\180001\9000\CAD-GIS\920-929 (GIS-Graphics)\Projects\MLPV_VAB_SWMU056\ArcGIS_mxd\12_Apr\2021\DPT\20210809\F4_HS3_DPT_ANALYTICAL_COMPOSITE_14_18.mxd



Legend

- DPT sampling location
- Monitoring well location (screen interval (ft bls)) (most recent VC concentration (µg/L))
- 1 µg/L VC isopleth (dashed where inferred)
- 100 µg/L VC isopleth (dashed where inferred)
- 1,000 µg/L VC isopleth

Symbology Color Coding

- CVOC concentration less than or equal to GCTLs
- CVOC concentration greater than GCTLs
- CVOC concentration greater than NADCs and less than or equal to 10xNADC
- CVOC concentration greater than 10xNADC
- CVOC concentration greater than 100xNADC
- CVOC detection limit greater than GCTLs
- Sample not collected at this interval

Notes:
- Concentrations are in micrograms per Liter (µg/L)
- U = Indicates that the analyte was undetected
- I = Indicates the analyte was detected but below the reporting limit; therefore, an estimated value
- Q = Results from run #2
- **Bold** indicates a detected value
- **Red bold font** indicates an exceedance of FDEP GCTLs
- **Highlighted Red bold font** indicates an exceedance of FDEP NADCs
- ***Highlighted Red italic font*** indicates an exceedance of FDEP 10xNADCs
- bls = below land surface
- GCTL = Groundwater Cleanup Target Levels as provided in 62-777, F.A.C.
- NADC = Natural Attenuation Default Concentration as provided in 62-777, F.A.C.
- MLP/VAB indicates Mobile Launch Platform/Vehicle Assembly Building
- Aerial Source: FDOT 2018

Abbreviation	Analyte	GCTL	NADC
TCE	Trichloroethene	3	300
cDCE	1,1-Dichloroethene	70	700
11DCE	cis-1,2-Dichloroethene	7	70
tDCE	trans--Dichloroethene	100	1000
VC	Vinyl Chloride	1	100

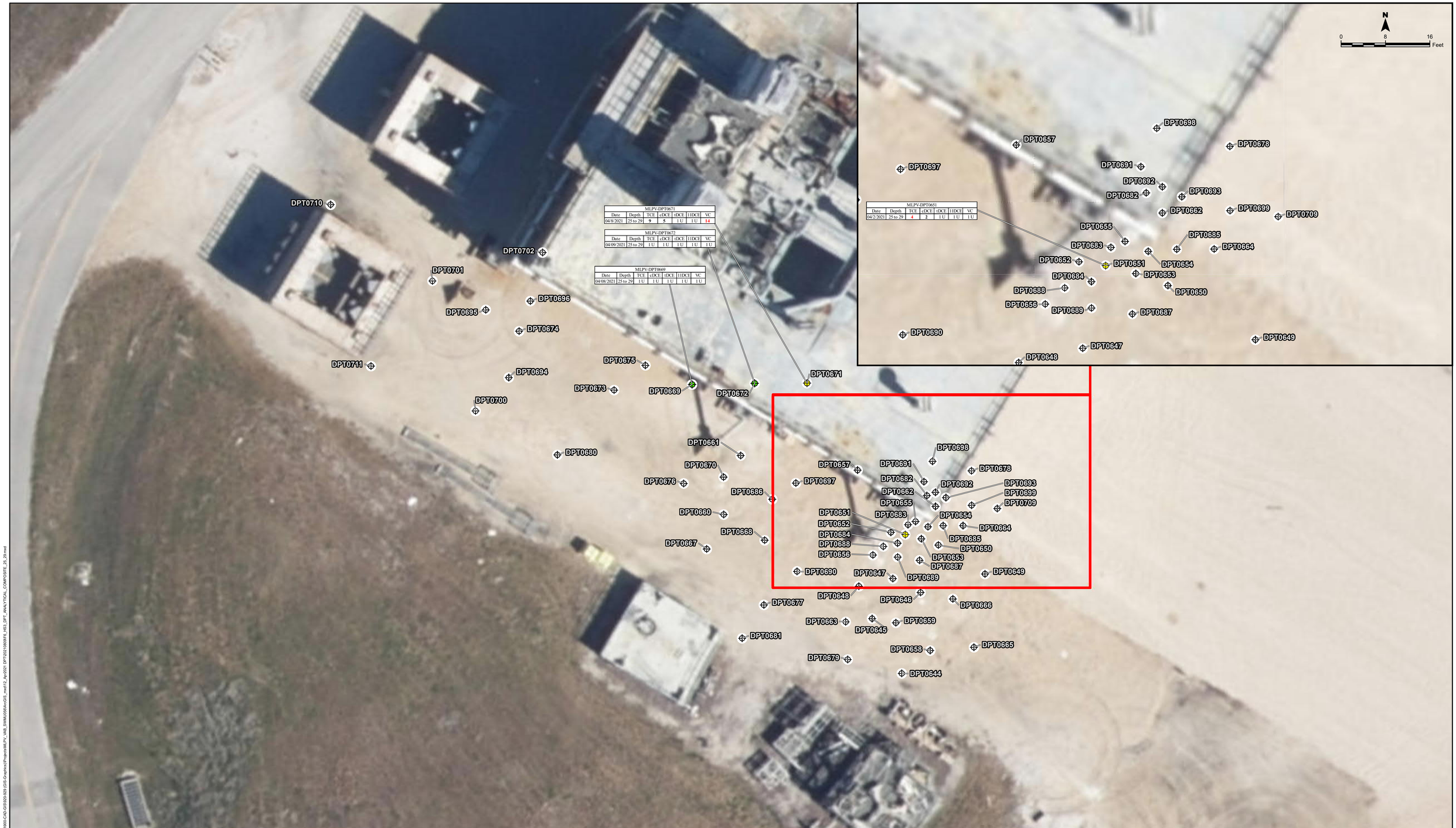
Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

N
0 15 30 Feet

FIGURE 5
Hot Spot 3 DPT Sampling Locations (20 to 24 ft bls) Composite 2021

Hot Spot 3
MLP/VAB (SWMU 056)
NASA Kennedy Space Center, Florida

Date Saved: 8/10/2021
Document Path: P:\CS\Projects\EWV\NASA\IDIQ 80KSC011D0010\0001-CAD-GIS\2020-323 (GIS-Graphics)\Projects\MLPV_VAB_SWMU056\ArcGIS_mxd\12_Apr2021 DPT2021\8089FS_HS3_DPT_ANALYTICAL_COMPOSITE_20_24.mxd



Legend

- DPT sampling location
- Monitoring well location (screen interval (ft bls)) (most recent VC concentration (µg/L))
- 1 µg/L VC isopleth (dashed where inferred)
- 100 µg/L VC isopleth (dashed where inferred)
- 1,000 µg/L VC isopleth

Symbology Color Coding

- CVOC concentration less than or equal to GCTLs
- CVOC concentration greater than GCTLs
- CVOC concentration greater than NADCs and less than or equal to 10xNADC
- CVOC concentration greater than 10xNADC
- CVOC concentration greater than 100xNADC
- CVOC detection limit greater than GCTLs
- Sample not collected at this interval

Notes:
- Concentrations are in micrograms per Liter (µg/L)
- U = Indicates that the analyte was undetected
- I = Indicates the analyte was detected but below the reporting limit; therefore, an estimated value
- Q = Results from run #2
- **Bold** indicates a detected value
- **Red bold font** indicates an exceedance of FDEP GCTLs
- **Highlighted Red bold font** indicates an exceedance of FDEP NADCs
- ***Highlighted Red italic font*** indicates an exceedance of FDEP 10xNADCs
- bls = below land surface
- GCTL = Groundwater Cleanup Target Levels as provided in 62-777, F.A.C.
- NADC = Natural Attenuation Default Concentration as provided in 62-777, F.A.C.
- MLP/VAB indicates Mobile Launch Platform/Vehicle Assembly Building
- Aerial Source: FDOT 2018

Abbreviation	Analyte	GCTL	NADC
TCE	Trichloroethene	3	300
cDCE	1,1-Dichloroethene	70	700
11DCE	cis-1,2-Dichloroethene	7	70
tDCE	trans--Dichloroethene	100	1000
VC	Vinyl Chloride	1	100

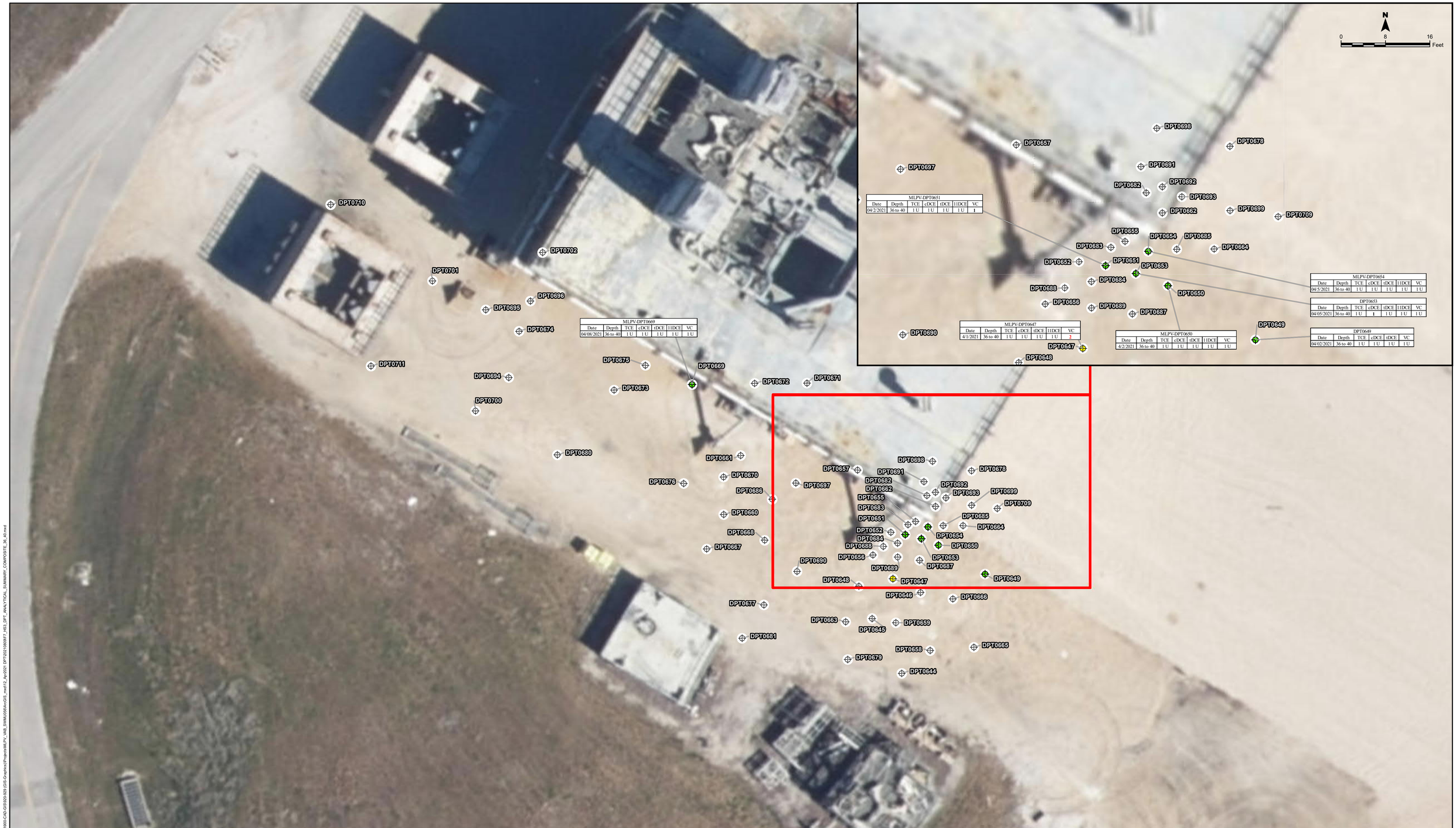
Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

N
0
15
30
Feet

FIGURE 6
Hot Spot 3 DPT Sampling Locations (25 to 29 ft bls) Composite 2021

Hot Spot 3
MLP/VAB (SWMU 056)
NASA Kennedy Space Center, Florida

Date Saved: 8/10/2021
Document Path: P:\GCS\Projects\EWV\NASA\UXO 009\SCO1\00001\600-CAD-GIS\020-929 (GIS-Graphics)\Projects\MLPV_VAB_SWMU056\ArcGIS_mxd\12_Apr2021 DPT2021\8089FR_HS3_DPT_ANALYTICAL_COMPOSITE_25_29.mxd



MLPV-DPT0651						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/2/2021	36 to 40	1 U	1 U	1 U	1 U	**1**

MLPV-DPT0654						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/5/2021	36 to 40	1 U	1 U	1 U	1 U	1 U

DPT0653						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/05/2021	36 to 40	1 U	**1**	1 U	1 U	1 U

MLPV-DPT0647						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/1/2021	36 to 40	1 U	1 U	1 U	1 U	**2**

MLPV-DPT0650						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/2/2021	36 to 40	1 U	1 U	1 U	1 U	1 U

DPT0649						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/02/2021	36 to 40	1 U	1 U	1 U	1 U	1 U

MLPV-DPT0669						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/08/2021	36 to 40	1 U	1 U	1 U	1 U	1 U

Legend

- DPT sampling location
- Monitoring well location (screen interval (ft bls)) (most recent VC concentration (µg/L))
- 1 µg/L VC isopleth (dashed where inferred)
- 100 µg/L VC isopleth (dashed where inferred)
- 1,000 µg/L VC isopleth

Symbology Color Coding

- CVOC concentration less than or equal to GCTLs
- CVOC concentration greater than GCTLs
- CVOC concentration greater than NADCs and less than or equal to 10xNADC
- CVOC concentration greater than 10xNADC
- CVOC concentration greater than 100xNADC
- CVOC detection limit greater than GCTLs
- Sample not collected at this interval

Notes:
- Concentrations are in micrograms per Liter (µg/L)
- U = Indicates that the analyte was undetected
- I = Indicates the analyte was detected but below the reporting limit; therefore, an estimated value
- Q = Results from run #2
- **Bold** indicates a detected value
- **Red bold font** indicates an exceedance of FDEP GCTLs
- **Highlighted Red bold font** indicates an exceedance of FDEP NADCs
- ***Highlighted Red italic font*** indicates an exceedance of FDEP 10xNADCs
- bls = below land surface
- GCTL = Groundwater Cleanup Target Levels as provided in 62-777, F.A.C.
- NADC = Natural Attenuation Default Concentration as provided in 62-777, F.A.C.
- MLP/VAB indicates Mobile Launch Platform/Vehicle Assembly Building
- Aerial Source: FDOT 2018

Abbreviation	Analyte	GCTL	NADC
TCE	Trichloroethene	3	300
cDCE	1,1-Dichloroethene	70	700
11DCE	cis-1,2-Dichloroethene	7	70
tDCE	trans--Dichloroethene	100	1000
VC	Vinyl Chloride	1	100

Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

FIGURE 7
Hot Spot 3 DPT Sampling Locations (36 to 40 ft bls) Composite 2021

Hot Spot 3
MLP/VAB (SWMU 056)
NASA Kennedy Space Center, Florida

Date Saved: 8/6/2021
Document Path: P:\SCS\Projects\EWV\NASA\DIG 806\SCS\190010500-CAD-GIS\020-323 (GIS-Graphics)\Projects\MLPV_VAB_SWMU056\ArcGIS_mxd\12_Apr2021 DPT2021\06\6FT_HS3_DPT_ANALYTICAL_SUMMARY_COMPOSITE_36_40.mxd

DPT0696						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/14/2021	43 to 47	1	2	1 U	1 U	2

DPT0695						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/14/2021	43 to 47	1 U	5	1 U	1 U	3

MLPV-DPT0674						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/9/2021	43 to 47	1 U	2	1 U	1 U	1 U

MLPV-DPT0694						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/14/2021	43 to 47	1 U	2	1	1 U	1 U

MLPV-DPT0669						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/08/2021	43 to 47	1 U	1	1	1 U	3

MLPV-DPT0675						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/09/2021	43 to 47	1 U	4	1 U	1 U	1

MLPV-DPT0661						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/7/2021	43 to 47	2 U	2 U	2 U	2 U	2 U

DPT0673						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/09/2021	43 to 47	1 U	2	1 U	1 U	3

MLPV-DPT0680						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/12/2021	43 to 47	1 U	2	1	1 U	1 U

MLPV-DPT0676						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/09/2021	43 to 47	1 U	2	1 U	1 U	2

MLPV-DPT0670						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/8/2021	43 to 47	2 U	2 U	2 U	2 U	2 U

MLPV-DPT0660						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/06/2021	43 to 47	1 U	1 U	1 U	1 U	3

MLPV-DPT0686						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/13/2021	43 to 47	2 U	2 U	2 U	2 U	2 U

MLPV-DPT0667						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/08/2021	43 to 47	1 U	6	1 U	1 U	1

MLPV-DPT0668						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/08/2021	43 to 47	1 U	2	4	1 U	3

MLPV-DPT0677						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/09/2021	43 to 47	1 U	3	1 U	1 U	36

MLPV-DPT0681						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/12/2021	43 to 47	1 U	7	1 U	1 U	1 U

MLPV-DPT0663						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/07/2021	43 to 47	1 U	2	1 U	1 U	1

MLPV-DPT0679						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/9/2021	43 to 47	1 U	2	1 U	1 U	3

MLPV-DPT0697						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/15/2021	43 to 47	10	2	2	1 U	6

MLPV-DPT0651						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/2/2021	43 to 47	8900	5700	100 U	100 U	5400

MLPV-DPT0652						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/05/2021	43 to 47	93	7	2 U	2 U	9

MLPV-DPT0684						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/12/2021	43 to 47	2 U	2 U	2 U	2 U	3

MLPV-DPT0656						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/05/2021	43 to 47	21	13	3 U	3 U	16

MLPV-DPT0690						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/13/2021	43 to 47	1 U	2	1 U	1 U	5

MLPV-DPT0648						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/01/2021	43 to 47	1 U	3	1 U	1 U	1 U

MLPV-DPT0654						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/5/2021	43 to 47	55000	14000	29	200 U	7000

MLPV-DPT0650						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/2/2021	43 to 47	3000	2900	220	48	15400

MLPV-DPT0647						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/1/2021	43 to 47	3 U	3 U	3 U	3 U	10

MLPV-DPT0649						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/2/2021	43 to 47	1 U	1 U	1 U	1 U	1 U

MLPV-DPT0646						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/1/2021	43 to 47	2 U	6	130	2 U	130

MLPV-DPT0666						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/7/2021	43 to 47	2	1 U	2	1 U	4

MLPV-DPT0659						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/6/2021	43 to 47	55	4600	200	40 U	9000

MLPV-DPT0665						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/7/2021	43 to 47	1 U	11	1 U	1 U	3

MLPV-DPT0658						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/6/2021	43 to 47	25	8	2 U	2 U	4

MLPV-DPT0645						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/1/2021	43 to 47	1 U	1	1 U	1 U	2

MLPV-DPT0644						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/1/2021	43 to 47	1 U	7	1 U	1 U	3

Legend

- DPT sampling location
- Monitoring well location (screen interval (ft bls)) (most recent VC concentration (µg/L))
- 1 µg/L VC isopleth (dashed where inferred)
- 100 µg/L VC isopleth (dashed where inferred)
- 1,000 µg/L VC isopleth

Symbology Color Coding

- CVOC concentration less than or equal to GCTLs
- CVOC concentration greater than GCTLs
- CVOC concentration greater than NADCs and less than or equal to 10xNADC
- CVOC concentration greater than 10xNADC
- CVOC concentration greater than 100xNADC
- CVOC detection limit greater than GCTLs
- Sample not collected at this interval

Notes:
- Concentrations are in micrograms per Liter (µg/L)
- U = Indicates that the analyte was undetected
- I = Indicates the analyte was detected but below the reporting limit; therefore, an estimated value
- Q = Results from run #2
- **Bold** indicates a detected value
- **Red bold font** indicates an exceedance of FDEP GCTLs
- **Highlighted Red bold font** indicates an exceedance of FDEP NADCs
- ***Highlighted Red italic font*** indicates an exceedance of FDEP 10xNADCs
- bls = below land surface
- GCTL = Groundwater Cleanup Target Levels as provided in 62-777, F.A.C.
- NADC = Natural Attenuation Default Concentration as provided in 62-777, F.A.C.
- MLP/VAB indicates Mobile Launch Platform/Vehicle Assembly Building
- Aerial Source: FDOT 2018

Abbreviation	Analyte	GCTL	NADC
TCE	Trichloroethene	3	300
cDCE	1,1-Dichloroethene	70	700
11DCE	cis-1,2-Dichloroethene	7	70
tDCE	trans-Dichloroethene	100	1000
VC	Vinyl Chloride	1	100

Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

N
0 15 30 Feet

FIGURE 8
Hot Spot 3 DPT Sampling Locations (43 to 47 ft bls) Composite 2021

Hot Spot 3
MLP/VAB (SWMU 056)
NASA Kennedy Space Center, Florida

Date Saved: 8/10/2021
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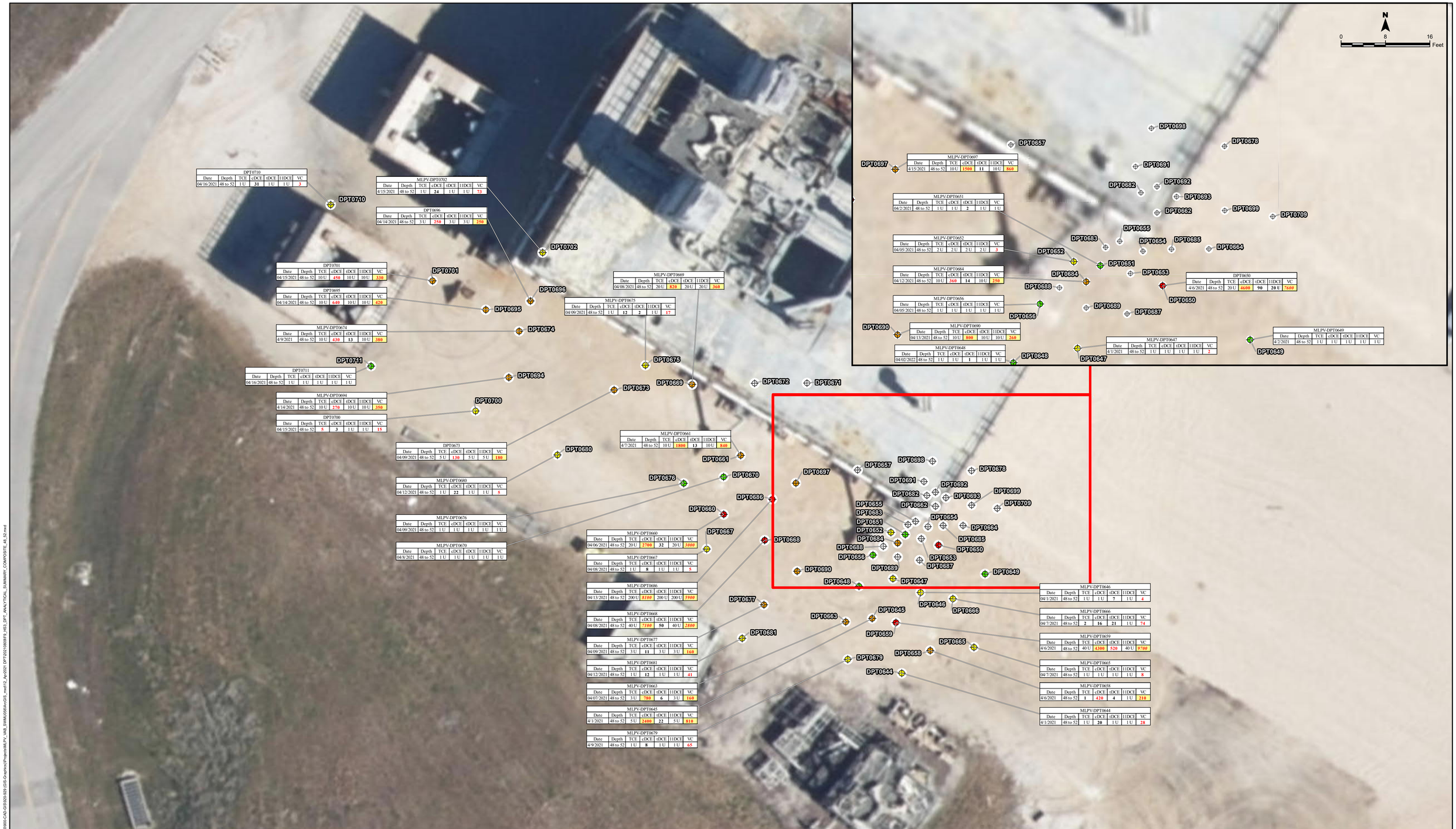


DPT0710

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/16/2021	48 to 52	1 U	31	1 U	1 U	3

MLPV-DPT0702

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/15/2021	48 to 52	1 U	24	1 U	1 U	73

DPT0696

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/14/2021	48 to 52	3 U	250	3 U	3 U	250

DPT0701

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/15/2021	48 to 52	10 U	450	10 U	10 U	330

DPT0695

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/14/2021	48 to 52	10 U	640	10 U	10 U	420

MLPV-DPT0674

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/9/2021	48 to 52	10 U	430	13	10 U	380

DPT0711

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/16/2021	48 to 52	1 U	1 U	1 U	1 U	1 U

MLPV-DPT0694

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/14/2021	48 to 52	10 U	270	10 U	10 U	350

DPT0700

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/15/2021	48 to 52	5	3	1 U	1 U	15

DPT0673

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/09/2021	48 to 52	5 U	130	5 U	5 U	180

MLPV-DPT0680

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/12/2021	48 to 52	1 U	22	1 U	1 U	5

MLPV-DPT0676

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/09/2021	48 to 52	1 U	1 U	1 U	1 U	1 U

MLPV-DPT0670

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/8/2021	48 to 52	1 U	1 U	1 U	1 U	1 U

MLPV-DPT0669

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/08/2021	48 to 52	20 U	820	20 U	20 U	360

MLPV-DPT0675

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/06/2021	48 to 52	1 U	12	2	1 U	17

MLPV-DPT0661

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/7/2021	48 to 52	10 U	1800	13	10 U	840

MLPV-DPT0660

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/06/2021	48 to 52	20 U	2700	32	20 U	3000

MLPV-DPT0667

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/08/2021	48 to 52	1 U	8	1 U	1 U	5

MLPV-DPT0686

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/13/2021	48 to 52	200 U	8100	200 U	200 U	3900

MLPV-DPT0668

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/08/2021	48 to 52	40 U	7100	50	40 U	2800

MLPV-DPT0677

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/09/2021	48 to 52	3 U	11	3 U	3 U	160

MLPV-DPT0681

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/12/2021	48 to 52	1 U	12	1 U	1 U	41

MLPV-DPT0663

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/07/2021	48 to 52	3 U	780	6	3 U	160

MLPV-DPT0645

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/1/2021	48 to 52	5 U	2400	22	5 U	810

MLPV-DPT0679

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/9/2021	48 to 52	1 U	8	1 U	1 U	65

MLPV-DPT0697

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/15/2021	48 to 52	10 U	1500	11	10 U	860

MLPV-DPT0651

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/2/2021	48 to 52	1 U	1 U	2	1 U	1 U

MLPV-DPT0652

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/05/2021	48 to 52	2 U	2 U	2 U	2 U	3

MLPV-DPT0684

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/12/2021	48 to 52	10 U	360	14	10 U	250

MLPV-DPT0656

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/05/2021	48 to 52	1 U	1 U	1 U	1 U	1 U

MLPV-DPT0690

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/13/2021	48 to 52	10 U	800	10 U	10 U	260

MLPV-DPT0648

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/02/2022	48 to 52	1 U	1 U	1	1 U	1 U

DPT0650

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/6/2021	48 to 52	20 U	4600	90	20 U	7600

MLPV-DPT0647

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/1/2021	48 to 52	1 U	1 U	1 U	1 U	2

MLPV-DPT0649

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/2/2021	48 to 52	1 U	1 U	1 U	1 U	1 U

MLPV-DPT0646

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/1/2021	48 to 52	1 U	1 U	7	1 U	4

MLPV-DPT0666

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/7/2021	48 to 52	2	16	21	1 U	74

MLPV-DPT0659

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/6/2021	48 to 52	40 U	4300	520	40 U	9700

MLPV-DPT0665

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/7/2021	48 to 52	1 U	1 U	1 U	1 U	8

MLPV-DPT0658

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/6/2021	48 to 52	1	420	4	1 U	210

MLPV-DPT0644

Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/1/2021	48 to 52	1 U	20	1 U	1 U	28

Legend

- DPT sampling location
- Monitoring well location (screen interval (ft bls)) (most recent VC concentration (µg/L))
- 1 µg/L VC isopleth (dashed where inferred)
- 100 µg/L VC isopleth (dashed where inferred)
- 1,000 µg/L VC isopleth

Symbology Color Coding

- CVOC concentration less than or equal to GCTLs
- CVOC concentration greater than GCTLs
- CVOC concentration greater than NADCs and less than or equal to 10xNADC
- CVOC concentration greater than 10xNADC
- CVOC concentration greater than 100xNADC
- CVOC detection limit greater than GCTLs
- Sample not collected at this interval

Notes:
- Concentrations are in micrograms per Liter (µg/L)
- U = Indicates that the analyte was undetected
- I = Indicates the analyte was detected but below the reporting limit; therefore, an estimated value
- Q = Results from run #2
- **Bold** indicates a detected value
- **Red bold font** indicates an exceedance of FDEP GCTLs
- **Highlighted Red bold font** indicates an exceedance of FDEP NADCs
- ***Highlighted Red italic font*** indicates an exceedance of FDEP 10xNADCs
- bls = below land surface
- GCTL = Groundwater Cleanup Target Levels as provided in 62-777, F.A.C.
- NADC = Natural Attenuation Default Concentration as provided in 62-777, F.A.C.
- MLP/VAB indicates Mobile Launch Platform/Vehicle Assembly Building
- Aerial Source: FDOT 2018

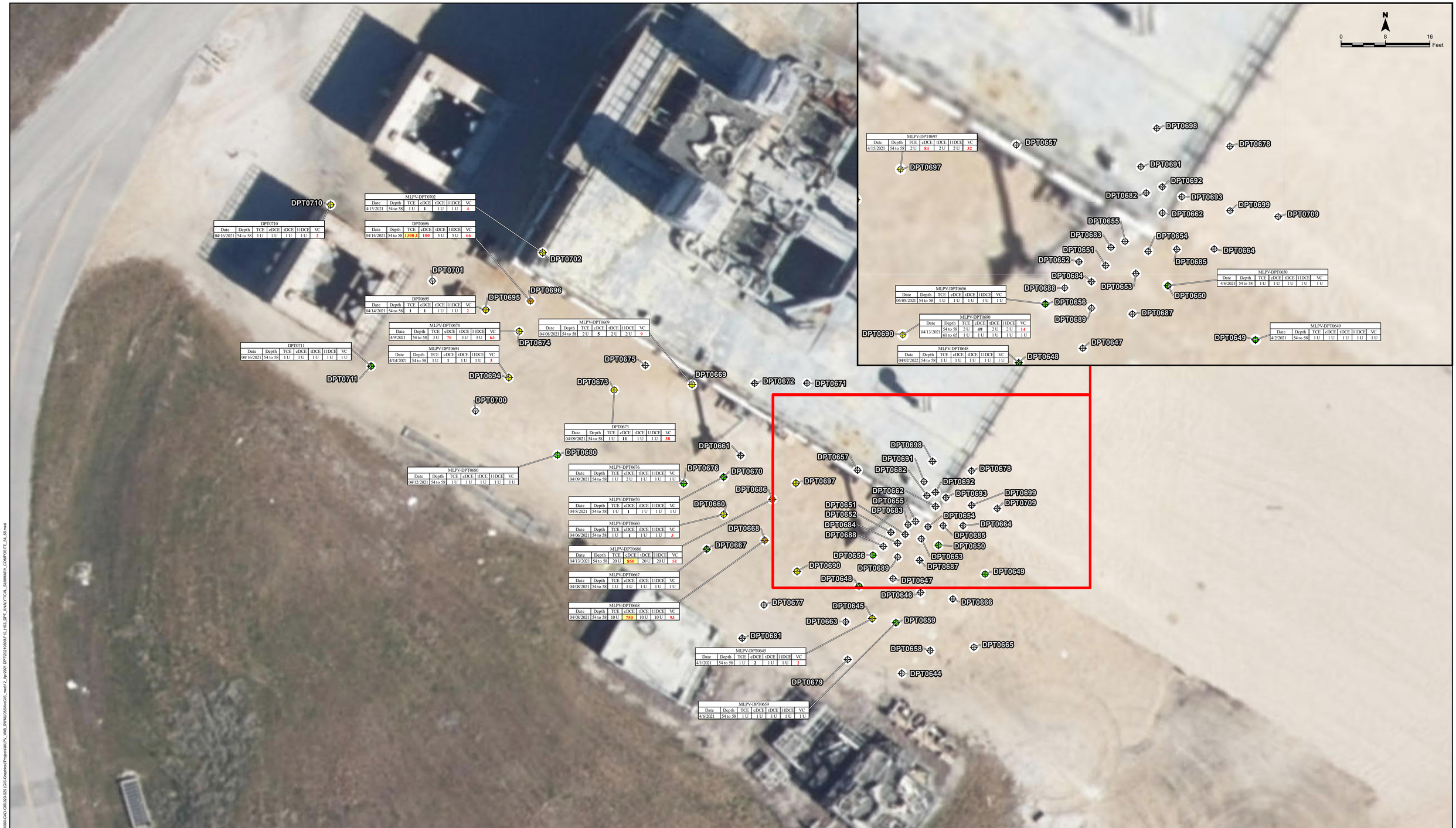
Abbreviation	Analyte	GCTL	NADC
TCE	Trichloroethene	3	300
cDCE	1,1-Dichloroethene	70	700
11DCE	cis-1,2-Dichloroethene	7	70
tDCE	trans-Dichloroethene	100	1000
VC	Vinyl Chloride	1	100

Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

FIGURE 9
Hot Spot 3 DPT Sampling Locations (48 to 52 ft bls) Composite 2021

Hot Spot 3
MLP/VAB (SWMU 056)
NASA Kennedy Space Center, Florida

Date Saved: 8/10/2021
Document Path: P:\GCS\Projects\EW\NASA\UIQ 80505231\00010500-CAD-GIS\20-323 (GIS Graphics)\Projects\MLPV_VAB_SWMU056\ArcGIS_mxd\12_Apr2021 DPT\2021\8\09\F9_HS3_DPT_ANALYTICAL_SUMMARY_COMPOSITE_48_52.mxd



MLPV-DPT0697						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/15/2021	54 to 58	2 U	**84**	2 U	2 U	**32**

MLPV-DPT0702						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/15/2021	54 to 58	1 U	**1**	1 U	1 U	**4**

DPT0710						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/16/2021	54 to 58	1 U	1 U	1 U	1 U	**2**

DPT0696						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/14/2021	54 to 58	**1300 J**	**100**	5 U	5 U	**66**

DPT0695						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/14/2021	54 to 58	**1**	**1**	1 U	1 U	**2**

MLPV-DPT0674						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/9/2021	54 to 58	3 U	**76**	3 U	3 U	**63**

MLPV-DPT0669						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/08/2021	54 to 58	2 U	**5**	2 U	2 U	**9**

DPT0711						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/16/2021	54 to 58	1 U	1 U	1 U	1 U	1 U

MLPV-DPT0694						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/14/2021	54 to 58	1 U	**1**	1 U	1 U	**3**

DPT0673						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/09/2021	54 to 58	1 U	**11**	1 U	1 U	**38**

MLPV-DPT0680						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/12/2021	54 to 58	1 U	1 U	1 U	1 U	1 U

MLPV-DPT0676						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/09/2021	54 to 58	1 U	2 U	1 U	1 U	1 U

MLPV-DPT0670						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/8/2021	54 to 58	1 U	**1**	1 U	1 U	1 U

MLPV-DPT0660						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/06/2021	54 to 58	1 U	**1**	1 U	1 U	**3**

MLPV-DPT0686						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/13/2021	54 to 58	20 U	***850***	20 U	20 U	**51**

MLPV-DPT0667						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/08/2021	54 to 58	1 U	1 U	1 U	1 U	1 U

MLPV-DPT0668						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/08/2021	54 to 58	10 U	***750***	10 U	10 U	**93**

MLPV-DPT0656						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/05/2021	54 to 58	1 U	1 U	1 U	1 U	1 U

MLPV-DPT0650						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/6/2021	54 to 58	1 U	1 U	1 U	1 U	1 U

MLPV-DPT0690						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/13/2021	54 to 58	2 U	**49**	2 U	2 U	**14**
	61 to 65	1 U	1 U	1 U	1 U	1 U

MLPV-DPT0649						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/2/2021	54 to 58	1 U	1 U	1 U	1 U	1 U

MLPV-DPT0648						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
04/02/2022	54 to 58	1 U	1 U	1 U	1 U	1 U

MLPV-DPT0645						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/1/2021	54 to 58	1 U	**2**	1 U	1 U	**2**

MLPV-DPT0659						
Date	Depth	TCE	cDCE	tDCE	11DCE	VC
4/6/2021	54 to 58	1 U	1 U	1 U	1 U	1 U

Legend

- DPT sampling location
- Monitoring well location (screen interval (ft bls)) (most recent VC concentration (µg/L))
- 1 µg/L VC isopleth (dashed where inferred)
- 100 µg/L VC isopleth (dashed where inferred)
- 1,000 µg/L VC isopleth

Symbology Color Coding

- CVOC concentration less than or equal to GCTLs
- CVOC concentration greater than GCTLs
- CVOC concentration greater than NADCs and less than or equal to 10xNADC
- CVOC concentration greater than 10xNADC
- CVOC concentration greater than 100xNADC
- CVOC detection limit greater than GCTLs
- Sample not collected at this interval

Notes:
- Concentrations are in micrograms per Liter (µg/L)
- U = Indicates that the analyte was undetected
- I = Indicates the analyte was detected but below the reporting limit; therefore, an estimated value
- Q = Results from run #2
- **Bold** indicates a detected value
- **Red bold font** indicates an exceedance of FDEP GCTLs
- **Highlighted Red bold font** indicates an exceedance of FDEP NADCs
- ***Highlighted Red italic font*** indicates an exceedance of FDEP 10xNADCs
- bls = below land surface
- GCTL = Groundwater Cleanup Target Levels as provided in 62-777, F.A.C.
- NADC = Natural Attenuation Default Concentration as provided in 62-777, F.A.C.
- MLP/VAB indicates Mobile Launch Platform/Vehicle Assembly Building
- Aerial Source: FDOT 2018

Abbreviation	Analyte	GCTL	NADC
TCE	Trichloroethene	3	300
cDCE	1,1-Dichloroethene	70	700
11DCE	cis-1,2-Dichloroethene	7	70
tDCE	trans--Dichloroethene	100	1000
VC	Vinyl Chloride	1	100

Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

FIGURE 10
Hot Spot 3 DPT Sampling Locations (54 to 58 ft bls) Composite 2021

Hot Spot 3
MLP/VAB (SWMU 056)
NASA Kennedy Space Center, Florida

Date Saved: 8/10/2021
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Table 3
DPT Groundwater Analytical Results: Chlorinated Volatile Organic Compounds
Mobile Launch Platform (MLP) and Vehicle Assembly Building (VAB) Area: Hot Spot 3 (OFW Area)

		Category	Volatile Organic Compounds (VOCs) by Method 8260				
		Analyte	TRICHLOROETHENE	CIS-1,2-DICHLOROETHENE	TRANS-1,2-DICHLOROETHENE	1,1-DICHLOROETHENE	VINYL CHLORIDE
		State of Florida GCTLs (µg/L)	3	70	100	7	1
Location ID	**Sample Date**	**Sample Depth (ft bls)**					
MLPV-DPT0644	4/1/2021	43 to 47	1 U	7	1 U	1 U	3
		48 to 52	1 U	20	1 U	1 U	28
MLPV-DPT0645	4/1/2021	43 to 47	1 U	1	1 U	1 U	2
		48 to 52	5 U	2400	22	5 U	810
		54 to 58	1 U	2	1 U	1 U	2
MLPV-DPT0646	4/1/2021	43 to 47	2 U	6	130	2 U	130
		48 to 52	1 U	1 U	7	1 U	4
MLPV-DPT0647	4/1/2021	36 to 40	1 U	1 U	1 U	1 U	2
		43 to 47	3 U	3 U	3 U	3 U	10
		48 to 52	1 U	1 U	1 U	1 U	2
MLPV-DPT0648	4/1/2021	43 to 47	1 U	3	1 U	1 U	1 U
	4/2/2021	48 to 52	1 U	1 U	1	1 U	1 U
		54 to 58	1 U	1 U	1 U	1 U	1 U
MLPV-DPT0649	4/2/2021	36 to 40	1 U	1 U	1 U	1 U	1 U
		43 to 47	1 U	1 U	1 U	1 U	1 U
		48 to 52	1 U	1 U	1 U	1 U	1 U
		54 to 58	1 U	1 U	1 U	1 U	1 U
MLPV-DPT0650	4/14/2021	5 to 9	1 U	1 U	1 U	1 U	2
	4/2/2021	9 to 13	1 U	1 U	1 U	1 U	1 U
		14 to 18	1 U	1 U	1 U	1 U	1 U
		36 to 40	1 U	1 U	1 U	1 U	1 U
		43 to 47	3000	2900	220	48	15000 J
		DUP	2800	2600	200	100 U	15400
	4/6/2021	48 to 52	20 U	4600	90	20 U	7600
		54 to 58	1 U	1 U	1 U	1 U	1 U
MLPV-DPT0651	4/2/2021	5 to 9	1 U	1 U	1 U	1 U	1 U
		9 to 13	2300	2600	33	10 U	910
		14 to 18	130	4	2 U	2 U	6
		20 to 24	2	1 U	1 U	1 U	1 U
		25 to 29	4	2	1 U	1 U	1 U
		36 to 40	1 U	1 U	1 U	1 U	1
		43 to 47	8900	5700	100 U	100 U	5400
		48 to 52	1 U	1 U	2	1 U	1 U
MLPV-DPT0652	4/5/2021	9 to 13	1 U	1 U	1 U	1 U	1 U
		14 to 18	1 U	1 U	1 U	1 U	1 U
		43 to 47	93	7	2 U	2 U	9
		48 to 52	2 U	2 U	2 U	2 U	3
MLPV-DPT0653	4/5/2021	5 to 9	1 U	20	6	1 U	470 J
		DUP	2 U	19	6	2 U	430
		9 to 13	20 U	2100	84	20 U	4200
		14 to 18	2100	87000 J	790	100	21000
		36 to 40	1 U	1	1 U	1 U	1 U
MLPV-DPT0654	4/5/2021	9 to 13	1 U	20	6	1 U	190
		14 to 18	1 U	4	1	1 U	88
		36 to 40	1 U	1 U	1 U	1 U	1 U
		43 to 47	55000	14000	29	200 U	17000
MLPV-DPT0655	4/5/2021	5 to 9	2 U	3	2 U	2 U	14
		9 to 13	25000	5200	200 U	200 U	2900
		14 to 18	120	360	20 U	20 U	3200
		20 to 24	16	1 U	1 U	1 U	1
MLPV-DPT0656	4/5/2021	43 to 47	21	13	3 U	3 U	16
		48 to 52	1 U	1 U	1 U	1 U	1 U
		54 to 58	1 U	1 U	1 U	1 U	1 U
MLPV-DPT0657	4/6/2021	9 to 13	11	1 U	1 U	1 U	2
		DUP	14	1 U	1 U	1 U	3
		14 to 18	1	1 U	1 U	1 U	1 U
		20 to 24	14	2 U	2 U	2 U	14
MLPV-DPT0658	4/6/2021	43 to 47	25	8	2 U	2 U	4
		48 to 52	1	420	4	1 U	210
MLPV-DPT0659	4/6/2021	43 to 47	55	4600	200	40 U	9000
		48 to 52	40 U	4300	520	40 U	9700
		54 to 58	1 U	1 U	1 U	1 U	1 U

Table 3
DPT Groundwater Analytical Results: Chlorinated Volatile Organic Compounds
Mobile Launch Platform (MLP) and Vehicle Assembly Building (VAB) Area: Hot Spot 3 (OFW Area)

		Category	Volatile Organic Compounds (VOCs) by Method 8260				
		Analyte	TRICHLOROETHENE	CIS-1,2-DICHLOROETHENE	TRANS-1,2-DICHLOROETHENE	1,1-DICHLOROETHENE	VINYL CHLORIDE
		State of Florida GCTLs (µg/L)	3	70	100	7	1
Location ID	**Sample Date**	**Sample Depth (ft bls)**					
MLPV-DPT0660	4/6/2021	43 to 47	1 U	1 U	1 U	1 U	**3**
		48 to 52	20 U	**2700**	**32**	20 U	**3000**
		54 to 58	1 U	**1**	1 U	1 U	**3**
MLPV-DPT0661	4/6/2021	14 to 18	1 U	1 U	1 U	1 U	1 U
	4/7/2021	20 to 24	1 U	1 U	1 U	1 U	1 U
		43 to 47	2 U	2 U	2 U	2 U	2 U
		48 to 52	10 U	**1600**	**12**	10 U	**770**
		DUP	10 U	**1800**	**13**	10 U	**840**
MLPV-DPT0662	4/7/2021	5 to 9	**4**	**2**	1 U	1 U	**140**
		9 to 13	1 U	1 U	1 U	1 U	**1**
		14 to 18	1 U	1 U	1 U	1 U	1 U
		20 to 24	**2**	**1**	1 U	1 U	1 U
MLPV-DPT0663	4/7/2021	43 to 47	1 U	**2**	1 U	1 U	**1**
		48 to 52	3 U	**780**	**6**	3 U	**160**
MLPV-DPT0664	4/7/2021	5 to 9	**1**	**8**	**2**	1 U	**54**
		9 to 13	1 U	1 U	1 U	1 U	**5**
		14 to 18	1 U	1 U	1 U	1 U	1 U
		20 to 24	1 U	1 U	1 U	1 U	1 U
MLPV-DPT0665	4/7/2021	43 to 47	1 U	**11**	1 U	1 U	**3**
		48 to 52	1 U	1 U	1 U	1 U	**8**
MLPV-DPT0666	4/7/2021	43 to 47	**2**	1 U	**2**	1 U	**4**
		48 to 52	**2**	**16**	**21**	1 U	**74**
MLPV-DPT0667	4/8/2021	43 to 47	1 U	**6**	1 U	1 U	**1**
		48 to 52	1 U	**8**	1 U	1 U	**4**
		DUP	1 U	**8**	1 U	1 U	**5**
		54 to 58	1 U	1 U	1 U	1 U	1 U
MLPV-DPT0668	4/8/2021	43 to 47	1 U	**2**	**4**	1 U	**3**
		48 to 52	40 U	**7100**	**50**	40 U	**2800**
		54 to 58	10 U	**750**	10 U	10 U	**93**
MLPV-DPT0669	4/8/2021	14 to 18	1 U	1 U	1 U	1 U	1 U
		20 to 24	1 U	**8**	1 U	1 U	**27**
		25 to 29	1 U	1 U	1 U	1 U	1 U
		36 to 40	1 U	1 U	1 U	1 U	1 U
		43 to 47	1 U	**1**	**1**	1 U	**3**
		48 to 52	20 U	**820**	20 U	20 U	**360**
		54 to 58	2 U	**5**	2 U	2 U	**9**
MLPV-DPT0670	4/8/2021	43 to 47	2 U	2 U	2 U	2 U	2 U
		48 to 52	1 U	1 U	1 U	1 U	1 U
		54 to 58	1 U	**1**	1 U	1 U	1 U
MLPV-DPT0671	4/8/2021	14 to 18	1 U	1 U	1 U	1 U	**5**
		20 to 24	1 U	1 U	1 U	1 U	1 U
		25 to 29	**9**	**5**	1 U	1 U	**14**
MLPV-DPT0672	4/8/2021	14 to 18	1 U	1 U	1 U	1 U	**1**
	4/9/2021	20 to 24	1 U	1 U	1 U	1 U	**6**
		25 to 29	1 U	1 U	1 U	1 U	1 U
MLPV-DPT0673	4/9/2021	43 to 47	1 U	**2**	1 U	1 U	**3**
		48 to 52	5 U	**130**	5 U	5 U	**160**
		DUP	5 U	**130**	5 U	5 U	**180**
		54 to 58	1 U	**11**	1 U	1 U	**38**
MLPV-DPT0674	4/9/2021	43 to 47	1 U	**2**	1 U	1 U	1 U
		48 to 52	10 U	**430**	**13**	10 U	**380**
		54 to 58	3 U	**76**	3 U	3 U	**63**
MLPV-DPT0675	4/9/2021	43 to 47	1 U	**4**	1 U	1 U	**1**
		48 to 52	1 U	**12**	**2**	1 U	**17**
MLPV-DPT0676	4/9/2021	43 to 47	1 U	**2**	1 U	1 U	**2**
		48 to 52	1 U	1 U	1 U	1 U	1 U
		54 to 58	1 U	1 U	1 U	1 U	1 U
MLPV-DPT0677	4/9/2021	43 to 47	1 U	**3**	1 U	1 U	**36**
		48 to 52	3 U	**11**	3 U	3 U	**160**
MLPV-DPT0678	4/9/2021	5 to 9	1 U	1 U	1 U	1 U	1 U
		9 to 13	1 U	1 U	1 U	1 U	1 U
MLPV-DPT0679	4/9/2021	43 to 47	1 U	**2**	1 U	1 U	**3**
		48 to 52	1 U	**8**	1 U	1 U	**65**

Table 3
DPT Groundwater Analytical Results: Chlorinated Volatile Organic Compounds
Mobile Launch Platform (MLP) and Vehicle Assembly Building (VAB) Area: Hot Spot 3 (OFW Area)

		Category	Volatile Organic Compounds (VOCs) by Method 8260				
		Analyte	TRICHLOROETHENE	CIS-1,2-DICHLOROETHENE	TRANS-1,2-DICHLOROETHENE	1,1-DICHLOROETHENE	VINYL CHLORIDE
		State of Florida GCTLs (µg/L)	3	70	100	7	1
Location ID	**Sample Date**	**Sample Depth (ft bls)**					
MLPV-DPT0680	4/12/2021	43 to 47	1 U	2	1	1 U	1 U
		DUP	1 U	2	1 U	1 U	1 U
		48 to 52	1 U	22	1 U	1 U	5
		54 to 58	1 U	1 U	1 U	1 U	1 U
MLPV-DPT0681	4/12/2021	43 to 47	1 U	7	1 U	1 U	1 U
		48 to 52	1 U	12	1 U	1 U	41
MLPV-DPT0682	4/12/2021	5 to 9	20 U	20 U	20 U	20 U	1100
		9 to 13	120	150	20 U	20 U	920
	4/14/2021	14 to 18	1 U	1 U	1 U	1 U	8
		20 to 24	1 U	1 U	1 U	1 U	1 U
MLPV-DPT0683	4/12/2021	5 to 9	5700	2300	40 U	40 U	310
		9 to 13	129000	25000	100 U	100 U	3000
	4/14/2021	14 to 18	100000	49000	1000 U	1000 U	11000
		20 to 24	37	22	3 U	3 U	7
MLPV-DPT0684	4/12/2021	5 to 9	380	28	10 U	10 U	10 U
		9 to 13	260	4	3 U	3 U	3
		43 to 47	2 U	2 U	2 U	2 U	3
		48 to 52	10 U	360	14	10 U	250
MLPV-DPT0685	4/12/2021	5 to 9	2 U	3	2 U	2 U	130
		9 to 13	1 U	1 U	2	1 U	2
MLPV-DPT0686	4/13/2021	43 to 47	2 U	2 U	2 U	2 U	2 U
		48 to 52	200 U	8100	200 U	200 U	5900
		DUP	100 U	7700	100 U	100 U	5700
		54 to 58	20 U	850	20 U	20 U	51
MLPV-DPT0687	4/13/2021	5 to 9	250	9	3 U	3 U	8
		9 to 13	190	10	3 U	3 U	7
MLPV-DPT0688	4/13/2021	5 to 9	2	2	1 U	1 U	1 U
		9 to 13	1 U	1 U	1 U	1 U	1 U
MLPV-DPT0689	4/13/2021	5 to 9	1 U	1 U	1 U	1 U	1 U
		9 to 13	1 U	1 U	1 U	1 U	1 U
MLPV-DPT0690	4/13/2021	43 to 47	1 U	2	1 U	1 U	5
		48 to 52	10 U	800	10 U	10 U	260
		54 to 58	2 U	49	2 U	2 U	14
		61 to 65	1 U	1 U	1 U	1 U	1 U
MLPV-DPT0691	4/13/2021	5 to 9	1 U	1 U	1 U	1 U	1 U
		9 to 13	1 U	1	1 U	1 U	1 U
		14 to 18	1 U	1 U	1 U	1 U	2
		20 to 24	1 U	1 U	1 U	1 U	1 U
MLPV-DPT0692	4/14/2021	5 to 9	1 U	12	1 U	1 U	280 J
		DUP	2 U	11	2 U	2 U	290
		9 to 13	2 U	6	2 U	2 U	440
		14 to 18	1 U	1 U	1 U	1 U	1 U
		20 to 24	1 U	1	1 U	1 U	1
MLPV-DPT0693	4/14/2021	5 to 9	3 U	3	3 U	3 U	130
		9 to 13	1 U	1 U	1 U	1 U	11
		14 to 18	1 U	1 U	1 U	1 U	1 U
		20 to 24	1 U	1 U	1 U	1 U	1 U
MLPV-DPT0694	4/14/2021	43 to 47	1 U	2	1	1 U	1 U
		48 to 52	10 U	270	10 U	10 U	350
		54 to 58	1 U	1	1 U	1 U	3
MLPV-DPT0695	4/14/2021	43 to 47	1 U	5	1 U	1 U	3
		48 to 52	10 U	640	10 U	10 U	420
		54 to 58	1	1	1 U	1 U	2
MLPV-DPT0696	4/14/2021	43 to 47	1 U	2	1 U	1 U	2
		48 to 52	3 U	250	3 U	3 U	250
		54 to 58	1300 J	100	5 U	5 U	66
		DUP	1300	95	10 U	10 U	59
MLPV-DPT0697	4/15/2021	43 to 47	10	2	2	1 U	6
		48 to 52	10 U	1500	11	10 U	860
		54 to 58	2 U	84	2 U	2 U	32
MLPV-DPT0698	4/15/2021	5 to 9	1 U	2	1 U	1 U	9
		9 to 13	1 U	1 U	1 U	1 U	4
MLPV-DPT0699	4/15/2021	5 to 9	2 U	40	3	2 U	180
		9 to 13	1 U	19	2	1 U	130

Table 3
DPT Groundwater Analytical Results: Chlorinated Volatile Organic Compounds
Mobile Launch Platform (MLP) and Vehicle Assembly Building (VAB) Area: Hot Spot 3 (OFW Area)

		Category	Volatile Organic Compounds (VOCs) by Method 8260				
		Analyte	TRICHLOROETHENE	CIS-1,2-DICHLOROETHENE	TRANS-1,2-DICHLOROETHENE	1,1-DICHLOROETHENE	VINYL CHLORIDE
		State of Florida GCTLs (µg/L)	3	70	100	7	1
Location ID	**Sample Date**	**Sample Depth (ft bls)**					
MLPV-DPT0700	4/15/2021	48 to 52	**5**	**3**	1 U	1 U	**15**
MLPV-DPT0701	4/15/2021	48 to 52	10 U	**450**	10 U	10 U	**330**
MLPV-DPT0702	4/15/2021	48 to 52	1 U	**24**	1 U	1 U	**73**
		54 to 58	1 U	**1**	1 U	1 U	**4**
MLPV-DPT0709	4/16/2021	5 to 9	1 U	1 U	1 U	1 U	**6**
		9 to 13	1 U	1 U	1 U	1 U	1 U
MLPV-DPT0710	4/16/2021	48 to 52	1 U	**31**	1 U	1 U	**3**
		54 to 58	1 U	1 U	1 U	1 U	**2**
MLPV-DPT0711	4/16/2021	48 to 52	1 U	1 U	1 U	1 U	1 U
		54 to 58	1 U	1 U	1 U	1 U	1 U

Notes:
Bolded results indicate the presence of an analyte at the specified concentration
Red font indicates an exceedance of FDEP GCTLs or Site Approved Target Levels for UIC Sampling
Yellow Highlighted cell indicates an exceedance of FDEP NADCs
Blank cells indicate the analyte was not analyzed for that specific well and date
ft bls = feet below land surface
GCTL = Groundwater Cleanup Target Level, Chapter 62-777 Florida Administrative Code, Table 1 (2005)
NADCs = Natural Attenuation Default Concentration, Chapter 62-777 Florida Administrative Code, Table V (April 2005)
J = Indicates an estimated value
U = Indicates the analyte was not detected
µg/L = micrograms per liter
DPT = Direct Push Technology .

APPENDIX C

EVS MODEL OF CVOC DISTRIBUTION

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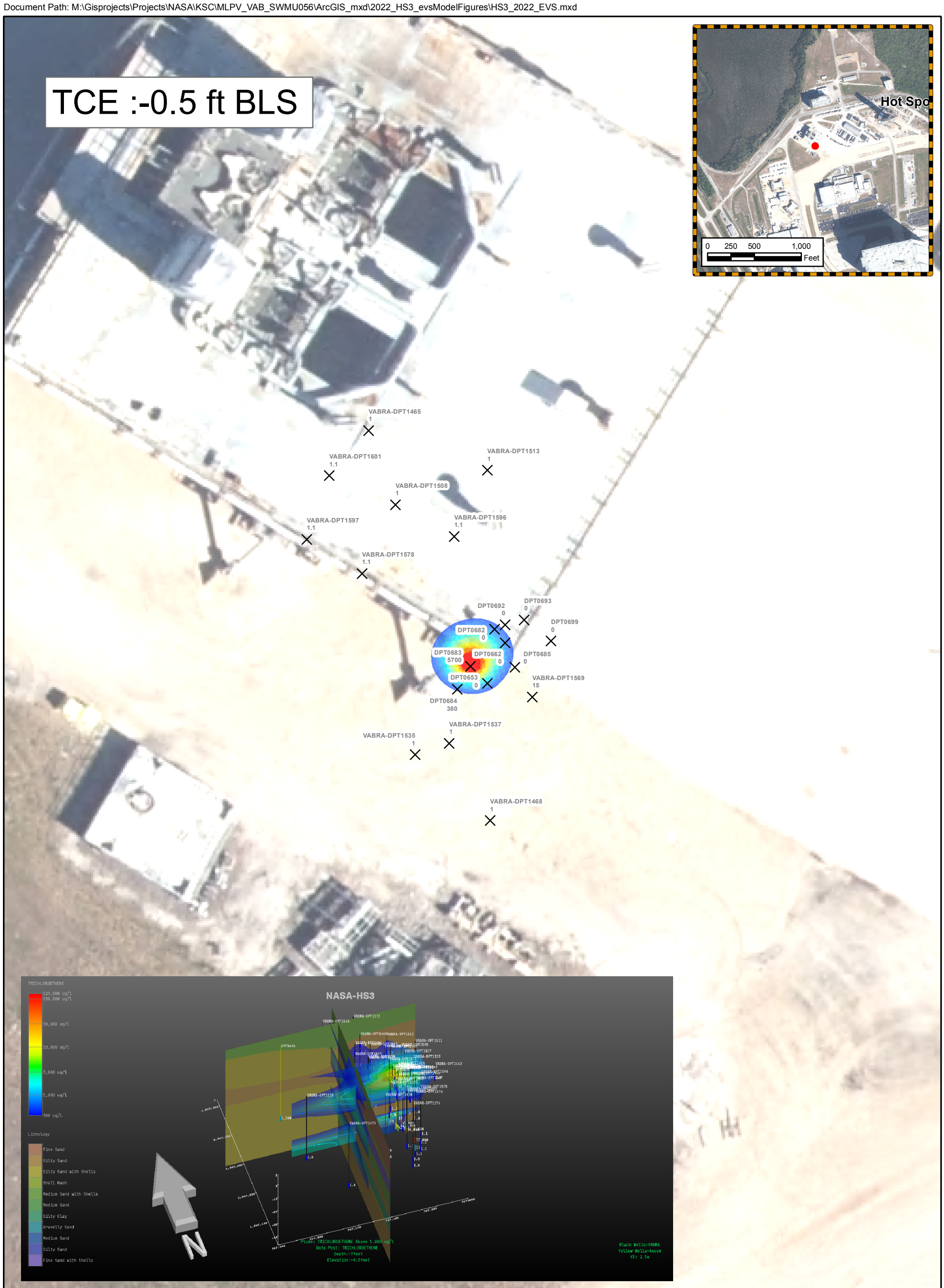

Legend

× Locations Used for EVS Model

1_-0_5

Value

High : 4142.11

Low : 1.00016

Notes:
1. MLP/VAB = Mobile Launcher Platform Rehabilitation Sites / Vehicle Assembly Building Area.
2. SWMU = Stormwater Waste Management Unit
3. Source of 2018 aerial: Florida Department of Transportation Aerial Photo Lookup System website.
4. Source of plume boundaries: 2018 Annual CMI and IM report that included additional data form DPT sampling locations.

N

0 20 40 Feet

FIGURE C-1
TCE :-0.5 feet bls

MLP/VAB (SWMU 056)
NASA Kennedy Space Center, Florida

Document Path: M:\Gisprojects\Projects\NASA\KSC\MLPV_VAB_SWMU056\ArcGIS_mxd\2022_HS3_evsModelFigures\HS3_2022_EVS.mxd

Legend

× Locations Used for EVS Model

1_-4_5

Value

High : 68985.8

Low : 1.00184

Notes:
1. MLP/VAB = Mobile Launcher Platform Rehabilitation Sites / Vehicle Assembly Building Area.
2. SWMU = Stormwater Waste Management Unit
3. Source of 2018 aerial: Florida Department of Transportation Aerial Photo Lookup System website.
4. Source of plume boundaries: 2018 Annual CMI and IM report that included additional data form DPT sampling locations.

N

0 20 40 Feet

FIGURE C-2
TCE :-4.5 feet bls

MLP/VAB (SWMU 056)
NASA Kennedy Space Center, Florida

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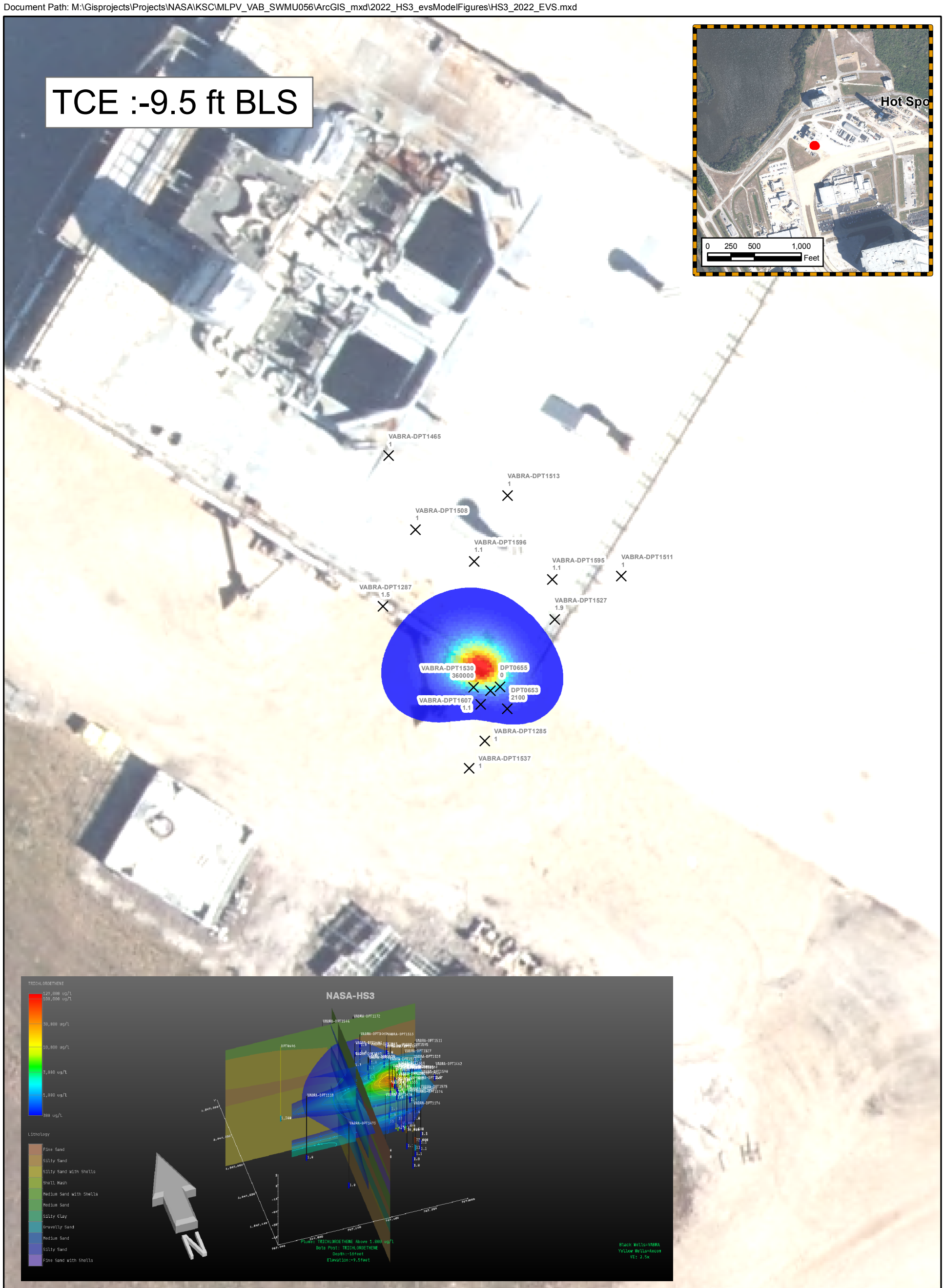

Legend

× Locations Used for EVS Model

1_-9_5

Value

High : 105054

Low : 1.00167

Notes:
1. MLP/VAB = Mobile Launcher Platform Rehabilitation Sites / Vehicle Assembly Building Area.
2. SWMU = Stormwater Waste Management Unit
3. Source of 2018 aerial: Florida Department of Transportation Aerial Photo Lookup System website.
4. Source of plume boundaries: 2018 Annual CMI and IM report that included additional data form DPT sampling locations.

N

0 20 40 Feet

FIGURE C-3
TCE :-9.5 feet bls

MLP/VAB (SWMU 056)
NASA Kennedy Space Center, Florida

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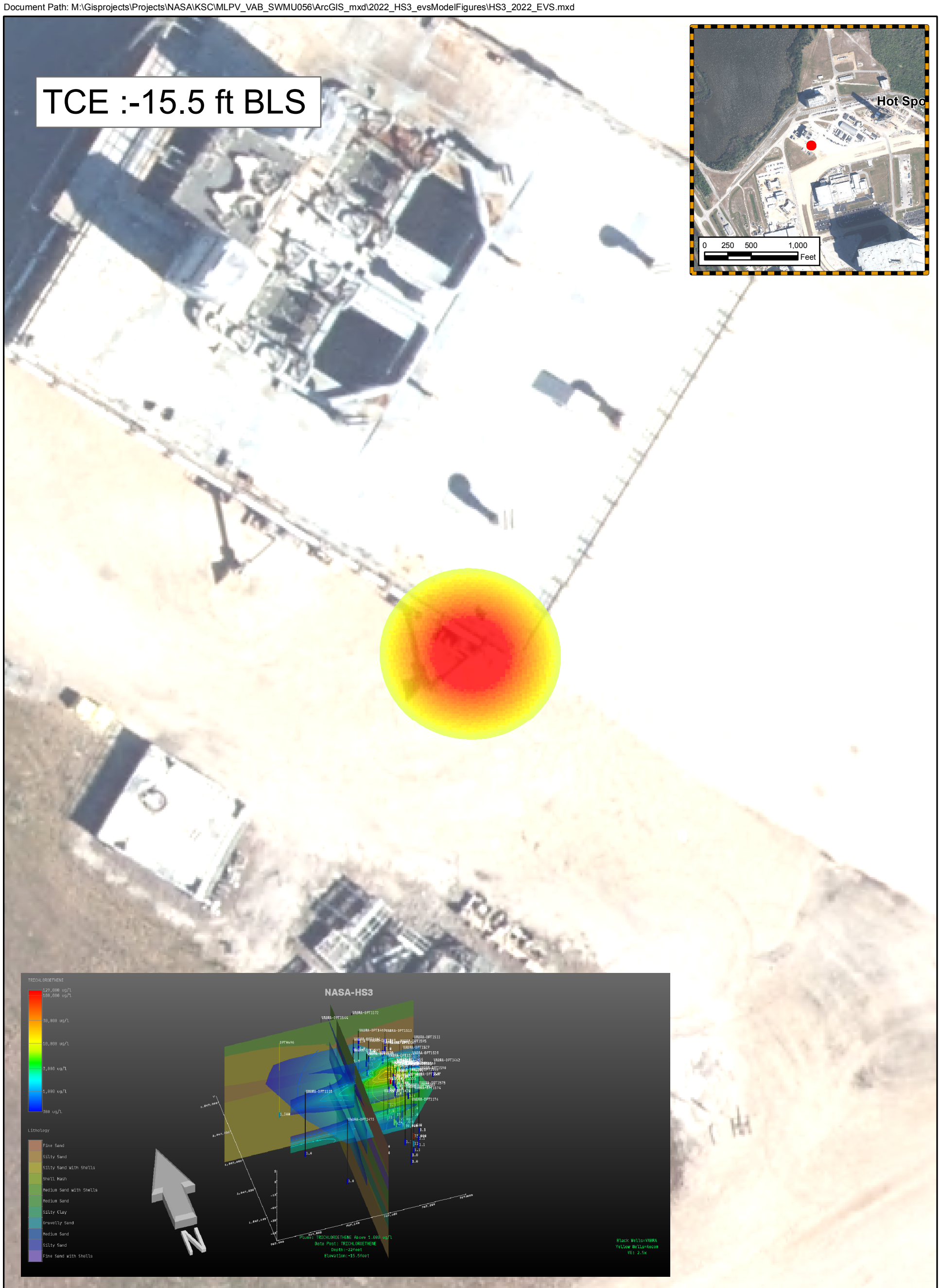

Legend

× Locations Used for EVS Model

1_-15_5

Value

High : 570.834

Low : 1.00234

Notes:
1. MLP/VAB = Mobile Launcher Platform Rehabilitation Sites / Vehicle Assembly Building Area.
2. SWMU = Stormwater Waste Management Unit
3. Source of 2018 aerial: Florida Department of Transportation Aerial Photo Lookup System website.
4. Source of plume boundaries: 2018 Annual CMI and IM report that included additional data form DPT sampling locations.

N

0 20 40 Feet

FIGURE C-4
TCE :-15.5 feet bls

MLP/VAB (SWMU 056)
NASA Kennedy Space Center, Florida

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N

0 20 40
Feet

Legend

× Locations Used for EVS Model

Notes:
1. MLP/VAB = Mobile Launcher Platform Rehabilitation Sites / Vehicle Assembly Building Area.
2. SWMU = Stormwater Waste Management Unit
3. Source of 2018 aerial: Florida Department of Transportation Aerial Photo Lookup System website.
4. Source of plume boundaries: 2018 Annual CMI and IM report that included additional data form DPT sampling locations.

FIGURE C-5
TCE :-20.5 feet bls

MLP/VAB (SWMU 056)
NASA Kennedy Space Center, Florida

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N

0 20 40
Feet

Legend

× Locations Used for EVS Model

Notes:
1. MLP/VAB = Mobile Launcher Platform Rehabilitation Sites / Vehicle Assembly Building Area.
2. SWMU = Stormwater Waste Management Unit
3. Source of 2018 aerial: Florida Department of Transportation Aerial Photo Lookup System website.
4. Source of plume boundaries: 2018 Annual CMI and IM report that included additional data form DPT sampling locations.

FIGURE C-6
TCE :-31.5 feet bls

MLP/VAB (SWMU 056)
NASA Kennedy Space Center, Florida

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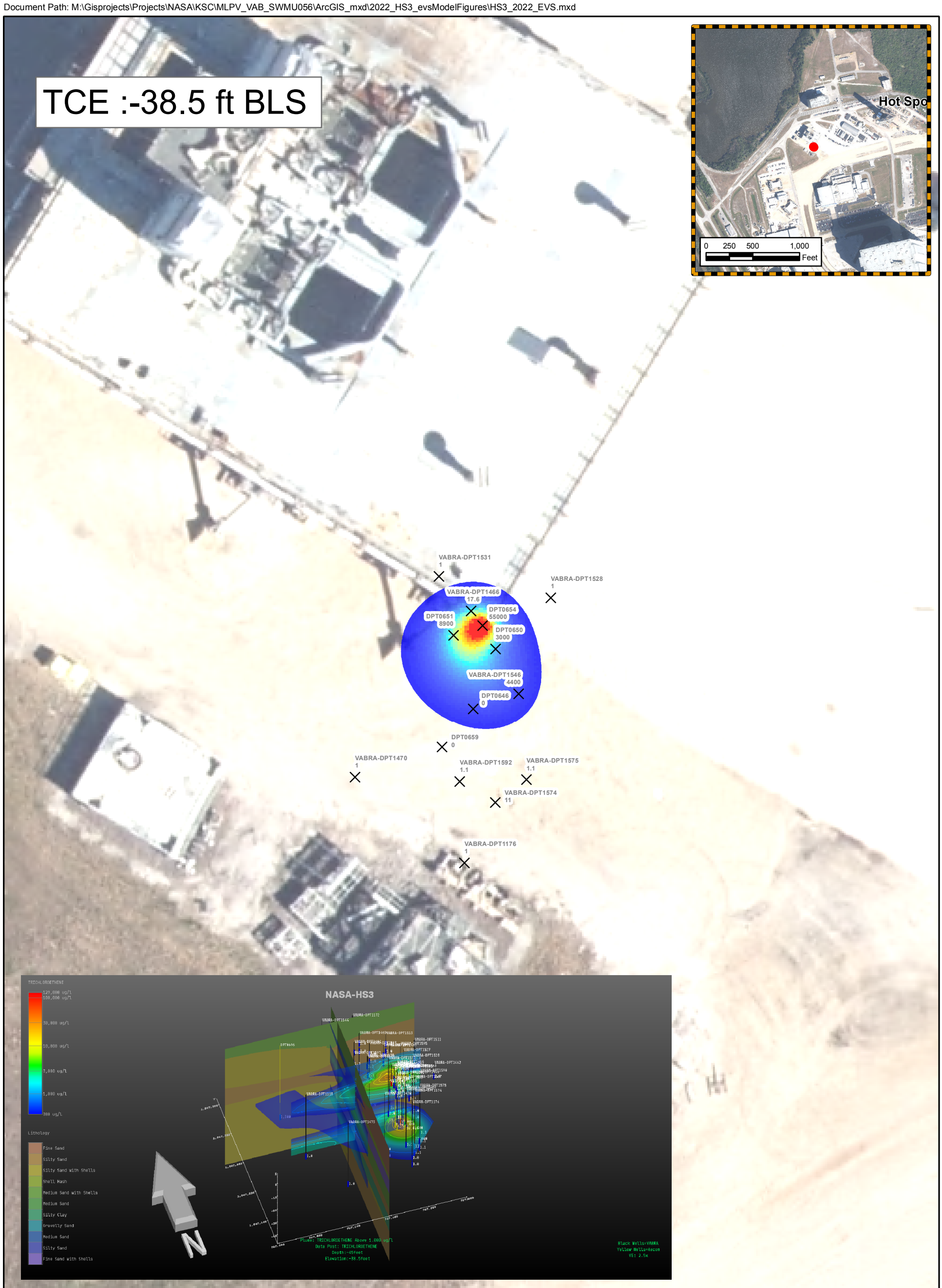

Legend

× Locations Used for EVS Model

1_-38_5

Value

High : 30286.6

Low : 1.00116

Notes:
1. MLP/VAB = Mobile Launcher Platform Rehabilitation Sites / Vehicle Assembly Building Area.
2. SWMU = Stormwater Waste Management Unit
3. Source of 2018 aerial: Florida Department of Transportation Aerial Photo Lookup System website.
4. Source of plume boundaries: 2018 Annual CMI and IM report that included additional data form DPT sampling locations.

N

0 20 40 Feet

FIGURE C-7
TCE :-38.5 feet bls

MLP/VAB (SWMU 056)
NASA Kennedy Space Center, Florida

Document Path: M:\Gisprojects\Projects\NASA\KSC\MLPV_VAB_SWMU056\ArcGIS_mxd\2022_HS3_evsModelFigures\HS3_2022_EVS.mxd

N

0 20 40
Feet

Legend

× Locations Used for EVS Model

Notes:
1. MLP/VAB = Mobile Launcher Platform Rehabilitation Sites / Vehicle Assembly Building Area.
2. SWMU = Stormwater Waste Management Unit
3. Source of 2018 aerial: Florida Department of Transportation Aerial Photo Lookup System website.
4. Source of plume boundaries: 2018 Annual CMI and IM report that included additional data form DPT sampling locations.

FIGURE C-8
TCE :-43.5 feet bls

MLP/VAB (SWMU 056)
NASA Kennedy Space Center, Florida

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Legend

× Locations Used for EVS Model

1_-49_5

Value

High : 1015.44

Low : 1.00355

Notes:
1. MLP/VAB = Mobile Launcher Platform Rehabilitation Sites / Vehicle Assembly Building Area.
2. SWMU = Stormwater Waste Management Unit
3. Source of 2018 aerial: Florida Department of Transportation Aerial Photo Lookup System website.
4. Source of plume boundaries: 2018 Annual CMI and IM report that included additional data form DPT sampling locations.

N

0 20 40 Feet

FIGURE C-9
TCE :-49.5 feet bls

MLP/VAB (SWMU 056)
NASA Kennedy Space Center, Florida

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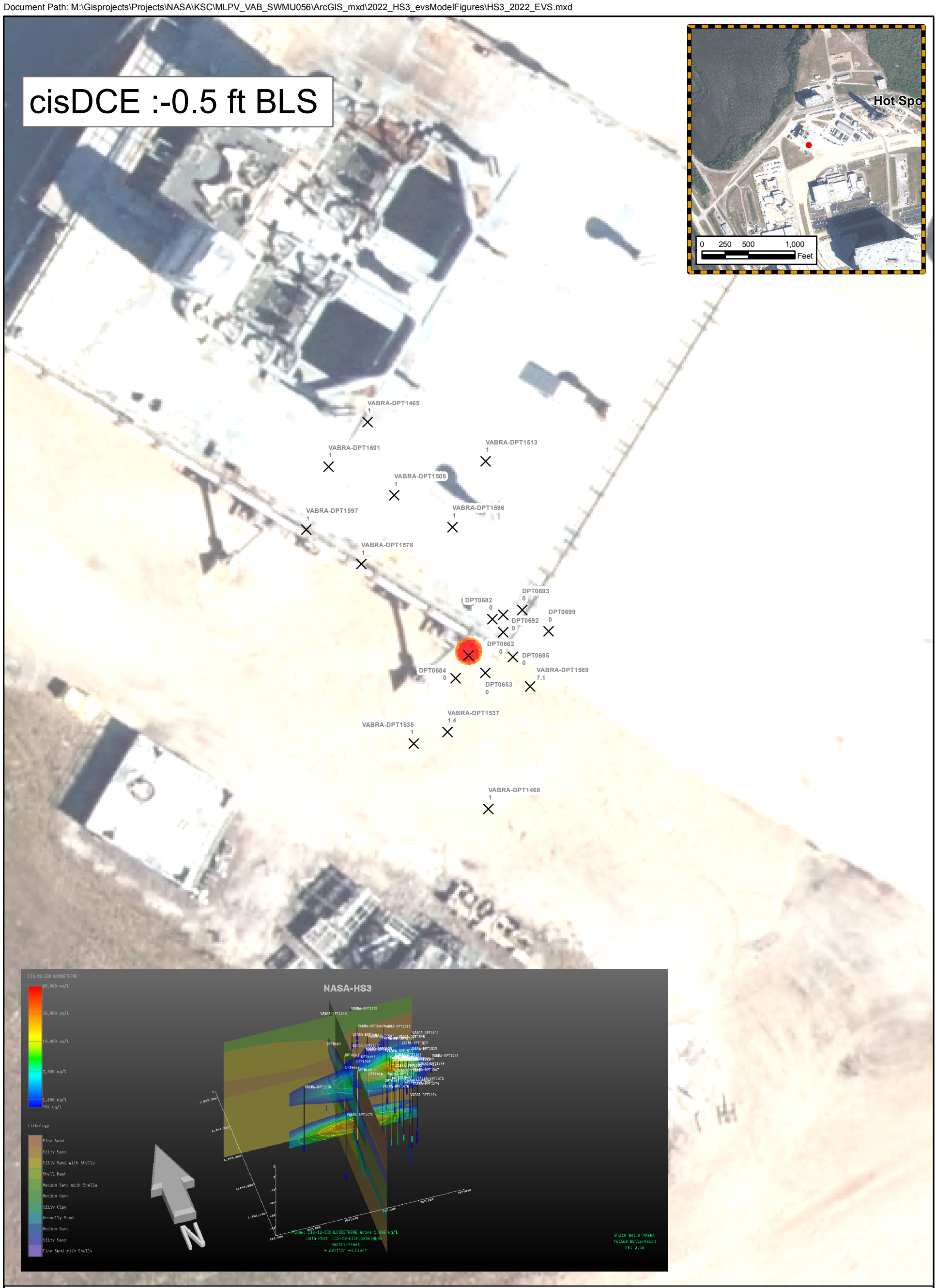

Legend

× Locations Used for EVS Model

0_-0_5

Value

High : 1723.26

Low : 1.00091

Notes:
1. MLP/VAB = Mobile Launcher Platform Rehabilitation Sites / Vehicle Assembly Building Area.
2. SWMU = Stormwater Waste Management Unit
3. Source of 2018 aerial: Florida Department of Transportation Aerial Photo Lookup System website.
4. Source of plume boundaries: 2018 Annual CMI and IM report that included additional data form DPT sampling locations.

N

0 20 40 Feet

FIGURE C-10
cisDCE :-0.5 feet bls

MLP/VAB (SWMU 056)
NASA Kennedy Space Center, Florida

Document Path: M:\Gisprojects\Projects\NASA\KSC\MLPV_VAB_SWMU056\ArcGIS_mxd\2022_HS3_evsModelFigures\HS3_2022_EVS.mxd

Legend

× Locations Used for EVS Model

0_-4_5

Value

High : 15808.8

Low : 1.00181

Notes:
1. MLP/VAB = Mobile Launcher Platform Rehabilitation Sites / Vehicle Assembly Building Area.
2. SWMU = Stormwater Waste Management Unit
3. Source of 2018 aerial: Florida Department of Transportation Aerial Photo Lookup System website.
4. Source of plume boundaries: 2018 Annual CMI and IM report that included additional data form DPT sampling locations.

N

0 20 40 Feet

FIGURE C-11
cisDCE :-4.5 feet bls

MLP/VAB (SWMU 056)
NASA Kennedy Space Center, Florida

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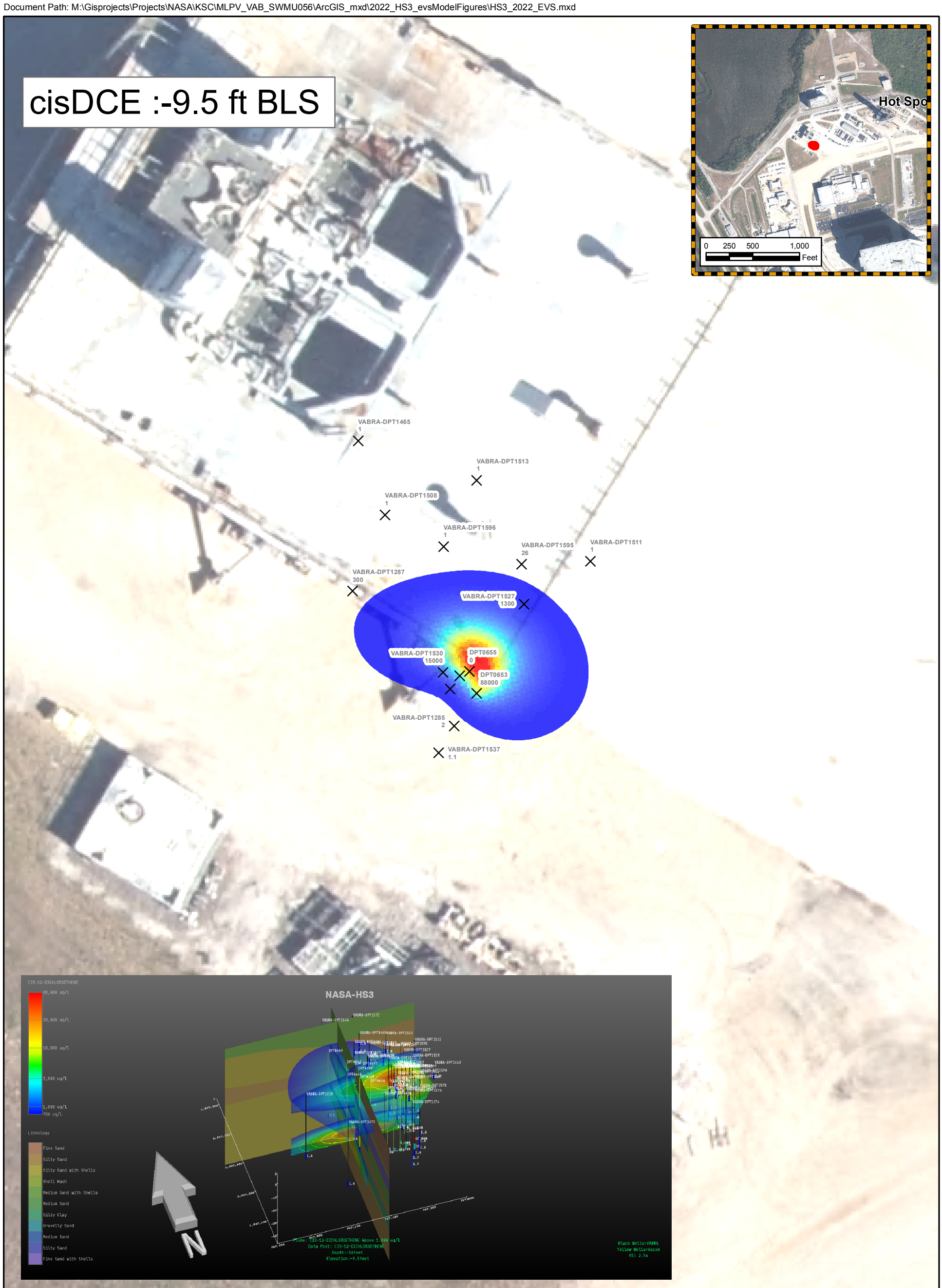

Legend

× Locations Used for EVS Model

0_-9_5

Value

High : 153564

Low : 1.00065

Notes:
1. MLP/VAB = Mobile Launcher Platform Rehabilitation Sites / Vehicle Assembly Building Area.
2. SWMU = Stormwater Waste Management Unit
3. Source of 2018 aerial: Florida Department of Transportation Aerial Photo Lookup System website.
4. Source of plume boundaries: 2018 Annual CMI and IM report that included additional data form DPT sampling locations.

N

0 20 40 Feet

FIGURE C-12
cisDCE :-9.5 feet bls

MLP/VAB (SWMU 056)
NASA Kennedy Space Center, Florida

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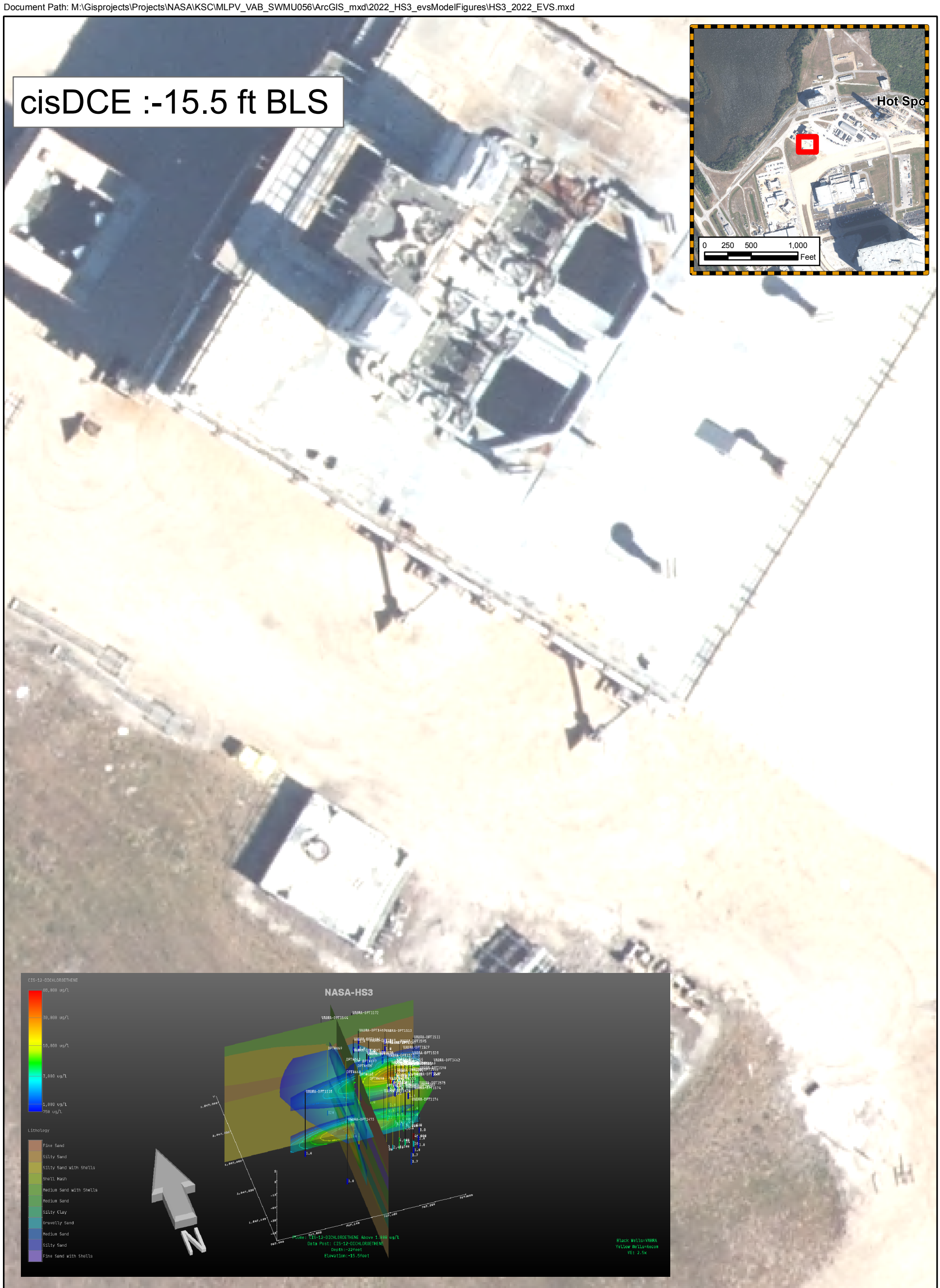

N

0 20 40
Feet

Legend

× Locations Used for EVS Model

Notes:
1. MLP/VAB = Mobile Launcher Platform Rehabilitation Sites / Vehicle Assembly Building Area.
2. SWMU = Stormwater Waste Management Unit
3. Source of 2018 aerial: Florida Department of Transportation Aerial Photo Lookup System website.
4. Source of plume boundaries: 2018 Annual CMI and IM report that included additional data form DPT sampling locations.

FIGURE C-13
cisDCE :-15.5 feet bls

MLP/VAB (SWMU 056)
NASA Kennedy Space Center, Florida

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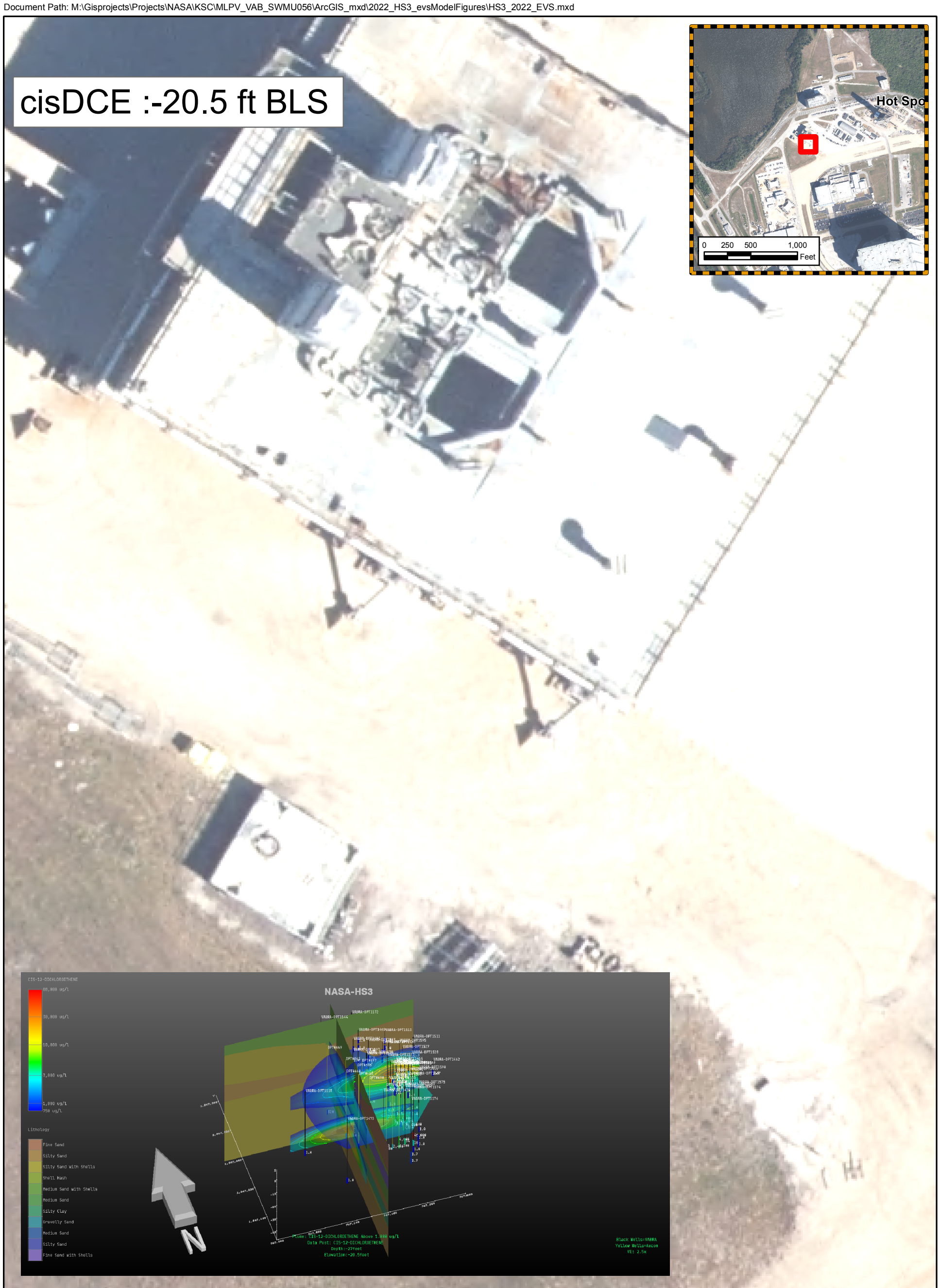

N

0 20 40
Feet

Legend

× Locations Used for EVS Model

Notes:
1. MLP/VAB = Mobile Launcher Platform Rehabilitation Sites / Vehicle Assembly Building Area.
2. SWMU = Stormwater Waste Management Unit
3. Source of 2018 aerial: Florida Department of Transportation Aerial Photo Lookup System website.
4. Source of plume boundaries: 2018 Annual CMI and IM report that included additional data form DPT sampling locations.

FIGURE C-14
cisDCE :-20.5 feet bls

MLP/VAB (SWMU 056)
NASA Kennedy Space Center, Florida

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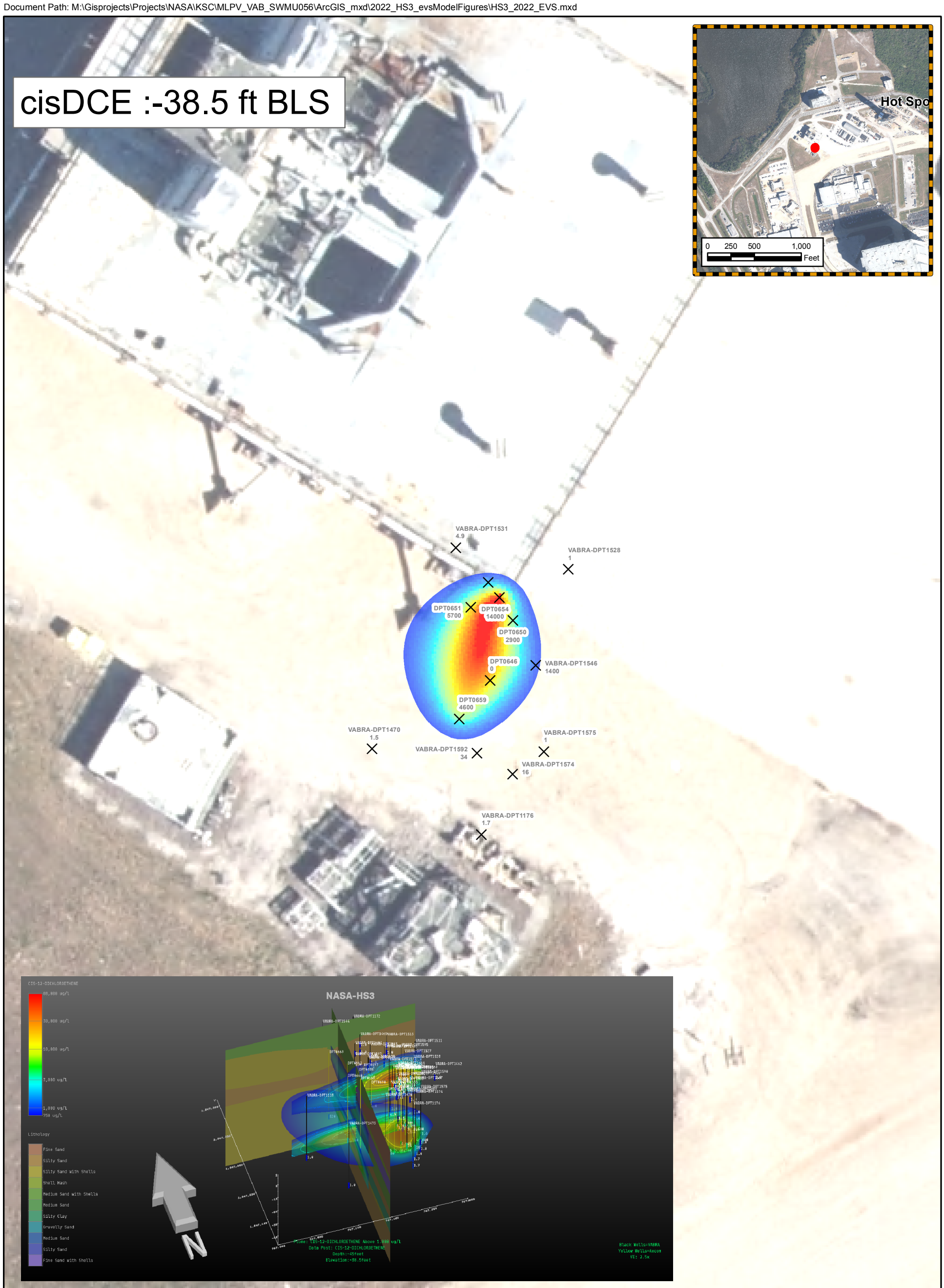

Legend

× Locations Used for EVS Model

0_-38_5

Value

High : 9194.8

Low : 1.00301

Notes:
1. MLP/VAB = Mobile Launcher Platform Rehabilitation Sites / Vehicle Assembly Building Area.
2. SWMU = Stormwater Waste Management Unit
3. Source of 2018 aerial: Florida Department of Transportation Aerial Photo Lookup System website.
4. Source of plume boundaries: 2018 Annual CMI and IM report that included additional data form DPT sampling locations.

N

0 20 40
Feet

FIGURE C-15
cisDCE :-38.5 feet bls

MLP/VAB (SWMU 056)
NASA Kennedy Space Center, Florida

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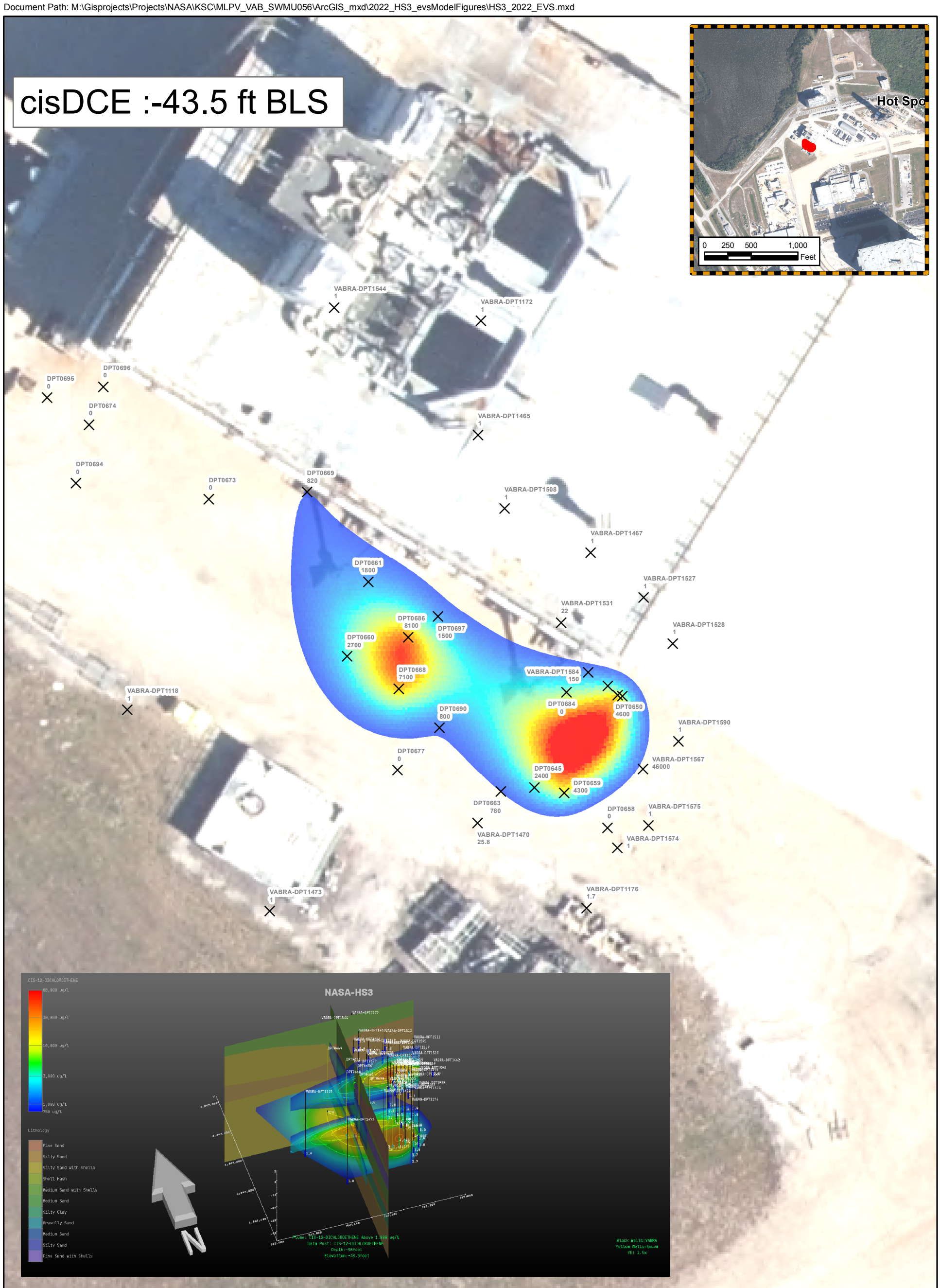


Legend

× Locations Used for EVS Model

0_-43_5

Value

High : 7844.97

Low : 1.0082

Notes:
1. MLP/VAB = Mobile Launcher Platform Rehabilitation Sites / Vehicle Assembly Building Area.
2. SWMU = Stormwater Waste Management Unit
3. Source of 2018 aerial: Florida Department of Transportation Aerial Photo Lookup System website.
4. Source of plume boundaries: 2018 Annual CMI and IM report that included additional data form DPT sampling locations.

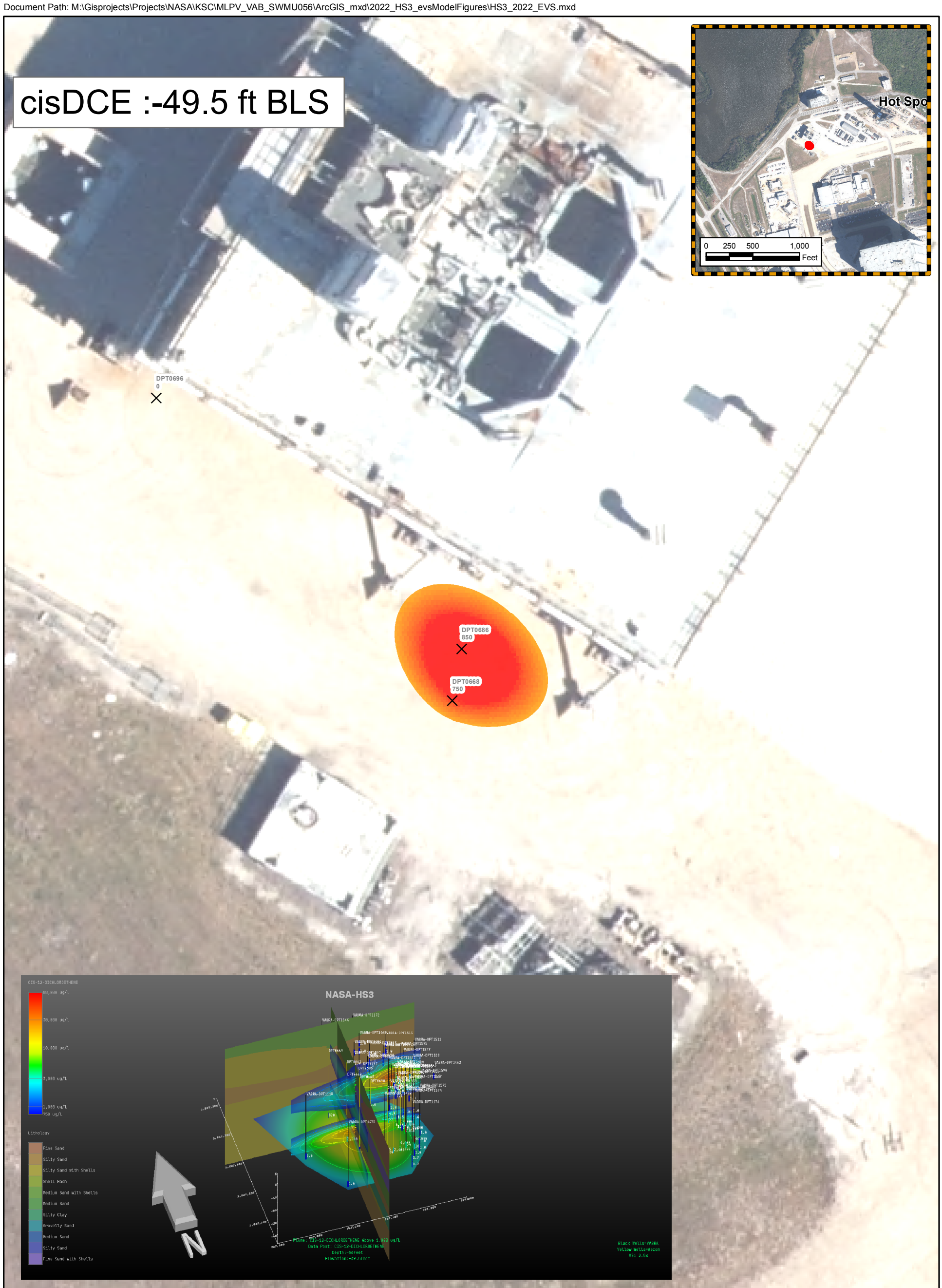
N

0 20 40 Feet

FIGURE C-16
cisDCE :-43.5 feet bls

MLP/VAB (SWMU 056)
NASA Kennedy Space Center, Florida

Document Path: M:\Gisprojects\Projects\NASA\KSC\MLPV_VAB_SWMU056\ArcGIS_mxd\2022_HS3_evsModelFigures\HS3_2022_EVS.mxd



Legend

× Locations Used for EVS Model

0_-49_5

Value

High : 983.436

Low : 1.28621

Notes:
1. MLP/VAB = Mobile Launcher Platform Rehabilitation Sites / Vehicle Assembly Building Area.
2. SWMU = Stormwater Waste Management Unit
3. Source of 2018 aerial: Florida Department of Transportation Aerial Photo Lookup System website.
4. Source of plume boundaries: 2018 Annual CMI and IM report that included additional data form DPT sampling locations.

N

0 20 40 Feet

FIGURE C-17
cisDCE :-49.5 feet bls

MLP/VAB (SWMU 056)
NASA Kennedy Space Center, Florida

Document Path: M:\Gisprojects\Projects\NASA\KSC\MLPV_VAB_SWMU056\ArcGIS_mxd\2022_HS3_evsModelFigures\HS3_2022_EVS.mxd

Legend

× Locations Used for EVS Model

2_-0_5

Value

High : 514.297

Low : 0.650217

Notes:
1. MLP/VAB = Mobile Launcher Platform Rehabilitation Sites / Vehicle Assembly Building Area.
2. SWMU = Stormwater Waste Management Unit
3. Source of 2018 aerial: Florida Department of Transportation Aerial Photo Lookup System website.
4. Source of plume boundaries: 2018 Annual CMI and IM report that included additional data form DPT sampling locations.

N

0 20 40
Feet

FIGURE C-18
VC :-0.5 feet bls

MLP/VAB (SWMU 056)
NASA Kennedy Space Center, Florida

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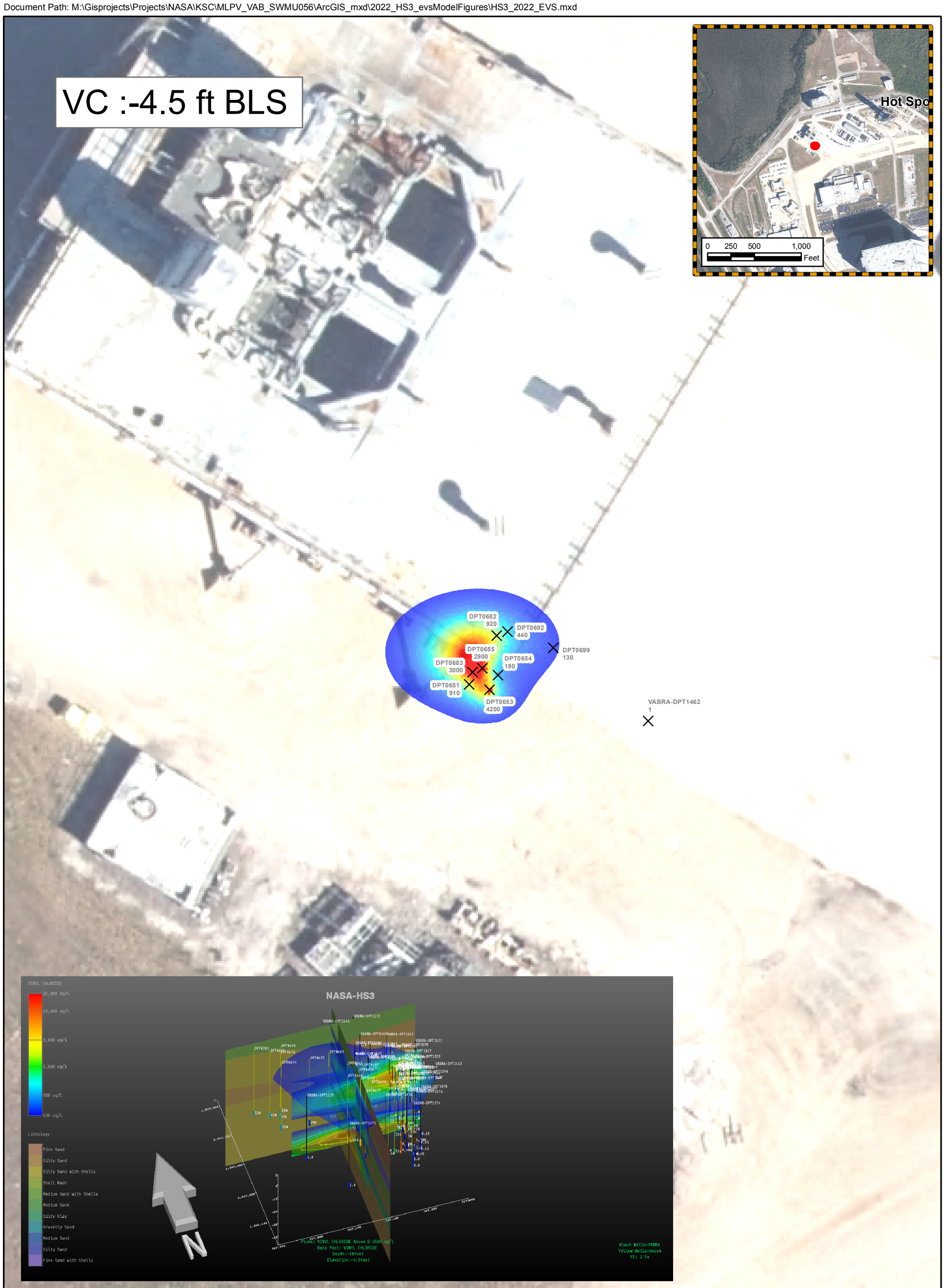

Legend

× Locations Used for EVS Model

2_-4_5

Value

High : 2322.46

Low : 0.650983

Notes:
1. MLP/VAB = Mobile Launcher Platform Rehabilitation Sites / Vehicle Assembly Building Area.
2. SWMU = Stormwater Waste Management Unit
3. Source of 2018 aerial: Florida Department of Transportation Aerial Photo Lookup System website.
4. Source of plume boundaries: 2018 Annual CMI and IM report that included additional data form DPT sampling locations.

N

0 20 40 Feet

FIGURE C-19
VC :-4.5 feet bls

MLP/VAB (SWMU 056)
NASA Kennedy Space Center, Florida

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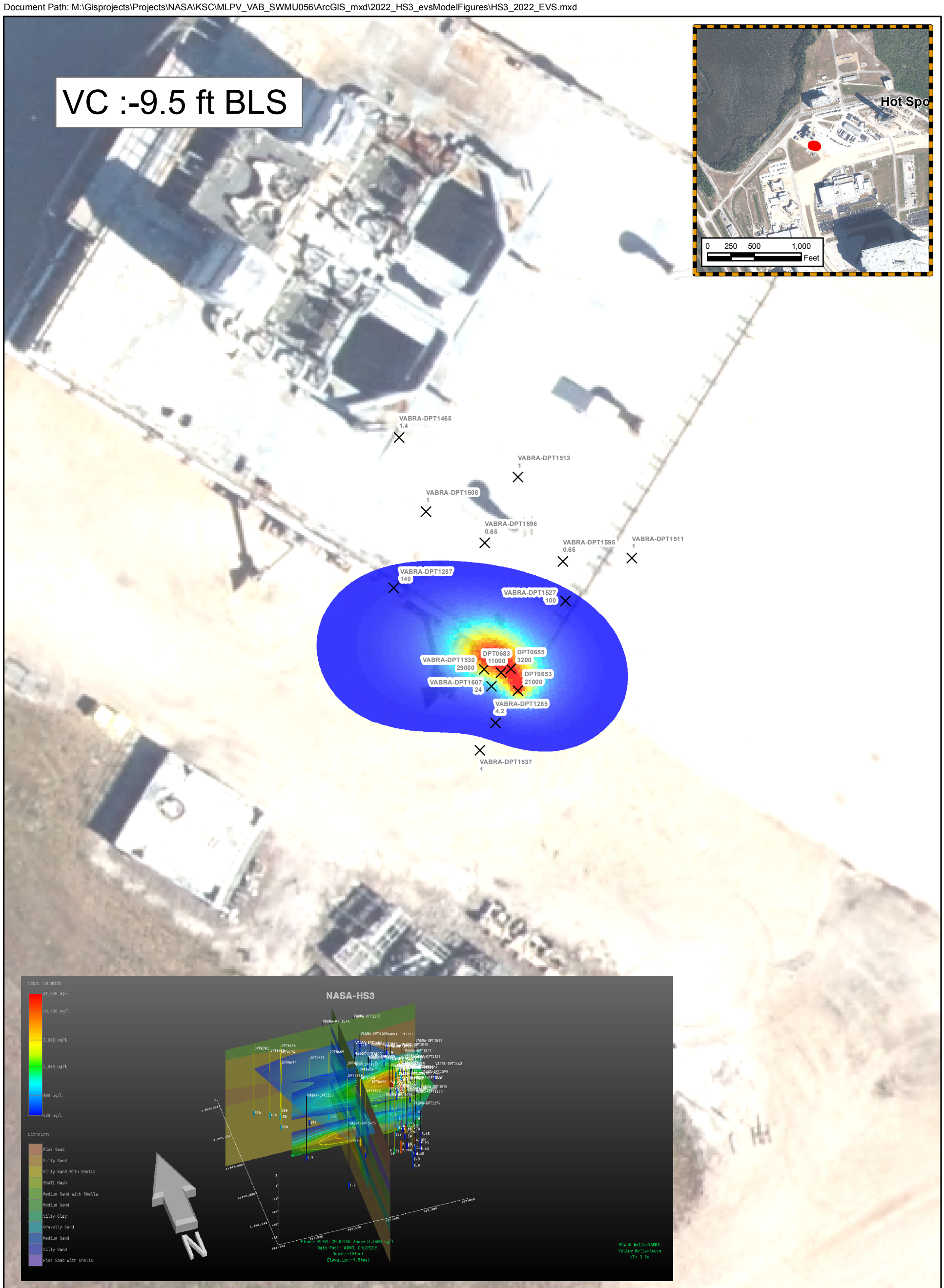


Legend

× Locations Used for EVS Model

2_-9_5

Value

High : 16702.4

Low : 0.821454

Notes:
1. MLP/VAB = Mobile Launcher Platform Rehabilitation Sites / Vehicle Assembly Building Area.
2. SWMU = Stormwater Waste Management Unit
3. Source of 2018 aerial: Florida Department of Transportation Aerial Photo Lookup System website.
4. Source of plume boundaries: 2018 Annual CMI and IM report that included additional data form DPT sampling locations.

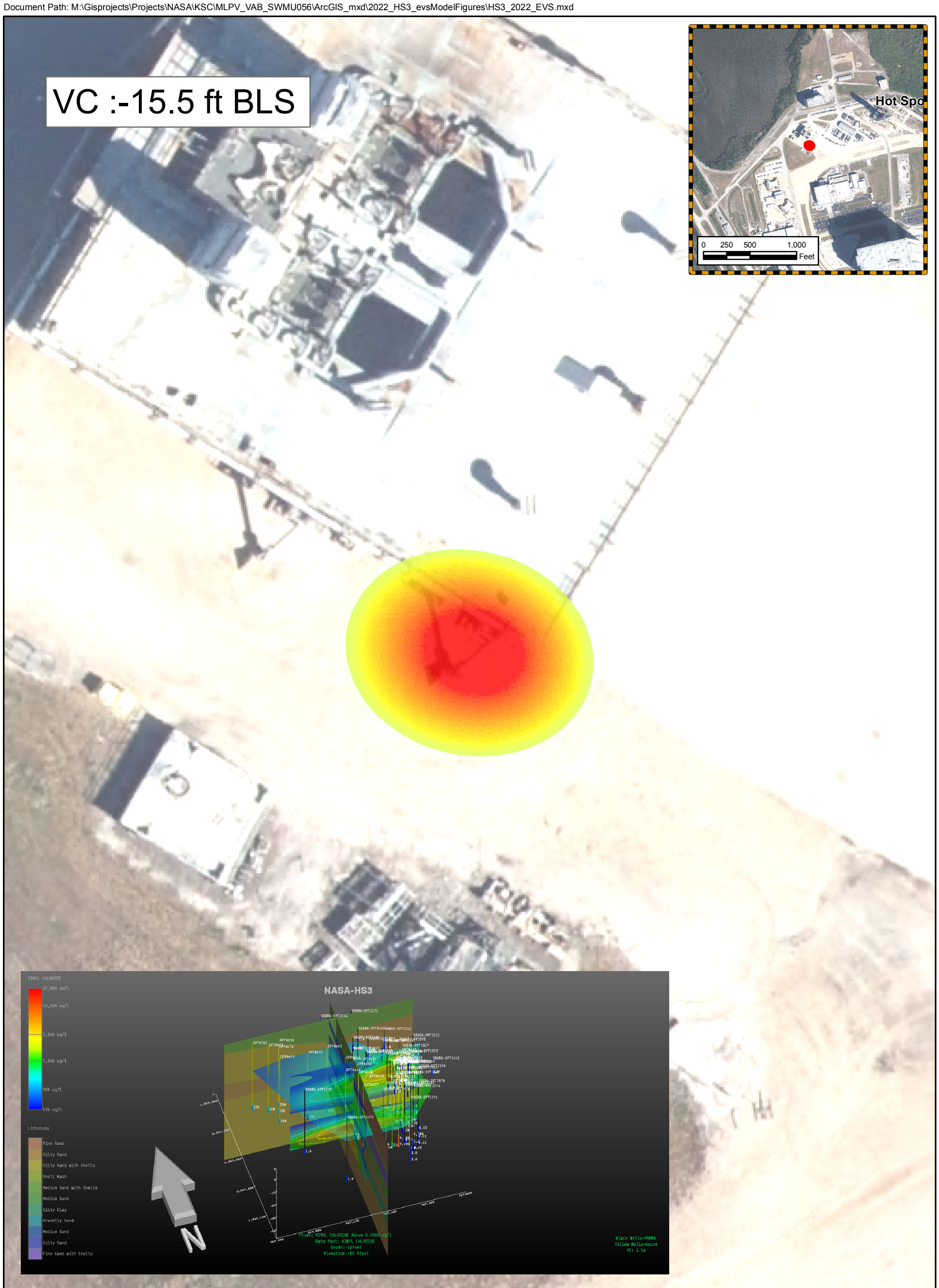
N

0 20 40 Feet

FIGURE C-20
VC :-9.5 feet bls

MLP/VAB (SWMU 056)
NASA Kennedy Space Center, Florida

Document Path: M:\Gisprojects\Projects\NASA\KSC\MLPV_VAB_SWMU056\ArcGIS_mxd\2022_HS3_evsModelFigures\HS3_2022_EVS.mxd



Legend

× Locations Used for EVS Model

2_-15_5

Value

High : 194.893

Low : 1.25901

Notes:
1. MLP/VAB = Mobile Launcher Platform Rehabilitation Sites / Vehicle Assembly Building Area.
2. SWMU = Stormwater Waste Management Unit
3. Source of 2018 aerial: Florida Department of Transportation Aerial Photo Lookup System website.
4. Source of plume boundaries: 2018 Annual CMI and IM report that included additional data form DPT sampling locations.

N

0 20 40 Feet

FIGURE C-21
VC :-15.5 feet bls

MLP/VAB (SWMU 056)
NASA Kennedy Space Center, Florida

Document Path: M:\Gisprojects\Projects\NASA\KSC\MLPV_VAB_SWMU056\ArcGIS_mxd\2022_HS3_evsModelFigures\HS3_2022_EVS.mxd

Legend

× Locations Used for EVS Model

Notes:
1. MLP/VAB = Mobile Launcher Platform Rehabilitation Sites / Vehicle Assembly Building Area.
2. SWMU = Stormwater Waste Management Unit
3. Source of 2018 aerial: Florida Department of Transportation Aerial Photo Lookup System website.
4. Source of plume boundaries: 2018 Annual CMI and IM report that included additional data form DPT sampling locations.

FIGURE C-22
VC :-20.5 feet bls

MLP/VAB (SWMU 056)
NASA Kennedy Space Center, Florida

Document Path: M:\Gisprojects\Projects\NASA\KSC\MLPV_VAB_SWMU056\ArcGIS_mxd\2022_HS3_evsModelFigures\HS3_2022_EVS.mxd

N

0 20 40 Feet

Legend

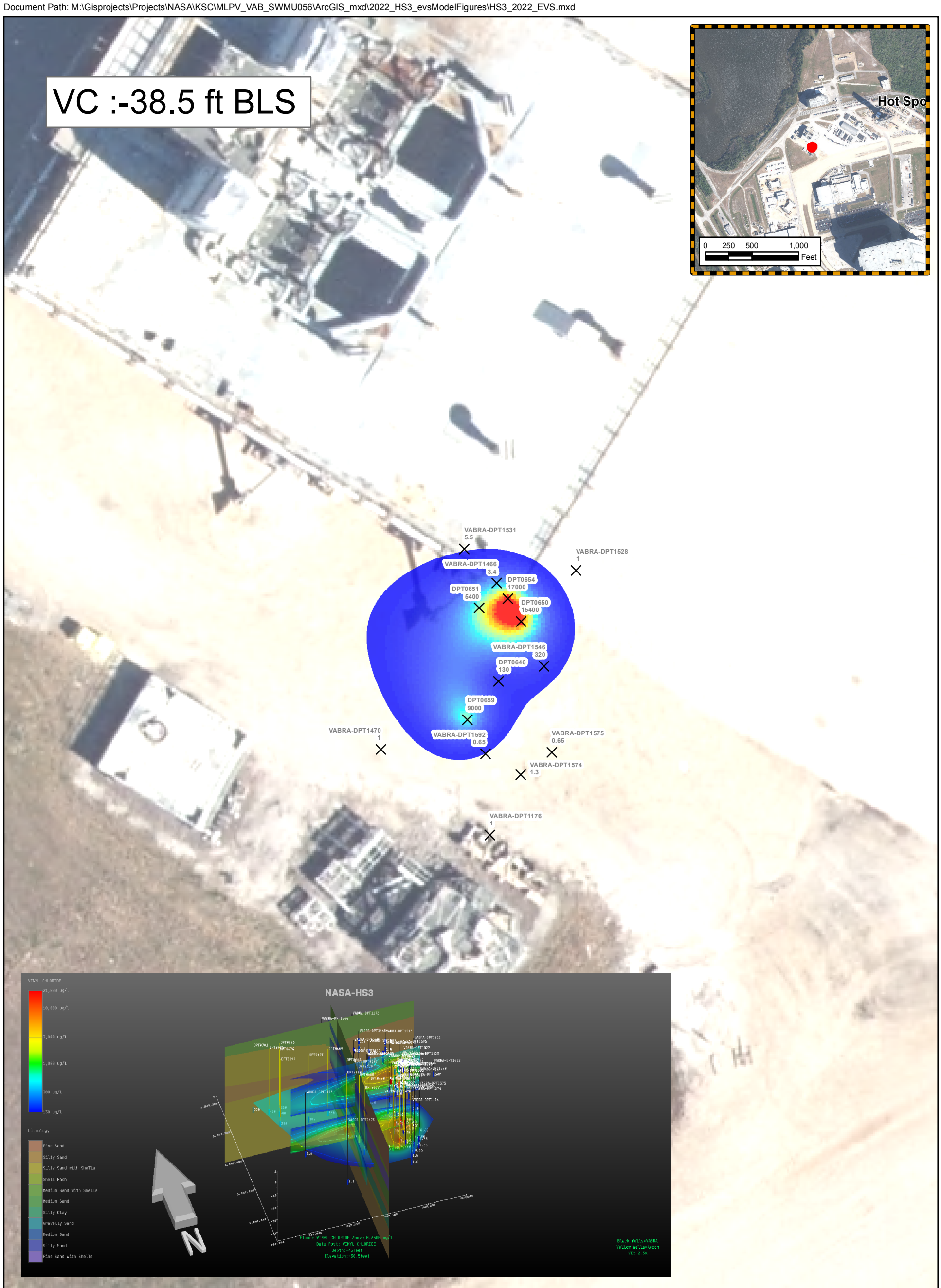
× Locations Used for EVS Model

Notes:
1. MLP/VAB = Mobile Launcher Platform Rehabilitation Sites / Vehicle Assembly Building Area.
2. SWMU = Stormwater Waste Management Unit
3. Source of 2018 aerial: Florida Department of Transportation Aerial Photo Lookup System website.
4. Source of plume boundaries: 2018 Annual CMI and IM report that included additional data form DPT sampling locations.

FIGURE C-23
VC :-31.5 feet bls

MLP/VAB (SWMU 056)
NASA Kennedy Space Center, Florida

Document Path: M:\Gisprojects\Projects\NASA\KSC\MLPV_VAB_SWMU056\ArcGIS_mxd\2022_HS3_evsModelFigures\HS3_2022_EVS.mxd



Legend

× Locations Used for EVS Model

2_-38_5

Value

High : 11642.9

Low : 0.653164

Notes:
1. MLP/VAB = Mobile Launcher Platform Rehabilitation Sites / Vehicle Assembly Building Area.
2. SWMU = Stormwater Waste Management Unit
3. Source of 2018 aerial: Florida Department of Transportation Aerial Photo Lookup System website.
4. Source of plume boundaries: 2018 Annual CMI and IM report that included additional data form DPT sampling locations.

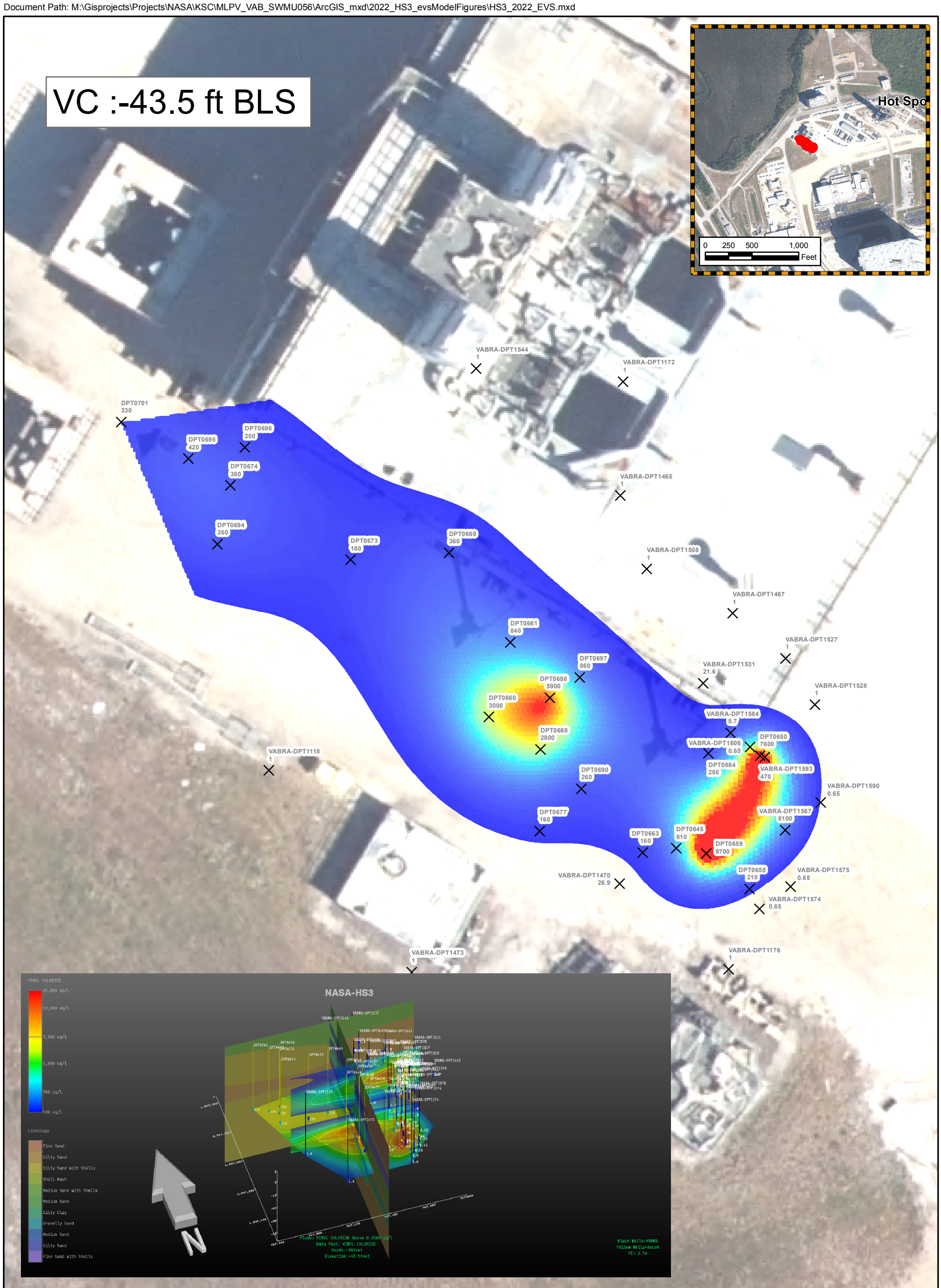
N

0 20 40 Feet

FIGURE C-24
VC :-38.5 feet bls

MLP/VAB (SWMU 056)
NASA Kennedy Space Center, Florida

Document Path: M:\Gisprojects\Projects\NASA\KSC\MLPV_VAB_SWMU056\ArcGIS_mxd\2022_HS3_evsModelFigures\HS3_2022_EVS.mxd



Legend

× Locations Used for EVS Model

2_-43_5

Value

High : 7412.44

Low : 0.930817

Notes:
1. MLP/VAB = Mobile Launcher Platform Rehabilitation Sites / Vehicle Assembly Building Area.
2. SWMU = Stormwater Waste Management Unit
3. Source of 2018 aerial: Florida Department of Transportation Aerial Photo Lookup System website.
4. Source of plume boundaries: 2018 Annual CMI and IM report that included additional data form DPT sampling locations.

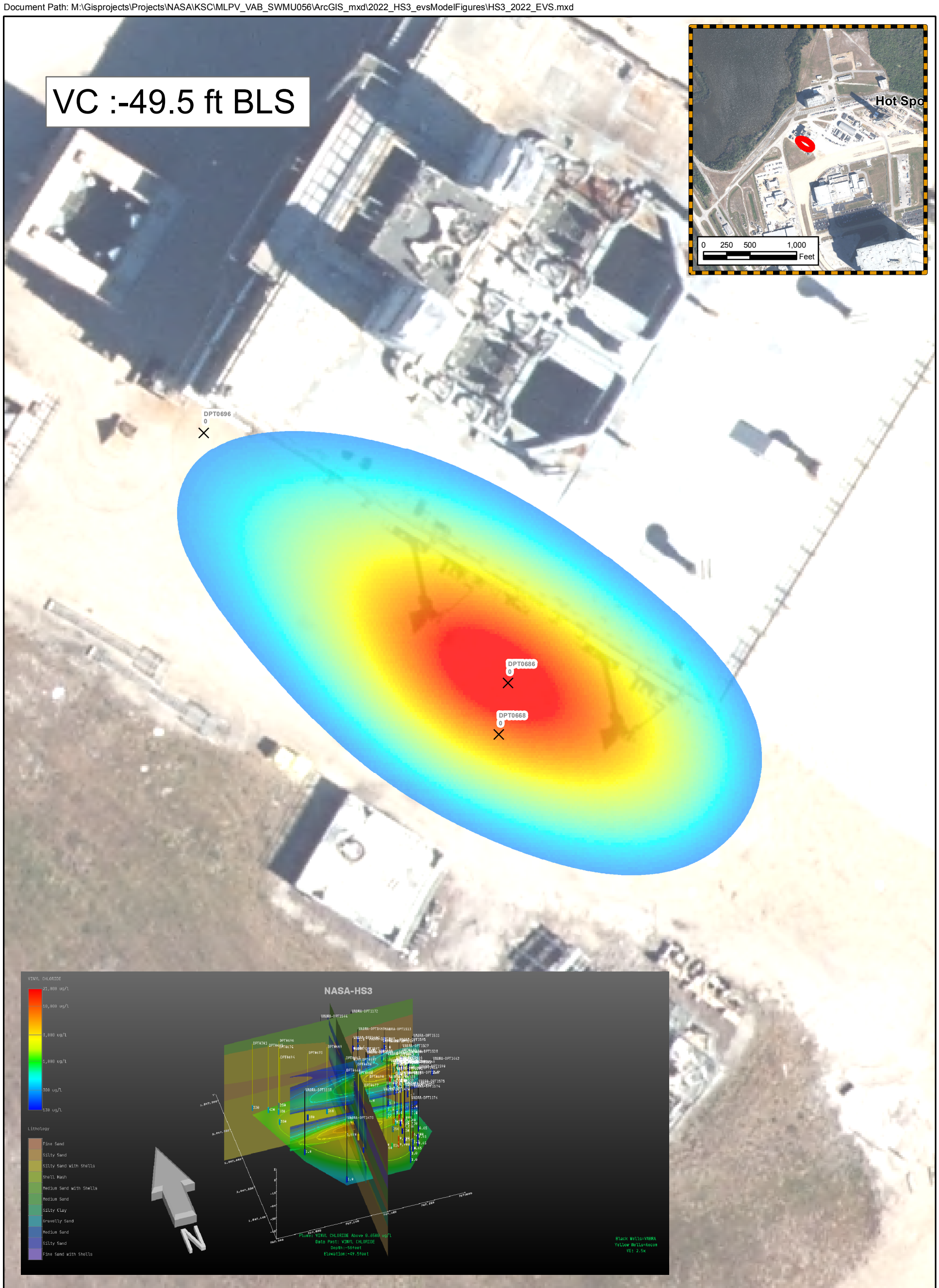
N

0 20 40 Feet

FIGURE C-25
VC :-43.5 feet bls

MLP/VAB (SWMU 056)
NASA Kennedy Space Center, Florida

Document Path: M:\Gisprojects\Projects\NASA\KSC\MLPV_VAB_SWMU056\ArcGIS_mxd\2022_HS3_evsModelFigures\HS3_2022_EVS.mxd



Legend

× Locations Used for EVS Model

2_-49_5

Value

High : 488.682

Low : 4.40251

Notes:
1. MLP/VAB = Mobile Launcher Platform Rehabilitation Sites / Vehicle Assembly Building Area.
2. SWMU = Stormwater Waste Management Unit
3. Source of 2018 aerial: Florida Department of Transportation Aerial Photo Lookup System website.
4. Source of plume boundaries: 2018 Annual CMI and IM report that included additional data form DPT sampling locations.

N

0 20 40 Feet

FIGURE C-26
VC :-49.5 feet bls

MLP/VAB (SWMU 056)
NASA Kennedy Space Center, Florida

APPENDIX D

DISTRIBUTION OF CVOCs IN PROPOSED IMNJECTION INTERVALS

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Figure D-1. Estimated TCE NADC plume and TCE concentrations (ug/L) from 2021 DPT samples.
DPT Sample Interval: 5 to 9 ft bls
Proposed Injection Interval: 4 to 10 ft bls

Figure D-2. Estimated cDCE NADC plume and cDCE concentrations (ug/L) from 2021 DPT samples.
DPT Sample Interval: 5 to 9 ft bls
Proposed Injection Interval: 4 to 10 ft bls

Estimated extent of cDCE NADC plume (700 ug/L)

Figure D-3. Estimated VC NADC plume and VC concentrations (ug/L) from 2021 DPT samples.
DPT Sample Interval: 5 to 9 ft bls
Proposed Injection Interval: 4 to 10 ft bls

Estimated extent of VC NADC plume (100 ug/L)

Figure D-4. Estimated CVOC NADC plumes from 2021 DPT samples.
DPT Sample Interval: 5 to 9 ft bls
Proposed Injection Interval: 4 to 10 ft bls

Figure D-5. Estimated TCE NADC plume and TCE concentrations (ug/L) from 2021 DPT samples.
DPT Sample Interval: 9 to 13 ft bls
Proposed Injection Interval: 10 to 14 ft bls

Figure D-6. Estimated cDCE NADC plume and cDCE concentrations (ug/L) from 2021 DPT samples.
DPT Sample Interval: 9 to 13 ft bls
Proposed Injection Interval: 10 to 14 ft bls

Estimated extent of cDCE NADC plume (700 ug/L)

Figure D-7. Estimated VC NADC plume and VC concentrations (ug/L) from 2021 DPT samples.
DPT Sample Interval: 9 to 13 ft bls
Proposed Injection Interval: 10 to 14 ft bls

Estimated extent of VC NADC plume (100 ug/L)

Figure D-8. Estimated CVOC NADC plumes from 2021 DPT samples.
DPT Sample Interval: 9 to 13 ft bls
Proposed Injection Interval: 10 to 14 ft bls

Figure D-9. Estimated TCE NADC plume and TCE concentrations (ug/L) from 2021 DPT samples.
DPT Sample Interval: 14 to 18 ft bls
Proposed Injection Interval: 14 to 18 ft bls

Figure D-10. Estimated cDCE NADC plume and cDCE concentrations (ug/L) from 2021 DPT samples.
DPT Sample Interval: 14 to 18 ft bls
Proposed Injection Interval: 14 to 18 ft bls

Estimated extent of cDCE NADC plume (700 ug/L)

Figure D-11. Estimated VC NADC plume and VC concentrations (ug/L) from 2021 DPT samples.
DPT Sample Interval: 14 to 18 ft bls
Proposed Injection Interval: 14 to 18 ft bls

Figure D-12. Estimated CVOC NADC plumes from 2021 DPT samples.
DPT Sample Interval: 14 to 18 ft bls
Proposed Injection Interval: 14 to 18 ft bls

Figure D-13. Estimated TCE NADC plume and TCE concentrations (ug/L) from 2021 DPT samples.
DPT Sample Interval: 43 to 47 ft bls
Proposed Injection Interval: 42 to 48 ft bls

Estimated extent of TCE NADC plume (300 ug/L)

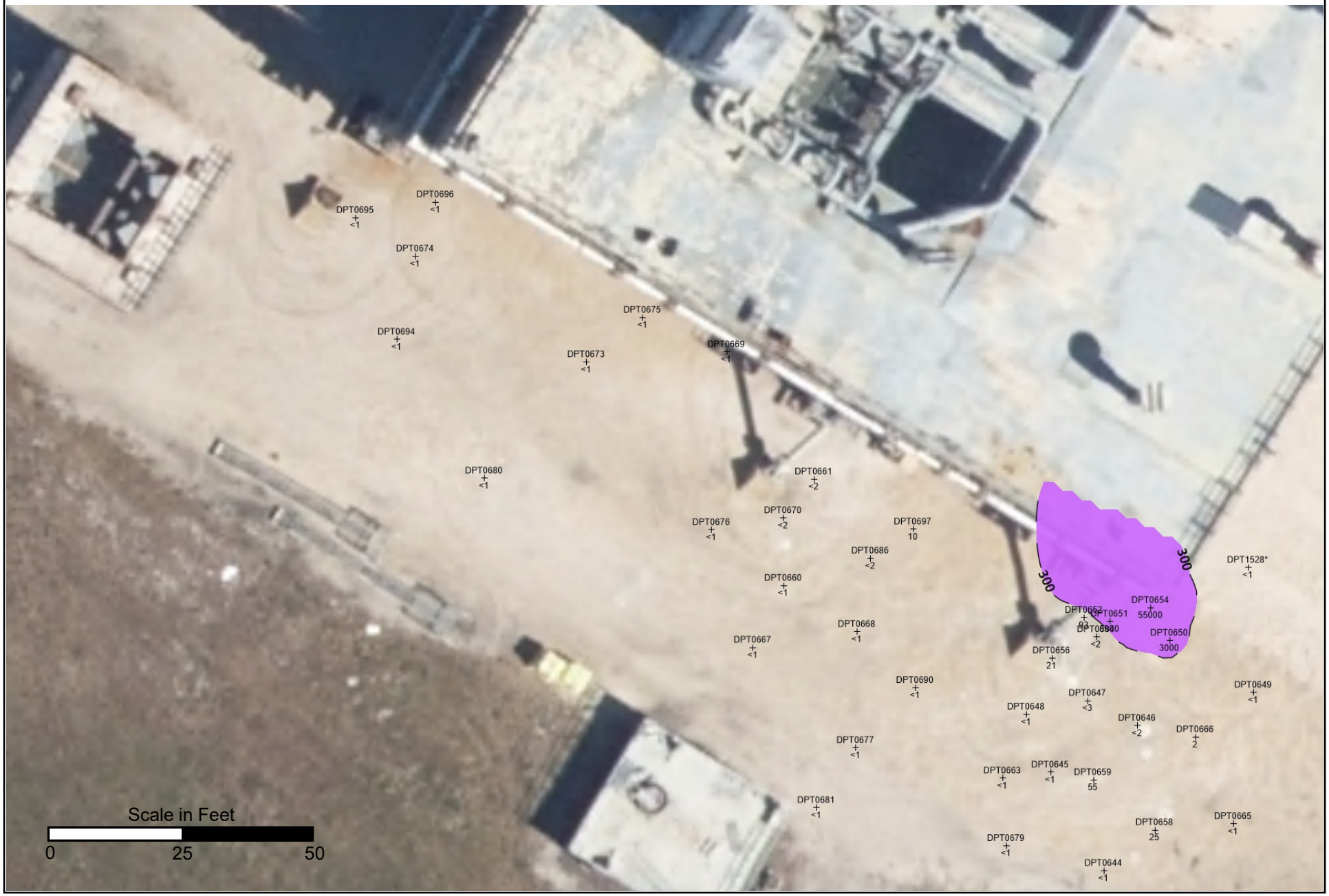

Figure D-14. Estimated cDCE NADC plume and cDCE concentrations (ug/L) from 2021 DPT samples.
DPT Sample Interval: 43 to 47 ft bls
Proposed Injection Interval: 42 to 48 ft bls

Estimated extent of cDCE NADC plume (700 ug/L)

Figure D-15. Estimated VC NADC plume and VC concentrations (ug/L) from 2021 DPT samples.
DPT Sample Interval: 43 to 47 ft bls
Proposed Injection Interval: 42 to 48 ft bls

Estimated extent of VC NADC plume (100 ug/L)

Figure D-16. Estimated CVOC NADC plumes from 2021 DPT samples.
DPT Sample Interval: 43 to 47 ft bls
Proposed Injection Interval: 42 to 48 ft bls

Figure D-17. Estimated cDCE NADC plume and cDCE concentrations (ug/L) from 2021 DPT samples.
DPT Sample Interval: 48 to 52 ft bls
Proposed Injection Interval: 48 to 52 ft bls

Estimated extent of cDCE NADC plume (700 ug/L)

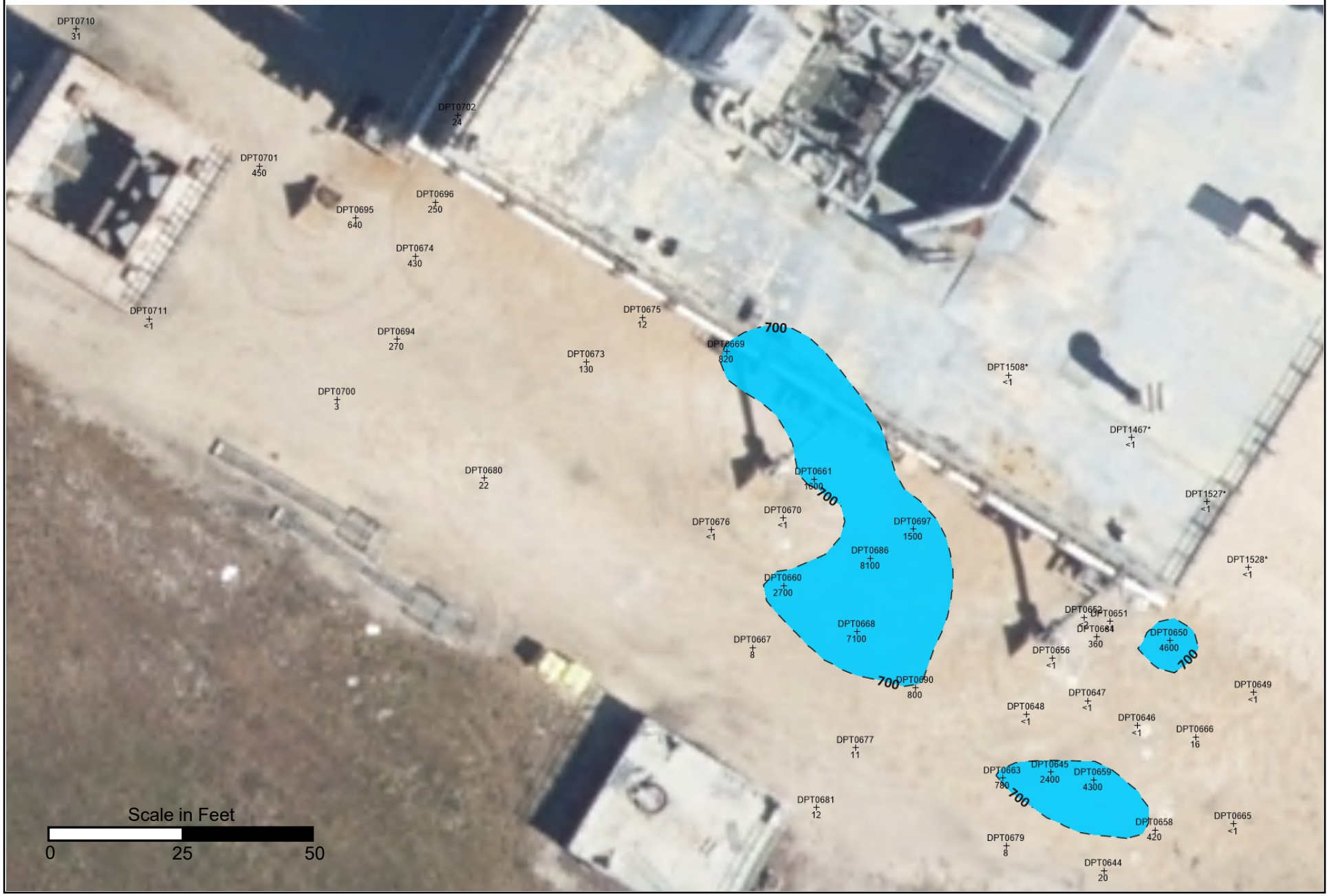

Figure D-18. Estimated VC NADC plume and VC concentrations (ug/L) from 2021 DPT samples.
DPT Sample Interval: 48 to 52 ft bls
Proposed Injection Interval: 48 to 52 ft bls

Estimated extent of VC NADC plume (100 ug/L)

Figure D-19. Estimated CVOC NADC plumes from 2021 DPT samples.
DPT Sample Interval: 48 to 52 ft bls
Proposed Injection Interval: 48 to 52 ft bls

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APPENDIX E

PRODUCT SAFETY DATA SHEET AND TECHNICAL DATA SHEET

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PO Box 358
Freeport, Illinois 61032
(815) 650-2230

May 19, 2023

To Whom it May Concern,

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Christopher A. Mullen

May 19, 2023

Signature

Date

Company Name: Provectus Environmental Products, Inc.

Company Representative Name: Christopher A. Mullen

Company Representative Title: Director of Marketing & Communications

Company Address: PO Box 358, Freeport, IL 61032

Company Representative Phone: (815) 650-2230

Company Representative E-Mail: chris.mullen@provectusenv.com

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Safety Data Sheet (SDS)

OSHA HazCom 2012 Standard 29 CFR 1910.1200. Prepared to GHS Rev03.

Printing date 01/25/2016 *Reviewed on 01/23/2016*

* 1 Identification

· ***Product identifier***

· ***Trade name: Provect-IR ISCR Reagent (Antimethanogenic)***
· ***Product description***
Remediation product for the treatment of soil, sediment and groundwater. Not for use in potable water sources.

· ***Details of the supplier of the safety data sheet***
· ***Manufacturer/Supplier:***
Provectus Environmental Products, Inc.
2871 W. Forest Road - Suite 2
Freeport, IL 61032
Phone: 815-650-2230
Fax: 815-650-2230
www.provectusenvironmental.com
· ***Emergency telephone number:*** 815-650-2230

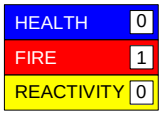
* 2 Hazard(s) identification

· ***Classification of the substance or mixture***
The product is not classified according to the Globally Harmonized System (GHS).

· ***Label elements***
· ***GHS label elements*** Non-Regulated Material
· ***Hazard pictograms*** Non-Regulated Material
· ***Signal word*** Non-Regulated Material
· ***Hazard statements*** Non-Regulated Material
· ***Hazard description:***
CONTAINMENT HAZARD: Any vessel that contains wetted reagent must be vented due to potential pressure build up from fermentation gases.
· ***Classification system:***
· ***NFPA ratings (scale 0 - 4)***

Health = 0
Fire = 1
Reactivity = 0

· ***HMIS-ratings (scale 0 - 4)***



Health = 0
Fire = 1
Reactivity = 0

3 Composition/information on ingredients

	Proprietary	40 to 90%
7439-89-6	iron	5 to 90%
4075-81-4	calcium dipropionate	0 to 4%

· ***Chemical characterization: Mixtures***
· ***Description:*** Mixture of the substances listed below with nonhazardous additions.

· ***Dangerous components:***

8013-01-2	Yeast extracts	STOT SE 3, H335	0.5 to 5%

(Contd. on page 2)

Safety Data Sheet (SDS)

OSHA HazCom 2012 Standard 29 CFR 1910.1200. Prepared to GHS Rev03.

Printing date 01/25/2016 *Reviewed on 01/23/2016*

Trade name: Provect-IR ISCR Reagent

(Contd. of page 1)

9000-30-0	Guar gum	STOT SE 3, H335; Eye Irritant 2B, H320; Combustible Dust	0 to 5%
7757-83-7	sodium sulfite	Acute Toxicity 4, H302	0 to 2%

· ***Additional information:*** Product contains red yeast rice

4 First-aid measures

· ***Description of first aid measures***
· ***After inhalation:*** Remove person to fresh air. If signs/symptoms continue, get medical attention.
· ***After skin contact:*** Wash off with soap and water. Get medical attention if irritation develops.
· ***After eye contact:*** Flush with water for 5 minutes
· ***After swallowing:***
Rinse mouth with water and afterwards drink plenty of milk or water. Call a poison control center or doctor immediately for treatment advice.
· ***Most important symptoms and effects, both acute and delayed*** No further relevant information available.
· ***Indication of any immediate medical attention and special treatment needed***
No further relevant information available.

5 Fire-fighting measures

· ***Extinguishing media***
· ***Suitable extinguishing agents:***
CO2, extinguishing powder or water spray. Fight larger fires with water spray or alcohol resistant foam.
· ***Special hazards arising from the substance or mixture*** No further relevant information available.
· ***Advice for firefighters***
· ***Protective equipment:*** No special measures required.

* 6 Accidental release measures

· ***Personal precautions, protective equipment and emergency procedures*** Not required.
· ***Environmental precautions:*** Do not allow to enter sewers or potable water sources.
· ***Methods and material for containment and cleaning up:***
Cover powder spill with plastic sheet or tarp to minimize spreading and keep powder dry. Sweep or vacuum up spillage and place in vented container.
· ***Reference to other sections***
See Section 7 for information on safe handling.
See Section 8 for information on personal protection equipment.
See Section 13 for disposal information.

* 7 Handling and storage

· ***Precautions for safe handling*** No special measures required.
· ***Information about protection against explosions and fires:*** Combustible material

· ***Conditions for safe storage, including any incompatibilities***
· ***Storage:***
· ***Requirements to be met by storerooms and receptacles:***
CONTAINMENT HAZARD: Any vessel that contains wetted reagent must be vented due to potential pressure build up from fermentation gases.
· ***Information about storage in one common storage facility:*** Not required.
· ***Further information about storage conditions:***
Keep tightly closed in a dry and cool place. Keep away from open flames, hot surfaces and sources of ignition. Any material that is wetted must be vented due to potential pressure build up from fermentation gases.

(Contd. on page 3)

Safety Data Sheet (SDS)

OSHA HazCom 2012 Standard 29 CFR 1910.1200. Prepared to GHS Rev03.

Printing date 01/25/2016 Reviewed on 01/23/2016

Trade name: Provect-IR ISCR Reagent

(Contd. of page 2)

· ***Specific end use(s)*** No further relevant information available.

* 8 Exposure controls/personal protection

· ***Additional information about design of technical systems:*** No further data; see section 7.

· ***Control parameters***
· ***Components with occupational exposure limits:***
The product does not contain any relevant quantities of materials with critical values that have to be monitored at the workplace.
· ***Additional information:***
Dry or powdered ingredients are combustible. Dispersal of finely divided dust from products into air may form mixtures that are ignitable and explosive. Minimize airborne dust generation and eliminate sources of ignition.

· ***Exposure controls***
· ***Personal protective equipment:***
· ***General protective and hygienic measures:***
The usual precautionary measures for handling chemicals should be followed.
· ***Breathing equipment:*** Not required.
· ***Protection of hands:*** Not required.
· ***Eye protection:*** Not required.

* 9 Physical and chemical properties

· ***Information on basic physical and chemical properties***
· ***General Information***
· ***Appearance:***

Form:	Solid
Color:	Brown to Green
· ***Odor:***	Pleasant
· ***Odor threshold:***	Not determined.
· ***pH-value:***	Not applicable.
· ***Change in condition***	
Melting point/Melting range:	Not determined.
Boiling point/Boiling range:	Undetermined.
· ***Flash point:***	Not applicable.
· ***Flammability (solid, gaseous):***	Not determined.
· ***Ignition temperature:***	
Decomposition temperature:	Not determined.
· ***Auto igniting:***	Product is not self-igniting.
· ***Danger of explosion:***	Dry or powdered ingredients are combustible. Dispersal of finely divided dust from products into air may form mixtures that are ignitable and explosive. Minimize airborne dust generation and eliminate sources of ignition.
· ***Explosion limits:***	
Lower:	Not determined.
Upper:	Not determined.
· ***Vapor pressure:***	Not applicable.
· ***Density:***	Not determined.

(Contd. on page 4)

(Contd. of page 3)

· **Relative density**	Not determined.
· **Vapor density**	Not applicable.
· **Evaporation rate**	Not applicable.
· **Solubility in / Miscibility with Water:**	Soluble.
· **Partition coefficient (n-octanol/water):**	Not determined.
· **Viscosity:**	
Dynamic:	Not applicable.
Kinematic:	Not applicable.
· **Solvent content:**	
Organic solvents:	0.0 %
Solids content:	100.0 %
· **Other information**	No further relevant information available.

10 Stability and reactivity

· **Reactivity** No further relevant information available.
· **Chemical stability** Product is stable under normal conditions.
· **Thermal decomposition / conditions to be avoided:** No decomposition if used according to specifications.
· **Possibility of hazardous reactions** No dangerous reactions known.
· **Conditions to avoid** No further relevant information available.
· **Incompatible materials:** No further relevant information available.
· **Hazardous decomposition products:** No dangerous decomposition products known.

* 11 Toxicological information

· **Information on toxicological effects**
· **Acute toxicity:**
· **Primary irritant effect:**
· **on the skin:** No irritant effect.
· **on the eye:** Product dust may cause eye irritation.
· **Sensitization:** No sensitizing effects known.
· **Additional toxicological information:**
The product is not subject to classification according to internally approved calculation methods for preparations:
When used and handled according to specifications, the product does not have any harmful effects according to our experience and the information provided to us.

· **Carcinogenic categories**

· **IARC (International Agency for Research on Cancer)**
None of the ingredients is listed.
· **NTP (National Toxicology Program)**
None of the ingredients is listed.
· **OSHA-Ca (Occupational Safety & Health Administration)**
None of the ingredients is listed.

12 Ecological information

· **Toxicity**
· **Aquatic toxicity:** No further relevant information available.

(Contd. on page 5)

(Contd. of page 4)

· ***Persistence and degradability*** No further relevant information available.
· ***Bioaccumulative potential*** No further relevant information available.
· ***Mobility in soil*** No further relevant information available.
· ***Additional ecological information:***
· ***General notes:*** Water hazard class 1 (Self-assessment): slightly hazardous for water
· ***Results of PBT and vPvB assessment***
· ***PBT:*** Not applicable.
· ***vPvB:*** Not applicable.
· ***Other adverse effects*** No further relevant information available.

13 Disposal considerations

· ***Waste treatment methods***
· ***Recommendation:*** Smaller quantities can be disposed of with household waste.

· ***Uncleaned packaging:***
· ***Recommendation:*** Disposal according to official regulations municipal.
· ***Recommended cleansing agent:*** Water, if necessary with cleansing agents.

* 14 Transport information

· ***UN-Number***
· ***DOT, ADR, ADN, IMDG, IATA*** Non-Regulated Material
· ***UN proper shipping name***
· ***DOT, ADR, ADN, IMDG, IATA*** Non-Regulated Material
· ***Transport hazard class(es)***

· ***DOT, ADR, ADN, IMDG, IATA***
· ***Class*** Non-Regulated Material
· ***Packing group***
· ***DOT, ADR, IMDG, IATA*** Non-Regulated Material
· ***Environmental hazards:***
· ***Marine pollutant:*** No
· ***Special precautions for user*** Not applicable.
· ***Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code*** Not applicable.
· ***UN "Model Regulation":*** -

15 Regulatory information

· ***Safety, health and environmental regulations/legislation specific for the substance or mixture***
· ***Sara***

· ***Section 355 (extremely hazardous substances):***	
None of the ingredients is listed.	
· ***Section 313 (Specific toxic chemical listings):***	
None of the ingredients is listed.	
· ***TSCA (Toxic Substances Control Act):***	
7439-89-6	iron
4075-81-4	calcium dipropionate
8013-01-2	Yeast extracts
9000-30-0	Guar gum
7757-83-7	sodium sulfite

(Contd. on page 6)

(Contd. of page 5)

· ***Proposition 65***

· ***Chemicals known to cause cancer:***
None of the ingredients is listed.
· ***Chemicals known to cause reproductive toxicity for females:***
None of the ingredients is listed.
· ***Chemicals known to cause reproductive toxicity for males:***
None of the ingredients is listed.
· ***Chemicals known to cause developmental toxicity:***
None of the ingredients is listed.

· ***Carcinogenic categories***

· ***EPA (Environmental Protection Agency)***
None of the ingredients is listed.
· ***TLV (Threshold Limit Value established by ACGIH)***
None of the ingredients is listed.
· ***NIOSH-Ca (National Institute for Occupational Safety and Health)***
None of the ingredients is listed.

· ***GHS label elements*** Non-Regulated Material
· ***Hazard pictograms*** Non-Regulated Material
· ***Signal word*** Non-Regulated Material
· ***Hazard statements*** Non-Regulated Material

· ***National regulations:***
The product is subject to be labeled according with the prevailing version of the regulations on hazardous substances.
· ***State Right to Know***

	Proprietary	40-90%
7439-89-6	iron	5-90%
4075-81-4	calcium dipropionate	2-12%
8013-01-2	Yeast extracts STOT SE 3, H335	≤ 2.5%
9000-30-0	Guar gum STOT SE 3, H335; Eye Irrit. 2B, H320; Combustible Dust	≤ 2.5%
7757-83-7	sodium sulfite Acute Tox. 4, H302	≤ 2.5%

All ingredients are listed.

· ***Chemical safety assessment:*** A Chemical Safety Assessment has not been carried out.

16 Other information

This information is based on our present knowledge. However, this shall not constitute a guarantee for any specific product features and shall not establish a legally valid contractual relationship.

· ***Date of preparation / last revision*** 01/23/2016 / 4
· ***Abbreviations and acronyms:***
ADR: Accord européen sur le transport des marchandises dangereuses par Route (European Agreement concerning the International Carriage of Dangerous Goods by Road)
IMDG: International Maritime Code for Dangerous Goods
DOT: US Department of Transportation
IATA: International Air Transport Association

(Contd. on page 7)

Safety Data Sheet (SDS)

OSHA HazCom 2012 Standard 29 CFR 1910.1200. Prepared to GHS Rev03.

Printing date 01/25/2016 *Reviewed on 01/23/2016*

Trade name: Provect-IR ISCR Reagent

(Contd. of page 6)

ACGIH: American Conference of Governmental Industrial Hygienists
EINECS: European Inventory of Existing Commercial Chemical Substances
ELINCS: European List of Notified Chemical Substances
CAS: Chemical Abstracts Service (division of the American Chemical Society)
NFPA: National Fire Protection Association (USA)
HMIS: Hazardous Materials Identification System (USA)
Acute Tox. 4: Acute toxicity, Hazard Category 4
Eye Irrit. 2B: Serious eye damage/eye irritation, Hazard Category 2B
STOT SE 3: Specific target organ toxicity - Single exposure, Hazard Category 3

· **** Data compared to the previous version altered.***

SDS / MSDS Created by MSDS Authoring Services (www.MSDSAuthoring.com)

Provect-IR® ISCR Reagent

Provect-IR® is a unique mixture of reagents combined into a single product that optimizes the *in situ* reductive dechlorination of chemicals present in soil, sediment, and groundwater. It acts by promoting synergistic interactions between:

- Natural antimethanogenic compounds
- Hydrophilic, nutrient rich organic carbon sources
- Zero-Valent Iron (ZVI)
- Chemical oxygen scavengers
- Vitamin and mineral sources

This distinctive, patented combination of natural and food-grade chemicals promotes *in situ* chemical reduction (ISCR) conditions for fast and effective destruction of targeted constituents of interest (COIs) such as chlorinated solvents, organochlorine pesticides, and other halogenated compounds (Brown *et al.*, 2009; Dolfing *et al.*, 2008; US Patent Office Scalzi *et al* 2012). Notably, Provect-IR® is the only ISCR reagent to simultaneously inhibit the production of methane during the requisite carbon fermentation processes (US Patent Office Scalzi *et al*, 2013, 2014). This promotes more efficient use of the hydrogen donor while avoiding negative issues associated with elevated methane (CH4) in groundwater, soil gas, and indoor air.

Current regulations for methane in groundwater vary from ca. 10 to 28 mg CH4/L (Indiana Department of Environmental Management, 2014). More State regulations are pending, with several enhanced reductive dechlorination (ERD) projects which intended to use liquid carbon (emulsified oils) sources failing to receive regulatory approval due to issues associated with excessive production of methane during previous technology applications (Personal Communication - State of California; State of Minnesota). Many remedial practitioners have subsequently been required to establish contingencies for conventional ERD/ISCR implementation if methane exceeds a threshold level ranging from 1 ppm to 10 ppm groundwater. These contingencies often entail expensive and extensive systems for capturing and treating methane in soil gas/vapor captured via SVE systems.

MODE OF ACTION – HOW DOES IT WORK?

What is a Methanogen? In the 1970s, Dr. Carl Woese (1928 to 2012) and his colleagues at the University of Illinois - Urbana studied prokaryotic relationships using DNA sequences and they found that microbes that produce methane – or methanogens - are Archaea (Woese and Fox, 1977). The identification of this new Domain of microorganism was very important for many reasons, but from our limited perspective herein this vast difference in genetic composition means that methanogens are significantly different from typical heterotrophic bacteria and eukaryotes. In other words, *Dehalococcoides* ethenogenes are as different from methanogens as you are.

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What is a Statin? A statin can be defined as "a class of lipid-lowering drugs that reduce serum cholesterol levels by inhibiting a key enzyme involved in the biosynthesis of cholesterol". Lovastatin is a widely known, potent statin used for decades to lower cholesterol in human blood by inhibiting 3-hydro-3-methylglutaryl-coenzyme A (HMG-CoA) reductase, which is a key enzyme in the cholesterol biosynthesis pathway (Alberts et al., 1980). It was the first statin approved by the United States Food and Drug Administration in 1987 as a hypercholesterolemic drug.

What is Red Yeast (Rice) Extract? The red yeast rice (RYR) extract that is component of Provect-IR® is a substance extracted from rice that has been fermented with a type of yeast called Monascus purpureus. Red yeast extract is used as a food coloring, food additive/preservative, and is widely consumed by humans. The RYR extract contains a number of monacolins - most importantly, Monacolin K, otherwise known as Lovastatin or Mevinolin. Monacolin K is the only naturally occurring statin compound. In addition to Monacolin K, RYR extract also contains mono-unsaturated fatty acids and other vitamins that will effectively stimulate anaerobic bacteria in the subsurface.

So - How Does a Statin Inhibit a Methanogen? Interestingly, Monacolin K is a potent inhibitor of methanogenic archaea because cell membrane production in archaea shares a similar pathway with cholesterol biosynthesis (Miller and Wolin, 2001). And since methanogens are so uniquely different than bacteria, the inhibitory effect is not observed in microbes that are typically associated with: i) catabolism of organic contaminants (such as pseudomonas species) and/or, ii) halo-respiration/biodegradation of chlorinated solvents (such as *Dehalococcoides* species). RYR has been used in the cattle industry for decades in efforts to manage rumen microbiology and control methane production in cows.

ATTENUATION PROCESSES – SAFER, MORE EFFICIENT ISCR TREATMENT

In situ chemical reduction as defined by Dolfing et al (2008) describes the combined effect of stimulated biological oxygen consumption (via fermentation of an organic carbon source), direct chemical reduction with ZVI or other reduced metals. The corresponding enhanced thermodynamic decomposition reactions that are realized at the lowered redox (Eh) conditions allow for more effective mineralization of many COIs.

Several ERD substrates and other accelerated anaerobic bioremediation technologies exist (e.g., emulsified oils, non-emulsified oils, carbon-based hydrogen release compounds, vegetable matter + ZVI amendments) that purportedly offer similar responses. However, the Provect-IR® antimethanogenic ISCR substrate is unique in its ability to yield Eh values most conducive to reductive dechlorination while simultaneously preventing methane production - which is a waste of the H being generated and potentially a safety issue under field conditions.

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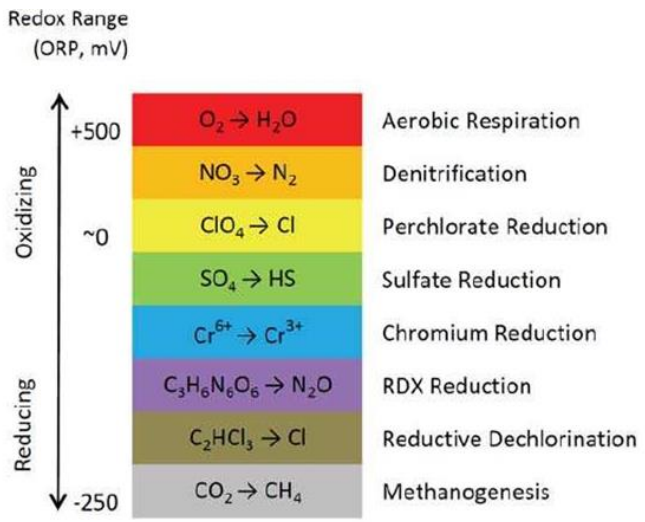

Provect-IR® uniquely combines RYR extract with of a variety of specially selected reagents in order to induce genuine ISCR conditions and facilitate the destruction of targeted COIs in a safer, more efficacious manner. As outlined below, it can be used to manage environments impacted by chlorinated solvents, pesticides, heavy metals and other COIs.

Specially Selected Organic Hydrogen Donors: A variety of hydrophilic, nutrient rich organic carbon sources are incorporated in Provect-IR® that assist in promoting the ISCR process. The Provect-IR bioremediation amendments consist of slow, medium and long-term release carbon sources. Such a formulation is desirable because it provides both a rapidly utilized electron donor (calcium propionate), slow-release long-term electron donors (kelp meal and yeast extract) and long-term release carbon sources (other cellulose and hemi-cellulose carbon such as soy meal). More specifically,

- Calcium propionate and other readily biodegradable carbon sources: Following the addition of simple carbon sources such as lactate, formate, ethanol or glucose to an aquifer setting these compounds are often converted rapidly to hydrogen and acetate. Although this is the desired response, the process is sometimes too rapid, and this can result in aquifer acidification (due to rapid VFA production) and the liberation of too much hydrogen (which allows methanogens and sulfate reducers to compete effectively with dehalogenators, which tend to grow more slowly). Hence, calcium propionate is used as a readily biodegradable carbon source.
- Yeast extract: This supplement provides a variety of organic hydrogen donors that have slower release profiles (i.e., they are not fermented as rapidly as proprionate). Yeast extract also contains biological components that are very useful to anaerobes, but are not available through other carbon-only media. In particular, yeast extract provides an abundant source of priming ATPase along with trace nutrients and vitamin B complexes.

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- Kelp meal/Cellulose based carbon: These hydrogen sources are composed of a hydrophilic, solid and complex carbon that ferment more slowly and inherently generate less methane. The hydrophilic organic component of the kelp meal, for example, is composed of cellulose and hemicellulose and it may be treated during the manufacturing process so that some of the components more easily undergo hydrolysis to glucose while maintaining an overall longevity of 3 to 5+ years.

Chemical Oxygen Scavengers: The presence of chemical oxygen scavengers such as sodium sulfite helps minimize performance lag phases that are often observed following the injection of remedial amendments. This is due, in part, to the presence of oxygen that is introduced as a result of the field mixing and blending operations. It takes a certain amount of time and reagent consumption to remove that introduced oxygen and allow the ISCR reactions to proceed. Provect-IR is unique it that manages this impact chemically, which is a more effective, reliable manner thus allowing the ISCR process to be more effective.

Zero-Valent Iron: The presence of ZVI in Provect-IR® is critical to ISCR reactions. The ZVI is added as a reduced material that is oxidized during the reductive dechlorination reactions which use ZVI as the reducing agent. The beta-elimination reaction mainly produces (chloro)acetylene, ethane/ethane and chloride ions, without the accumulation of potentially problematic catabolites typical of microbiologically mediated sequential reductive dehalogenation processes (e.g., DCE "stall"). As the ZVI reacts, hydroxyl ions are released and pH increases which is useful in neutralizing the acidity generated during the fermentation of carbon, where acids are generated. Oxidized iron species are also produced, where are useful in alpha-elimination reactions and iron cycling. One limitation to ZVI reactions is that they are surface mediated which means that direct contact is required for direct COI destruction.

RYR Extract: Provect-IR® is the only ISCR amendment that will rapidly induce ISCR conditions while simultaneously preventing or significantly minimizing the production of methane. The benefits are notable:

- Safer: Methane is explosive with an LEL of 5% and an UEL of 15%. Production of methane will result from the addition of any conventional ERD or ISCR amendment: excessive and extended production of methane can result in elevated in groundwater concentrations (as high as 1,000 ppm have been reported) which can lead to accumulation in soil gas subsequently impacting indoor air. State specific regulations for methane in groundwater have been promulgated, with others pending for soil gas and indoor air.
- More Efficient = More Cost Effective: Production of methane is a direct indication that the hydrogen generated from the organic carbon amendments was used by methanogens and the amendment has been wasted because it was not utilized by acetogens or

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dehalorespiration. By inhibiting the growth and proliferation of methane producing Archaea, chlororespiring bacteria can become the more dominant bacterial populations.

PRIMARY FEATURES

- Effective: No accumulation of dead-end catabolic intermediates as a function of substrate addition (as is common with [emulsified] oils and sources of carbon only).
  - Does not rely on physical sorption/sequestration as a major "removal" mechanism (as is common with oils).
  - Inherently buffered for pH control – will not acidify an aquifer and liberate heavy metals as potential secondary COIs.
- Efficient: Significantly lower costs as a result more efficient amendment utilization and avoidance of contingencies for methane management. No need for additional buffers.
- Safe: Fewer health and safety concerns as compared with use of traditional ERD or ISCR reagents; Avoid issues associated with new and emerging methane regulations.
- Ease of Use: Green and sustainable. All components integrated in a single package. Logistics with no surprises.
- Longevity: Engineered profile of carbon sources for multi-year longevity estimated at 3 to 7 years based on site-specific hydrogeology. Reagent will stay in place and remain active which prevents rebound.
- Improved Performance: More efficient use of hydrogen donors (does not get wasted as methane).
- Adaptable Formulations for Heavy Metals: Will not mobilize arsenic or other heavy metals yielding secondary contaminants (as is common with [emulsified] oils and sources of carbon only). Can be formulated to manage environments that are co-impacted by various inorganic contaminants while simultaneously mineralizing the organic compounds.
- Patented Technologies: Technology end users and their clients are fully protected from all Patent and other legal issues

PHYSICAL PROPERTIES

Particle Size: ranges from ca. <5 to >100 micron (can be manufactured to specifications).

Dry Density: ranges from 0.4 to 0.5 g/cm3

29% Aqueous Slurry Density: ranges from 0.9 to 1.0 g/cm3

29% Aqueous Slurry Viscosity: ranges from 500 to 1,500 cP

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APPENDIX F

PROVECT-IR HANDLING AND APPLICATION GUIDLINES

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OVERVIEW

Provect-IR® Antimethanogenic *In Situ* Chemical Reduction (ISCR) Reagent is designed to treat persistent organic and/or inorganic contaminants present in the subsurface environment. As developers of the conventional ISCR amendment (EHC®), scientists now at Provectus know that Provect-IR is a more efficient, safer, better amendment. It is unique in its composition:

- Zero-Valent Iron: Up to 85% (weight basis), average particle size = 20 µm yields 25 ft ZVI surface area / lb product
- Integrated Vitamins, minerals and nutrients (yeast extract) specially selected for anaerobes
- Chemical oxygen scavenger to maintain reduced condition
- Multiple, Complex, Hydrophilic, Timed-Release organic carbon sources (plant materials, Kelp, Calcium Propionate) @ 390 g H donor / lb product
- METHANE INHIBITORS to increase safety and efficiency

MATERIAL PACKAGING, HANDLING AND STORAGE

Provect-IR can be specially formulated to meet site-specific needs. The standard formulation contains 10% ZVI and is packaged as a dry powder in 50-lb easy-open (NO SHARPS), polyethylene-lined, recycled paper bags or, upon request, in 2,000 lb Supersacks. Typical shipments entail multiple units of 4x4 wooden pallets containing 40 bags x 50 lbs/ bag = 2,000 lbs reagent per pallet. Each pallet is neatly wrapped in water-resistant plastic, but direct exposure to rain should be avoided.

GENERAL HEALTH AND SAFETY GUIDELINES

Provect-IR is non-hazardous and safe to handle. The use of standard personal protective equipment is always recommended, including safety glasses, steel-toe boots, gloves, hearing protection (in the proximity of loud machinery) and hard hat. Dust mask may be desired when working with the material under certain conditions. The SDS is posted on our web site at the following link: Click Here!

SLURRY PREPARATION

Provect-IR is mixed with clean water on site to yield an aqueous slurry (see **Table 1** for field mixing guidelines). Experienced injection contractors can easily manage (mix, transport/pump,

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and inject) slurry containing between 20% and 30% solids (defined as the mass of dry Provect-IR divided by the total mass of slurry, including the water). For situations where more volume is desired, slurry density can be decreased, *e.g.*, using a thinner slurry. Conversely, for situations where less volume is required (for example to minimize surfacing issues), thicker slurry with higher solids can be applied. A slurry containing *ca.* 29% solids will have the following general characteristics:

- Wet Density = 0.9 to 1.1 g/cm^3
- Dry Density = 0.3 to 0.4 g/cm^3
- Viscosity = 500 to 1,500 c P

TABLE 1. FIELD GUIDE FOR MAKING SLURRY

per 50 pound bag		per 25 kg bag	
Target weight %	USG water required	Target weight %	Liters water required
15	34	15	142
20	24	20	100
22	21	22	89
24	19	24	79
26	17	26	71
28	15	28	64
30	14	30	58
32	13	32	53
34	12	34	49
36	11	36	44

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APPLICATION TECHNIQUES

Provect-IR has been employed for source area treatment, plume treatment and/or plume management using permeable reactive barrier (PRBs). The choice of installation method will depend on the site-specific conditions, including treatment depth and geology. The most commonly practiced *in situ* application method has been direct injection of aqueous slurry.

Provect-IR slurry containing 10 to 35% solids has been added to numerous aquifers using a variety of injection methods, including hydraulic fracturing, pneumatic fracturing and direct injection. It can also be added via direct soil mixing using deep soil mixing equipment, or it can placed directly into an open excavation or trench. ABC-CH4 is a liquid formulation of our antimethanogenic ERD reagent which has been added to existing well screens.

GENERAL GUIDELINES FOR DIRECT PUSH INJECTION OF AQUEOUS SLURRY

Mixing Equipment. Reagent slurry has be prepared in various ways, ranging from in-line automated mixing systems, to manual mixing using a hand-held drill with a mixing attachment, to more creative processes. Particularly for larger projects, experienced drillers will have some form of mechanical mixing system on site that includes a tank with a paddle-type mixer at the bottom. The slurry is then transferred to a feed tank connected to an injection pump so that slurry can be prepared continuously while injections are being performed (see example, ChemGrout mixing system www.chemgrout.com/500hp.htm). Slurry mixes quickly in these systems (<1 minute), and injections can proceed without interruption.

Pumps. Experienced drillers will have a variety of pumping equipment on site. For injecting slurries, an injection pump capable of generating at least 300 psi of pressure at a flow rate of >5 gpm is desired. Obviously, the pump needs to be able to handle solids, such as piston pumps, grout pumps, and progressing cavity pumps - with a preference towards the piston and grout pumps. Slurry is typically injected at pressures of 100 to 200 psi; however, higher pressures are sometimes required to initiate the injection. It is recommended to have a higher pressure pump available on site that can generate over 500 psi and ca. >10 gpm, as deeper installations often require higher injection pressures.

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Tooling. Experienced drillers will have sufficient rod length on site to allow 3 to 5 injection points to be capped overnight to allow pressure to dissipate. This can help prevent backflow and surfacing of slurry as the injection rods are retracted. Likewise, experienced drillers will have on hand a variety of injection tips, some that direct the slurry horizontally (see for example GeoProbe's pressure activated tip at geoprobe.com).

In a "top-down" injection approach, the rods are initially advanced to the top of the targeted depth interval, and a specified volume of slurry is injected while recording flow rate, injection pressure, and slurry volume delivered. The injection rods are then further advanced a distance ranging 2 to 4 feet and the process is repeated to help ensure even distribution of slurry over the targeted depth interval. At the end of each injection point, a small volume of water (15 USG) is often used to clear the rods and the injection tip of any slurry.

CONTACT US FOR A COMPLIMENTARY SITE EVALUATION

PROVECTUS ENVIRONMENTAL PRODUCTS, INC.

2871 West Forest Road, Suite 2 | Freeport, IL 61032

Tel: (815) 650-2230 | Fax: (815) 650-2232 | Email: info@ProvectusEnv.com

Multiple remedial contracting options available via strategic providers

Turn-Key, Risk-Reward, Pay-for Performance, Remedial Guarantees/Warranties

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APPENDIX G

UIC ACCEPTANCE LETTER FOR PROVECT-IR

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Enclosure 1
FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION
BOB MARTINEZ CENTER
2600 BLAIR STONE ROAD
TALLAHASSEE, FLORIDA 32399-2400

RICK SCOTT
GOVERNOR

CARLOS LOPEZ-CANTERA
LT. GOVERNOR

HERSCHEL T. VINYARD JR.
SECRETARY

June 16, 2014

Via Electronic Mail
Jim Mueller [jim.mueller@provectusenv.com]

Dr. James Mueller, President
Provectus Environmental Products, Inc.
2871 West Forest Road, Suite 2
Freeport, Illinois 61032

Re: **Provect-IR™**

Dear Dr. Mueller:

The Waste Cleanup Program (WCP) hereby accepts the use of Provect-IR™ for the purpose of in-situ reductive dechlorination of chlorinated hydrocarbons in soil, sediment and groundwater. The primary ingredients are iron and a source of carbon. Enclosure 1 provides regulatory information.

The WCP does not provide endorsement of specific or brand name remediation products or processes, but it does recognize the need to determine their acceptability in the context of environmental regulations, safety and the protection of public health. For that reason, the WCP issues an "acceptance" letter, not an approval. In no way shall an acceptance be construed as a certification of performance. Additionally, vendors, upon receipt of an acceptance, must market their product or process on its own merits regarding performance, cost, and safety in comparison to competing alternatives in the marketplace.

Remedial action plans that propose the use of an accepted product or process should include a copy of the acceptance letter in the plan's appendix, and reference it in the text of the document. It is not a requirement that a particular remediation product or process have an official acceptance letter in order for it to be proposed in a site-specific remedial action plan. The plan, however, must contain sufficient information about the product or process to show that it meets all applicable rules and regulations.

The WCP reserves the right to revoke its acceptance of a product or process if it has been falsely represented. Additionally, WCP acceptance of any product or process does not imply it has been deemed applicable for all cleanup situations, or that it is preferred over other treatment or cleanup techniques in any particular case. A site-specific evaluation of applicability and cost-effectiveness must be considered for any product or process, whether conventional or innovative,

and adequate site-specific design details must be provided in a remedial action plan submitted for Department review and approval. If you have any questions, please contact us at the numbers below.

Sincerely,

Gary Millington, P.E.
Division of Waste Management
Office of District and Business Support
gary.millington@dep.state.fl.us
850.245.7502

enc: (1) Regulatory Information

c: Mubeen Darji, P.E. – WCP/Tallahassee

ENCLOSURE 1

REGULATORY INFORMATION

a. Regulations: Chapters of the Florida Administrative Code (F.A.C.) that may be applicable, either in part or in their entirety, include but are not necessarily limited to Chapter 62-550, F.A.C., for primary and secondary water quality standards; Chapter 62-520, F.A.C., for groundwater classes and standards, and groundwater permitting and monitoring requirements; Chapter 62-528, F.A.C., for Underground Injection Control (UIC), particularly Part V, for Class V, Group 4 aquifer remediation projects; Chapter 62-780, F.A.C., for cleanup criteria; and Chapter 62-777, F.A.C., for cleanup target levels.

   Users of Provect-IR shall comply with all applicable regulations. This includes meeting applicable cleanup target levels for residual concentrations of reagent ingredients and any byproducts of concern produced by chemical and biological reactions induced by those ingredients during the timeframe of the cleanup project. For the ingredients of concern that are present in excess of cleanup target levels, the timeframe is that which is permitted for a temporary injection zone of discharge (ZOD) as described below.

b. UIC and ZOD permits: Per Rule 62-528.630(2)(c), F.A.C., Class V injection-type aquifer remediation wells are exempt from the permitting requirements of Rule 62-528.635, F.A.C., when authorized by a Department-approved remedial action plan or other enforceable mechanism, provided the requirements of the rules governing the remediation project, as well as the construction, operation, and monitoring requirements of Chapter 62-528, F.A.C., are met. Per Rule 62-528.630(2)(c), F.A.C., <u>the issuance of an enforceable, site-specific remedial action plan approval order by the Department for injection-type aquifer remediation constitutes the granting of a Class V injection well construction/clearance permit. And per Rule 62-520.310(8)(c), F.A.C., if a temporary ZOD is necessary, and permissible by way of that rule, then the issuance of the site-specific remedial action plan approval order also constitutes the granting of permission for the temporary ZOD</u>.

c. UIC notification: Remedial action plans proposing injection-type aquifer remediation shall include information pursuant to Rules 62-528.630(2)(c)1 through 6, F.A.C., for the inventory purposes of the UIC program. Reviewers of those plans, upon issuance of an enforceable remedial action plan approval order by the Department, must submit a completed copy of the UIC inventory notification form to the UIC program in Tallahassee.

d. General information about temporary ZODs: For groundwater remediation, the composition of an injected material must meet the primary and secondary drinking water standards set forth in Chapter 62-550, F.A.C., and the minimum groundwater criteria of Chapter 62-520, F.A.C., pursuant to UIC Rule 62-528.600(2)(d), F.A.C. Aquifer remediation products that do not meet these requirements must seek relief from water quality criteria by one of two mechanisms. Permission for a temporary ZOD may be obtained via Rule 62-520.310(8)(c), F.A.C. If a ZOD is not permissible by rule, it will be necessary to seek a variance from Department rules in accordance with Section 120.542, Florida Statutes.

Rule 62-520.310(8)(c), F.A.C., allows for a temporary ZOD for closed-loop re-injection systems, for the prime constituents of the reagents used to remediate site contaminants, and for groundwater secondary standards. In order to obtain permission for a temporary ZOD by rule, a site-specific remedial action plan must indicate: (a) the chemical ingredients of concern in the fluid to be injected that will be present in excess of groundwater standards; (b) the size of the ZOD that is needed; (c) the amount of time that the ZOD will be needed; and (d) a plan for monitoring the injected chemical ingredients of concern. The size of the temporary ZOD will usually be the injection well radius of influence when the treatment system is a single injection point. For a multiple point system, the ZOD can usually be expressed and illustrated as the total area of the cluster formed by all the injection points, located side-by-side with overlapping radii of influence.

e. Specific ZOD information for Provect-IR: A site-specific remedial action plan shall specify the volume and concentration at which the product will be injected, and the size and duration of the ZOD needed. Monitoring requirements for the ZOD are ammonia, iron, pH, TDS and TRPH. Monitoring requirements will also include sodium if the injected material contains more than 4.5% Provect-IR and sulfate if the injected material contains more than 1.5% Provect-IR.

   Upon expiration of the time period granted for the ZOD, the concentration of each parameter must meet its respective groundwater standard or its natural-occurring background value at the specific cleanup site, whichever is less stringent.

g. Utilization of wells: If a remediation site happens to have an abundance of monitoring wells, then the WCP has no objection to the use of some wells for the application of injected products. However, no "designated" monitoring well, dedicated to the tracking of remediation progress (by sampling) shall be used to apply reagents. This will avoid premature conclusion that the entire site meets cleanup goals. By making sure that designated tracking wells are not also used for treatment, there will be more assurance that the treatment process has permeated the entire site and that it did not remain localized to the area immediately surrounding each injection well.

h. Avoidance of migration: For injection-type, in-situ aquifer remediation projects, pursuant to Rule 62-528.630(3), F.A.C., injection of remediation products shall be performed in such a way, and at such a rate and volume, that no undesirable migration of either the ingredients of concern, site contaminants, or remediation byproducts results.

i. Abandonment of wells: Upon issuance of a Site Rehabilitation Completion Order, injection wells shall be abandoned pursuant to Section 62-528.645, F.A.C., and the Underground Injection Control Section of the Department shall be notified so that the treatment wells can be removed from the injection well inventory-tracking list.