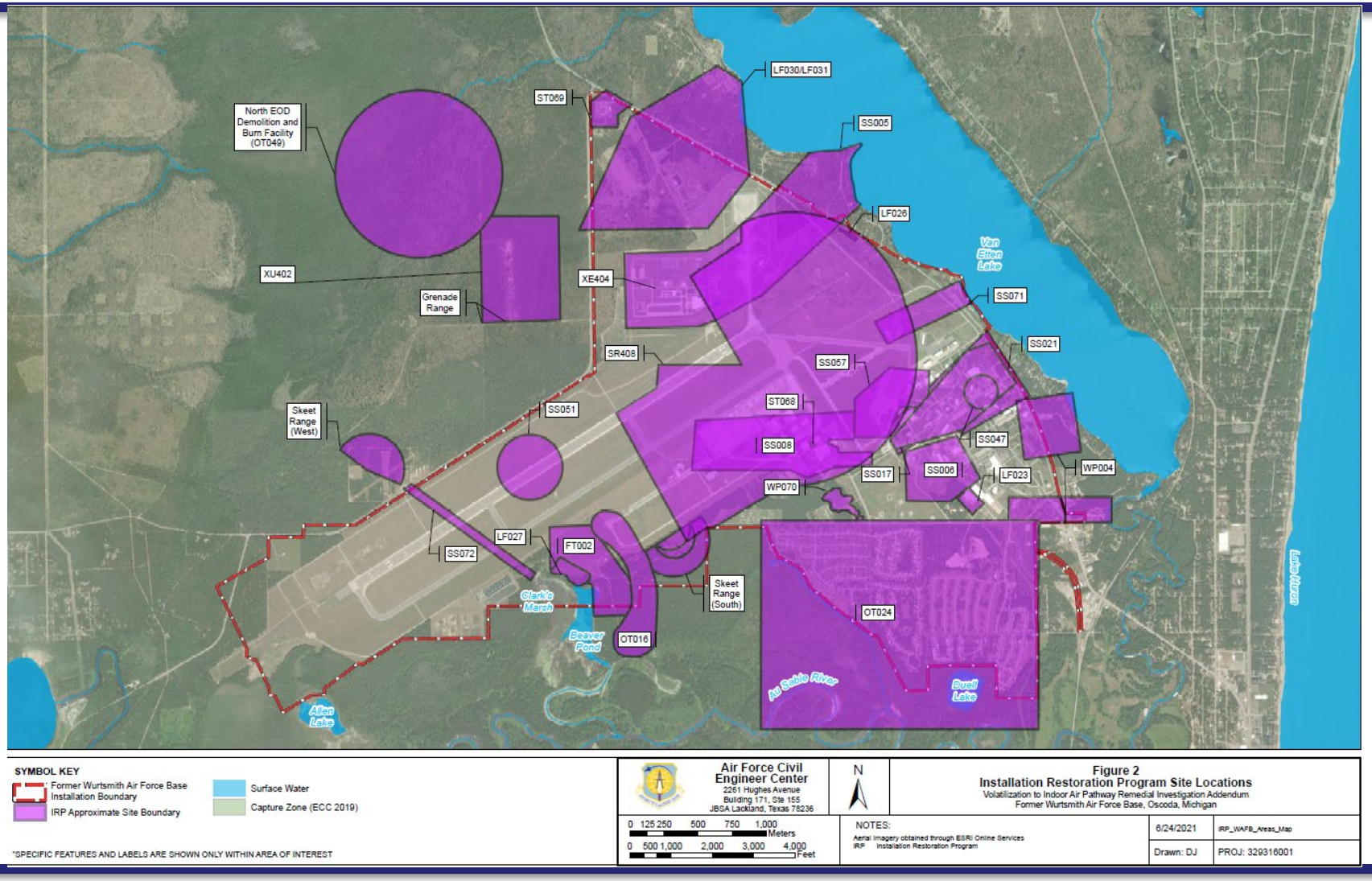
Volatilization to Indoor Air Pathway Remedial Investigation

25 May 2022

Classification

- The purpose of the VIAP RI Addendum activities were to evaluate the potential for complete Volatilization to Indoor Air Pathway (VIAP) due to previous VOC impacts to soil, groundwater and/or soil-gas at 25 IRP Sites
- Historical groundwater, soil, and soil-gas data were compared to the respective Site-Specific Volatilization-to-Indoor Air Criteria (SSVIAC) provided by the Michigan Department of Environment, Great Lakes, and Energy (EGLE) on 24 May 2019 for soil, groundwater, and soil vapor

IRP Sites



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Data Quality Objectives (DQOs)

- **A current VIAP was considered potentially complete if <u>all</u> the following evaluation criteria were valid:**

1. **If current or historical operations potentially released VOCs to the subsurface;**
2. **If VOCs are currently present in media (soil or groundwater);**
3. **If the most current groundwater, soil, or soil-gas concentrations exceeded the SSVIAC;**
4. **If a clean water lens (i.e., VOC concentrations in groundwater below SSVIAC) is absent, i.e., does not prevent vapor intrusion from groundwater to indoor air at the IRP site; and,**
5. **If an occupiable building exists.**

IRP Site VIAP Evaluation-Summary

Site	VIAP Evaluation Criteria					Investigation Rationale
	1.VOCs currently/historically used, released, stored	2.VOCs currently present in media	3.VOC concentrations exceed SSVIAC[a]	4.Absence of clean water lens to prevent vapor intrusion	5.Occupiable buildings present	
FT002	Yes	Yes	Yes – Residential and Nonresidential	Yes	No	VIAP incomplete based on current land use – No sampling conducted under this VIAP investigationb
WP004	Yes	Yes	Yes-Residential No-Nonresidential	No	Not Required	VIAP incomplete due to the presence of clean water lens – Sampling not required[c]
SS005	Yes	Yes	Yes – Residential and Nonresidential	Yes	Yes	Additional Investigation Conducted
SS006	Yes	Yes	No-Residential Yes -Nonresidential	Yes	No	VIAP incomplete based on current land use – No sampling conducted under this VIAP investigation[b]
SS008	Yes	Yes	Yes – Residential and Nonresidential	Yes	Yes	Additional Investigation Conducted
OT016	Yes	Yes	Yes – Residential and Nonresidential	Yes	No	VIAP incomplete based on current land use – No sampling conducted under this VIAP investigation
SS017	Yes	No (all active wells within SS017 are associated with SS021 contamination)	Not Required	Not Required	Not Required	VIAP incomplete due to absence of VOCs at SS017– Sampling not required[c]
SS021	Yes	Yes	Yes – Residential and Nonresidential	Yes	Yes	Additional Investigation Conducted
LF023	Yes	Yes	No – Residential and Nonresidential	Not Required	Not Required	VIAP incomplete due to no exceedances of Residential SSVIAC– Sampling not required[c]

IRP Site VIAP Evaluation-Summary

Site	VIAP Evaluation Criteria					Investigation Rationale
	1.VOCs currently/historically used, released, stored	2.VOCs currently present in media	3.VOC concentrations exceed SSVIAC[a]	4.Absence of clean water lens to prevent vapor intrusion	5.Occupiable buildings present	
OT024	Yes	Yes	Yes – Residential and Nonresidential	No	Not Required	VIAP incomplete due to the presence of clean water lens – Sampling not required[c]
LF026	Yes	Yes	No – Residential and Nonresidential	Not Required	Not Required	VIAP incomplete due to no exceedances of Residential SSVIAC– Sampling not required[c]
LF027	No	Not Required	Not Required	Not Required	Not Required	VIAP incomplete due to absence of VOCs – Sampling not required[c]
LF030/031	Yes	Yes	Yes-Nonresidential on-base Yes-Residential off-base	No-On-base No-Off-base	No-Onsite Not Required-Offsite	VIAP incomplete based on current land use – No sampling conducted under this VIAP investigation[b]
SS047	Yes	Yes	Yes – Residential and Nonresidential	Yes	Yes	Additional Investigation Conducted
SS051	Yes	Yes	No – Residential and Nonresidential	Not Required	Not Required	VIAP incomplete due to no exceedances of Residential SSVIAC– Sampling not required[c]
SS057	Yes	Yes	Yes - Residential No-Nonresidential	Yes	Yes	VIAP incomplete based on current land use – No sampling conducted under this VIAP investigation[b]
ST068	No	Not Required	Not Required	Not Required	Not Required	VIAP incomplete due to absence of VOCs – No sampling required**
ST069	Yes	Yes	Yes – Residential No - Nonresidential	Yes	No	VIAP incomplete based on current land use – No sampling conducted under this VIAP investigation[b]

IRP Site VIAP Evaluation-Summary

Site	VIAP Evaluation Criteria					Investigation Rationale
	1.VOCs currently/historically used, released, stored	2.VOCs currently present in media	3.VOC concentrations exceed SSVIAC[a]	4.Absence of clean water lens to prevent vapor intrusion	5.Occupiable buildings present	
WP070	No	Not Required	Not Required	Not Required	Not Required	VIAP incomplete due to lack of VOCs used on Site– Sampling not required[c]
SS071	Yes	Yes	Yes - Residential No - Nonresidential	Yes	Yes	VIAP incomplete based on current land use – No sampling conducted under this VIAP investigation[b]
SS072	Yes	Yes	Yes - Residential No - Nonresidential	Yes	No	VIAP incomplete based on current land use – No sampling conducted under this VIAP investigation[b]
SR048	No	Not Required	Not Required	Not Required	Not Required	VIAP incomplete due to lack of VOCs used on Site– Sampling not required[c]
XE404	No	Not Required	Not Required	Not Required	Not Required	VIAP incomplete due to lack of VOCs used on Site – Sampling not required[c]
XU402	No	Not Required	Not Required	Not Required	Not Required	VIAP incomplete due to lack of VOCs used on Site – Sampling not required[c]
OT049	No	Not Required	Not Required	Not Required	Not Required	VIAP incomplete due to lack of VOCs used on Site – Sampling not required[c]

Notes:

a- EGLE's SSVIAC are based on a noncancer HQ of one or a cancer TR of 1 in 100,000 (10^{-5}).

b- Orange shaded rows. VIAP incomplete based on current land use. No VIAP investigation was conducted under this effort. However, further VIAP evaluation is recommended to determine if the VIAP may be potentially complete if land use conditions change.

c- Green shaded rows. No further VIAP evaluation warranted because of one of the following conditions: no VOCs were used at the site, no VOCs were detected, or detected concentrations were below residential SSVIAC. A No Action DD will be prepared for these sites

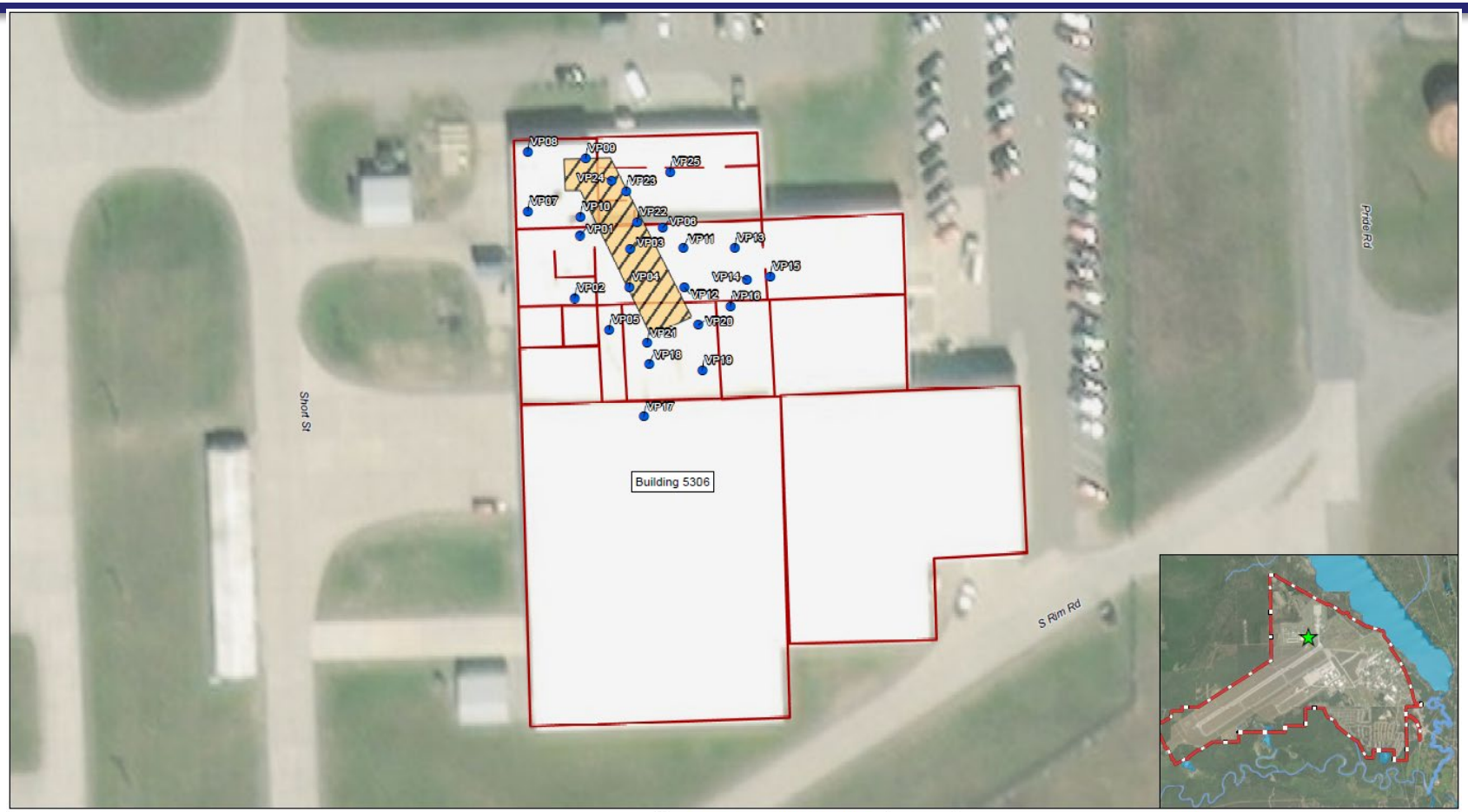
Soil-Gas Investigated Sites

- IRP Site SS005
- IRP Site SS008
- IRP Site SS021
- IRP Site SS047

IRP Site SS005

- IRP Site SS005 is broken up into two different portions as On-Base and Off-Base with different zoning restrictions.
- Remedial actions began in 1979 at Building 5306, where a septic tank was removed during the 1980s.
- Historical soil-gas analytical results exceeded the Nonresidential SSVIAC outside of Building 5306.
- Due to these exceedances, investigation is required.
- Twenty-five vapor points were installed inside Building 5306 for investigation.

IRP Site SS005



SYMBOL KEY

- Approximate Foundation Footprint
- Former Wurtsmith Air Force Base Installation Area
- Sample Location
- Suspected Location of Leach Field
- Site Location

Air Force Civil Engineer Center
2261 Hughes Avenue
Building 171, Ste 155
JBSA Lackland, Texas 78236

N

0 20 40 80 120 160 Feet
0 5 10 20 30 40 Meters

Figure 3
Sample Locations
Site SS005 TCE Spill, Southwest of SAC Alert Apron
Volatilization-to-Indoor Air Pathway Remedial Investigation Addendum Report
Former Wurtsmith Air Force Base, Oscoda, Michigan

NOTES:
Aerial Imagery obtained through ESRI Online Services

6/24/2021 | Fig_3_AFB_Sampling_SS005
Drawn: DGJ | PROJ: 329316001

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IRP Site SS008

- IRP Site SS008 is the location of the SAC Operational Apron, Nose Dock and maintenance areas.
- Remedial action began in 1981 which involved the installation of monitoring wells and groundwater sampling.
- Soil gas samples were collected in 1995 near oil water separators, the suspected source area.
- Concentrations of soil, groundwater and soil-gas had exceedances of Residential and/or Nonresidential SSVIAC.
- Exceedances led to the installation of nine soil gas wells.

IRP Site SS008

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IRP Site SS021

- IRP Site SS021 is located at Building 43 where a removed 500-gallon UST had a leak of TCE.
- Remedial Responses began in 1977 with the removal of the tank and when TCE was detected in supply wells near building 43.
- From 1978 to 2015 a total of 53 wells have been installed to delineate the plume.
- VOC concentrations in soil exceeded Nonresidential SSVIAC and groundwater VOCs exceeded Residential SSVIAC.
- These exceedances led to the installation of 6 soil gas wells.

IRP Site SS021

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IRP Site SS047

- The site was created in 1987 during a release of approximately 400 gallons of unleaded gasoline.
- VOC concentrations in soil exceed Residential and Nonresidential SSVIAC, while groundwater concentrations do not exceed any SSVIAC.
- Based on concentrations and lack of a clean water lens, two soil gas wells were installed.

IRP Site SS047

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Results

- Installation of these points were completed in May 2020
- 25 sub-slab points installed at SS005 within Building 5306.
- 9 soil-gas wells installed at SS008 to assess Buildings 5008, 5066, 5067 and 5068.
- 6 soil-gas wells installed at SS021 to assess Building 25, 43 and 7009.
- 2 soil-gas wells installed at SS047 to assess Building 406
- Quarterly sampling conducted May, Aug, Sept 2020 and Feb 2021

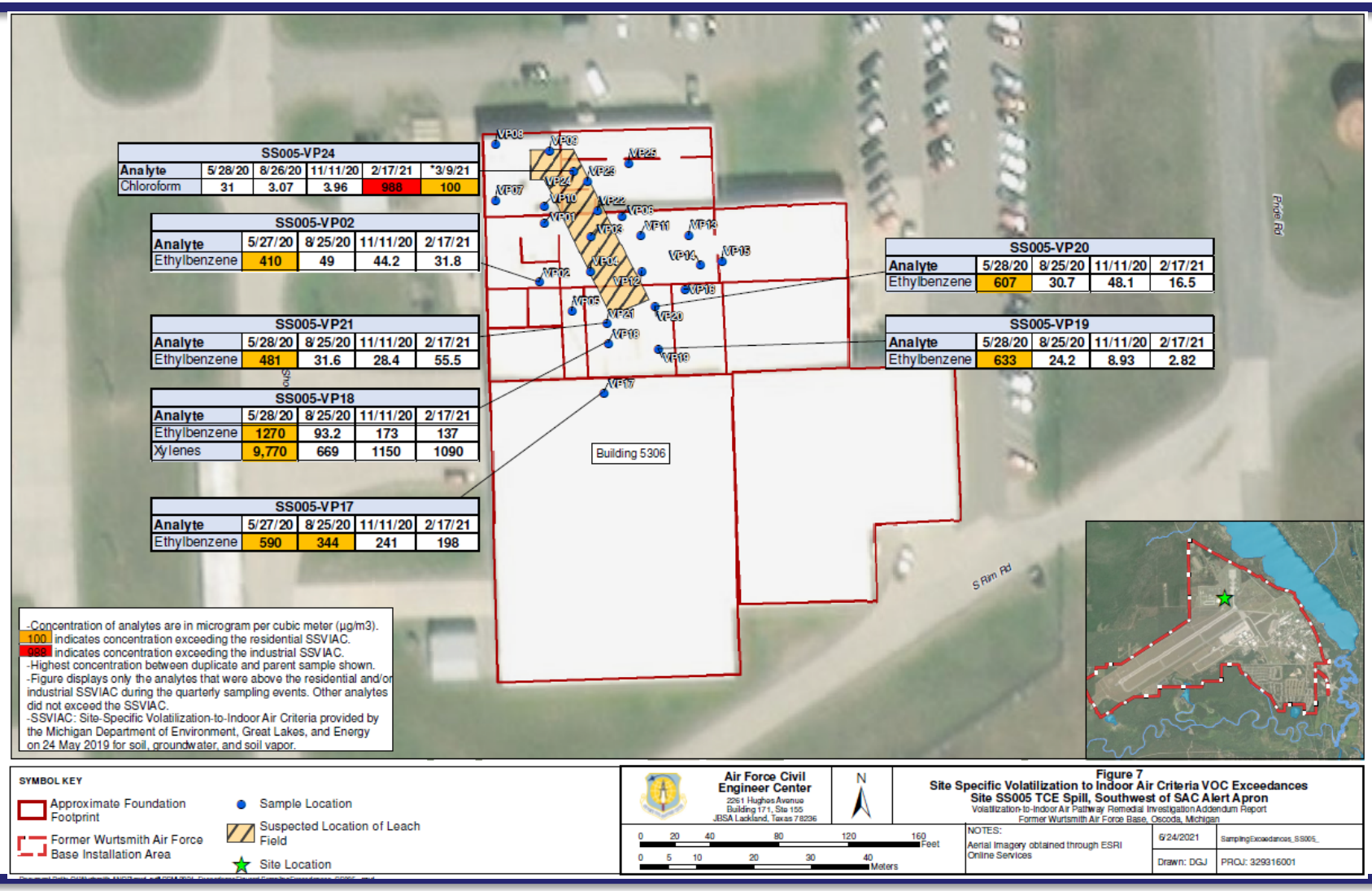
IRP Site SS005 Results

- **SS005-VP02: Ethylbenzene was detected exceeding the Residential SSVIAC (340 micrograms/cubic meter [µg/m^3]) with a concentration of 481 µg/m^3 in the first quarter only. There were no exceedances to Residential SSVIAC during the following three quarters.**
- **SS005-VP17: Ethylbenzene was detected exceeding the Residential SSVIAC (340 µg/m^3) in the first two quarters with concentrations of 590 µg/m^3 and 344 µg/m^3 respectfully. There were no exceedances to the Residential SSVIAC during the following two quarters.**
- **SS005-VP18: Ethylbenzene and xylenes were detected exceeding the Residential SSVIAC (340 µg/m^3 and 7,600 µg/m^3 respectfully). There were no exceedances to the Residential SSVIAC during the following three quarters.**
- **SS005-VP19: Ethylbenzene was detected exceeding the Residential SSVIAC (340 µg/m^3) with a concentration of 433 µg/m^3 in the first quarter only. There were no exceedances to the Residential SSVIAC during the following three quarters.**

IRP Site SS005 Results cont.

- **SS005-VP20: Ethylbenzene was detected exceeding the Residential SSVIAC (340 µg/m^3) with a concentration of 607 µg/m^3 in the first quarter only. There were no exceedances to the Residential SSVIAC during the following three quarters.**
- **SS005-VP21: Ethylbenzene was detected exceeding the Residential SSVIAC (340 µg/m^3) with a concentration of 481 µg/m^3 in the first quarter only. There were no exceedances to the Residential SSVIAC during the following three quarters.**
- **SS005-VP24: Chloroform was detected exceeding the Nonresidential SSVIAC (170 µg/m^3) during the fourth round of sampling with a concentration of 988 µg/m^3. A resample was conducted in March and the concentration dropped to 100 µg/m^3.**

IRP Site SS005 Results



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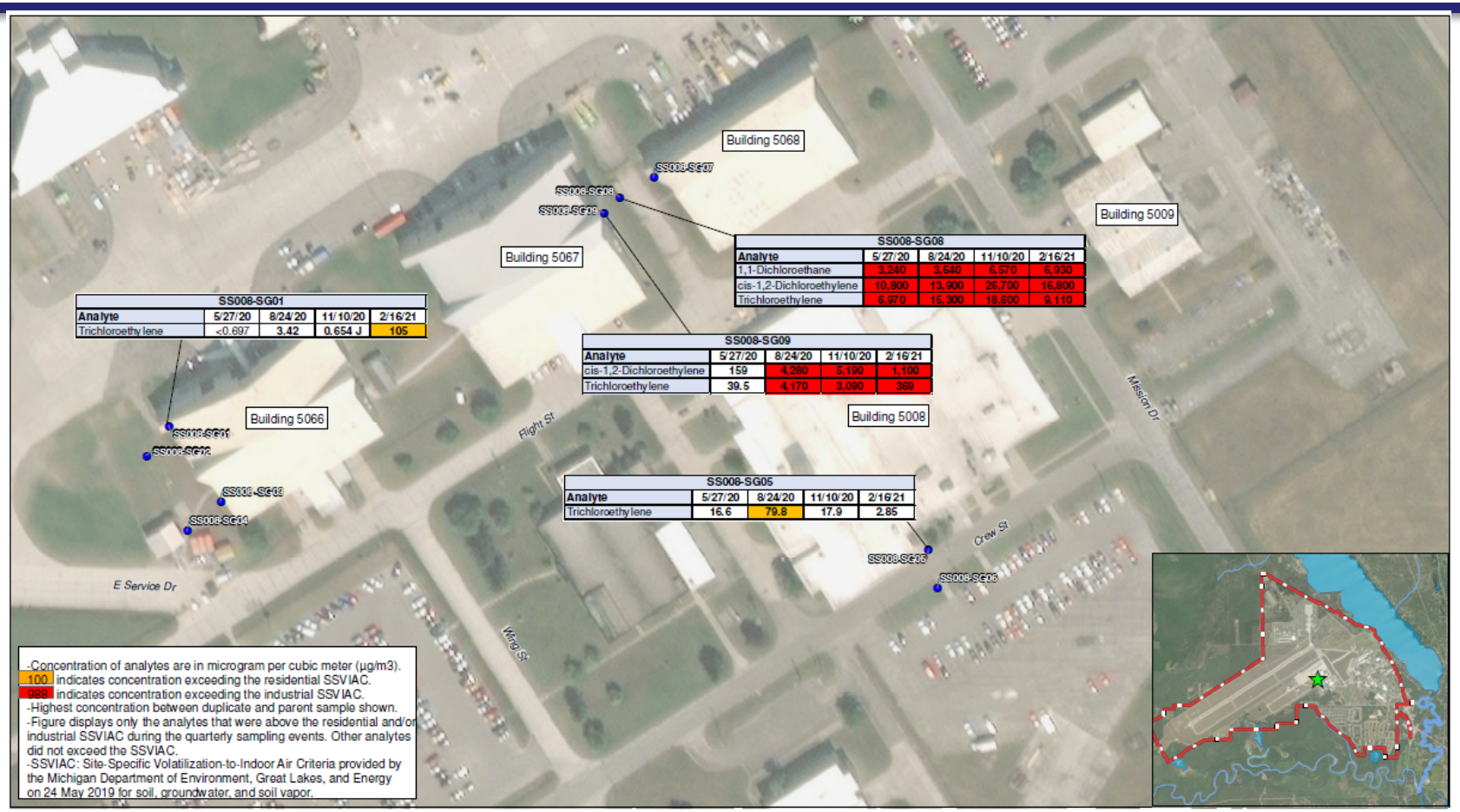
IRP Site SS008 Results

- **SS008-SG01: TCE was detected exceeding the Residential SSVIAC (67 µg/m^3) with a concentration of 105 µg/m^3 in the fourth quarter. The previous three quarters had no exceedances to the Residential SSVIAC.**
- **SS008-SG05: TCE was detected exceeding the Residential SSVIAC (67 µg/m^3) with a concentration of 79.8 µg/m^3 in the second quarter. The last two quarters had no exceedances to the Residential SSVIAC.**
- **SS008-SG08: 1,1-Dichloroethane, cis-1,2-Dichloroethylene and TCE were detected in all four quarters exceeding the Nonresidential SSVIAC (2,500 µg/m^3, 820 µg/m^3, and 130 µg/m^3 respectively). The concentrations for 1,1-Dichloroethane ranged from 3,240 µg/m^3 to 6,930 µg/m^3. The concentrations for cis-1,2-Dichloroethylene ranged from 10,800 µg/m^{3}µg/m^3 to 26,700 µg/m^3. The concentrations for TCE ranged from 6,970 µg/m^3 to 18,600 µg/m^3.**
- **SS008-SG09: cis-1,2-Dichloroethylene and TCE were detected in the final three quarters exceeding the Nonresidential SSVIAC (820 µg/m^3 and 130 µg/m^3 respectively). Concentrations for cis-1,2-Dichloroethylene ranged from 1,100 µg/m^3 to 5,190 µg/m^3. Concentrations for TCE ranged from 369 µg/m^3 to 4,170 µg/m^3.**

IRP Site SS008 Results



SS008-SG01

Analyte	5/27/20	8/24/20	11/10/20	2/16/21
Trichloroethylene	<0.697	3.42	0.654 J	105

SS008-SG08

Analyte	5/27/20	8/24/20	11/10/20	2/16/21
1,1-Dichloroethane	3,240	3,640	6,570	6,930
cis-1,2-Dichloroethylene	10,800	13,900	26,700	16,800
Trichloroethylene	6,970	15,300	18,600	9,110

SS008-SG09

Analyte	5/27/20	8/24/20	11/10/20	2/16/21
cis-1,2-Dichloroethylene	159	4,280	5,190	1,100
Trichloroethylene	39.5	4,170	3,090	369

SS008-SG05

Analyte	5/27/20	8/24/20	11/10/20	2/16/21
Trichloroethylene	16.6	79.8	17.9	2.85

SYMBOL KEY
- Sample Location
- Former Wurtsmith Air Force Base Installation Boundary
- Site Location

Air Force Civil Engineer Center
2261 Hughes Avenue
Building 171, Ste 155
JBSA Lackland, Texas 78236

N

0 10 20 40 60 80 Meters
0 40 80 160 240 320 Feet

Figure 8
Site Specific Volatilization to Indoor Air Criteria VOC Exceedances
Site SS008 TCE and Fuel Spill, SAC Nose Doc and Operational Apron
Volatilization-to-Indoor Air Pathway Remedial Investigation Addendum Report
Former Wurtsmith Air Force Base, Oscoda, Michigan

NOTES:
Aerial imagery obtained through ESRI Online Services

6/24/2021 SamplingExceedances_SS008_
Drawn: DJ PROJ: 329316001

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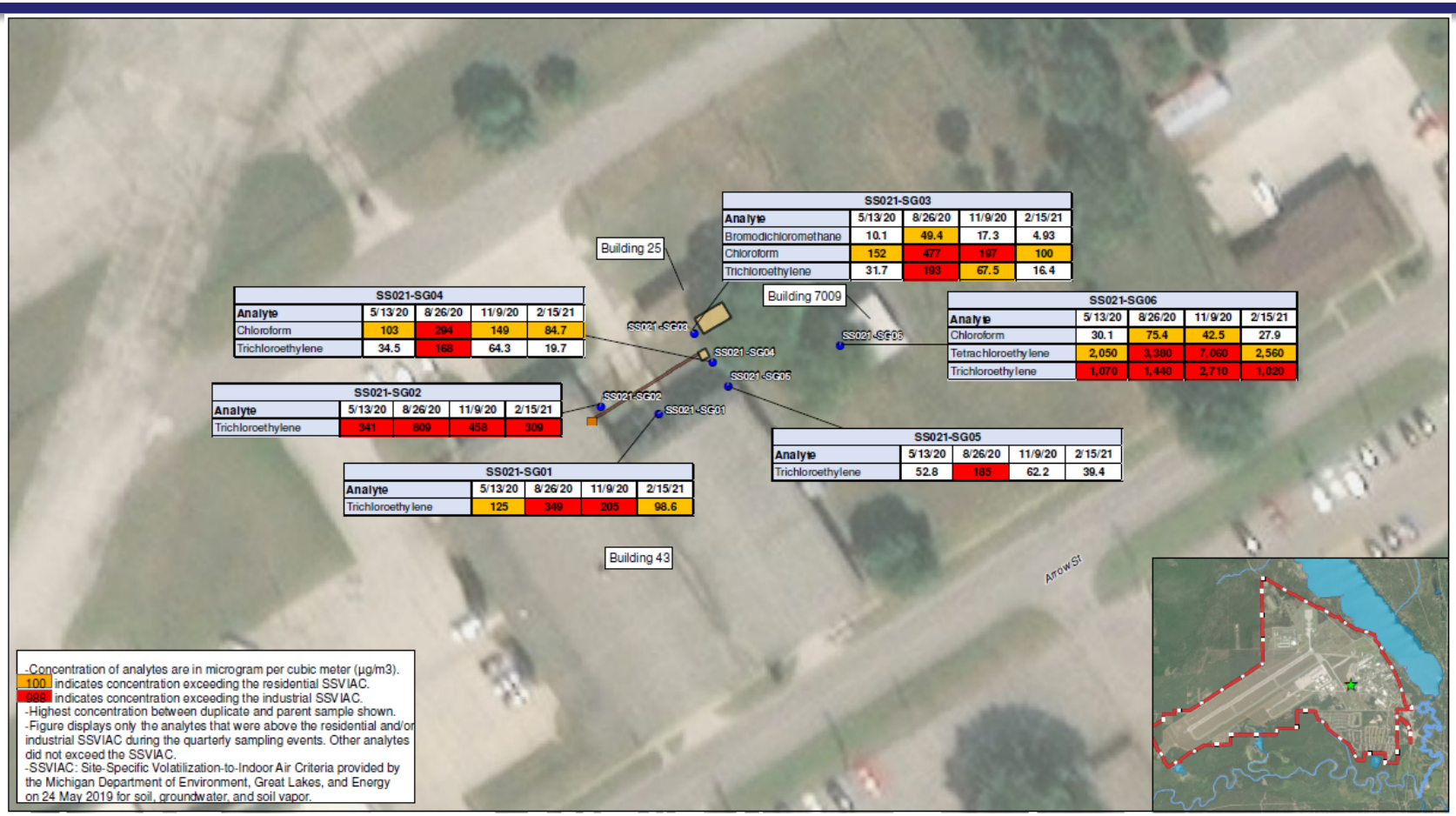
IRP Site SS021 Results

- **SS021-SG01: Concentrations of TCE in all four quarters exceeded either Residential or Nonresidential SSVIAC (67 µg/m^3 and 130 µg/m^3). TCE concentrations ranged from 98.6 µg/m^3 to 349 µg/m^3.**
- **SS021-SG02: Concentrations of TCE exceeded Nonresidential SSVIAC (130 µg/m^3) for all four quarters. Concentrations of TCE ranged from 309 µg/m^3 to 809 µg/m^3.**
- **SS021-SG03: Concentrations of Bromodichloromethane, Chloroform and TCE exceeded Residential and/or Nonresidential SSVIAC in at least one quarter. Bromodichloromethane exceeded Residential SSVIAC (48 µg/m^3) in the second quarter of 49.4 µg/m^3, and the remaining three quarters did not exceed the Residential SSVIAC. Chloroform exceeded the Residential and/or Nonresidential SSVIAC (37 µg/m^3 and 170 µg/m^3) in all four quarters. Concentrations of Chloroform ranged from 100 µg/m^3 to 477 µg/m^3. TCE exceeded either Residential and/or Nonresidential SSVIAC (67 and 130 µg/m^3) in the second and third sampling events with concentrations of 193 µg/m^3 and 67.5 µg/m^3 respectively.**

IRP Site SS021 Results

- **SS021-SG04: Concentrations of chloroform and TCE exceeded the Nonresidential SSVIAC during at least one round of sampling. Chloroform was detected exceeding Residential and/or Nonresidential SSVIAC (37 µg/m^3 and 170 µg/m^3) in all four rounds of sampling with concentrations ranging from 84.7 µg/m^3 to 294 µg/m^3. TCE was detected in the second round of sampling exceeding the Nonresidential SSVIAC (130 µg/m^3) with a concentration of 168 µg/m^3.**
- **SS021-SG05: Concentrations of TCE exceeded the Nonresidential SSVIAC (130 µg/m^3) with a concentration of 185 µg/m^3. The other three sampling events did not exceedance any of the SSVIAC.**
- **SS021-SG06: Chloroform was detected in the second and third round of sampling exceeding the Residential SSVIAC (37 µg/m^3) with concentrations ranging from 42.5 µg/m^3 to 75.4 µg/m^3 respectively. PCE was detected for all four rounds of sampling with concentrations exceeding Residential and/or Nonresidential SSVIAC (1,400 µg/m^3 and 2,700 µg/m^3) ranging from 2,050 µg/m^3 to 7,060 µg/m^3. TCE was detected for all four rounds of sampling with concentrations exceeding the Nonresidential SSVIAC (130 µg/m^3) ranging from 1,020 µg/m^3 to 2,710 µg/m^3.**

IRP Site SS021 Results



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IRP Site SS047 Results

- Two soil-gas sample locations were sampled quarterly.
- Analytical results indicated no exceedances of any of the SSVIAC.

Conclusions/Recommendations

Further evaluation needed if land use conditions change

- IRP Site FT002
- IRP Site SS006
- IRP Site OT016
- IRP Site LF030/031
- IRP Site SS057
- IRP Site ST069
- IRP Site SS071
- IRP Site SS072

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Conclusions/Recommendations

Sites recommended for a “No Action Decision Document”

- IRP Site WP004
- IRP Site SS017
- IRP Site LF023
- IRP Site OT024
- IRP Site LF026
- IRP Site LF027
- IRP Site SS051
- IRP Site ST068
- IRP Site WP070
- IRP Site SR408
- IRP Site XE404
- IRP Site XU402
- IRP Site OT049

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Conclusions/Recommendations – IRP Site SS005

- IRP Site SS005 was evaluated for potential VIAP, there is a leach field located under Building 5306 for the on-site portion. The off-site portion has a clean water lens of 20 ft.
- VOC concentrations from 18 of the 25 sub-slab samples collected, did not exceed the Residential SSVIAC during all four quarterly sampling events.
- In six locations, ethylbenzene and/or xylenes exceeded the Residential SSVIAC during only the first quarterly sampling event (May 2020), except for location SS005-VP17 (August 2020) which had an ethylbenzene concentration exceeding the Residential SSVIAC during the second sampling event (followed by two consecutive events with no exceedances).
- One sub-slab location, SS005-VP24 showed concentrations of chloroform detected exceeding the Nonresidential SSVIAC (170 µg/m^3) during only the fourth round of sampling with a concentration of 988 µg/m^3. A resample was conducted in March and the concentration dropped to 100 µg/m^3, exceeding only the Residential SSVIAC. It is believed that there is potential corrosion within the drainage pipe that is located near the sub-slab sampling port. The sampling port is located within a janitorial closet and there is a possibility that bleach, or bleach containing water, could react with organics in the subsurface to generate chloroform.

Conclusions/Recommendations – IRP Site SS005

- Quarterly data collected from the sub-slab points indicated that the vapor intrusion pathway is not complete for on-site workers within Building 5306, as concentrations do not exceed Nonresidential SSVIAC.
- However, some of the sub-slab points that exceeded the Residential SSVIAC are located at the perimeter of the sub-slab sampling network (SS005-VP02, SS005-VP21, SS005-VP18, SS005-VP17, SS007-VP19, and SS005-VP20).
- Therefore, it is recommended to install additional sub-slab points to fully delineate vapor points exceeding Residential SSVIAC and to collect four rounds of quarterly soil-vapor sampling from the newly installed sub-slab points as well as the existing seven soil-gas points that showed concentrations exceeding Residential SSVIAC.

Conclusions/Recommendations – IRP Site SS008

- IRP Site SS008 was evaluated for a potential VIAP, VOCs onsite had concentrations present in groundwater, soil and soil vapor which all exceeded either Residential and/or Nonresidential SSVIAC.
- The site currently has multiple occupiable buildings onsite and no clean water lens, so an investigation was conducted.
- 9 shallow soil-gas points (SS008-SG01 through SS008-SG09) were installed around four buildings (5066, 5067, 5068 and 5008). Of those 9 points, four locations (SS008-SG01, SS008-SG05, SS008-SG08 and SS008-SG09) had concentrations of various VOCs that exceeded either residential and/or non-residential SSVIAC

Conclusions/Recommendations – IRP Site SS008

- Quarterly data collected from the soil-gas points indicated that the vapor intrusion pathway needs to be further investigated.
- Installation of additional soil-gas points and sub-slab points to fully delineate the VIAP is recommended. Buildings 5066, 5067 and 5008 will need to be investigated.
- S008-SG01 should have an additional four rounds of sampling completed and impacts to soil vapor should be delineated to the north and east.
- SS008-SG08 and SS008-SG09 should be delineated to the north, south and west.
- SS008-SG05 should be delineated to the north, east and west.
- Additional step-outs may be required if concentrations exceed SSVIAC.

Conclusions/Recommendations – IRP Site SS021

- Site was evaluated for a potential VIAP, VOCs currently present in groundwater and soil with exceedances of residential and/or nonresidential SSVIAC.
- Site currently has occupiable buildings, and no clean water lens is present above impacted groundwater.
- Based on these conditions, nine shallow soil gas points were installed.

Conclusions/Recommendations – IRP Site SS021

- Quarterly data collected from the soil-gas points indicated that the vapor intrusion pathway needs to be further evaluated.
- It is recommended to install additional soil-gas points and sub-slab points to fully delineate and evaluate the potential VIAP inside the buildings.
- SS021-SG01 should be delineated to the north, south into building 43 and east.
- SS021-SG02 should be delineated to the north, south and west into building 43.
- SS021-SG03 through SS021-SG05 should be delineated to the north, south and east which involves going into Buildings 25 and 43.
- SS021-SG06 should be delineated in all directions.
- Additional step-outs may be required if concentrations exceed SSVIAC.

Conclusions/Recommendations – IRP Site SS047

- Site was evaluated for a potential VIAP, historical VOCs were present in soil exceeding the residential and nonresidential SSVIAC.
- Currently one occupiable building onsite, therefore, two soil-gas points were installed in and near the release area.
- The two sample locations (SS047-SG01 and SS047-SG02) were sampled for four consecutive quarters, and no VOC concentrations exceeded the unrestricted residential SSVIAC.
- The quarterly data collected from the site indicates that no further evaluation of the VIAP is warranted at IRP Site SS047 and no action is warranted to address the VIAP.

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Volatilization to Indoor Air Pathway Remedial Investigation Continuation

25 May 2022

Follow-On Contract

- Contract award planned through USACE Louisville District
- Contract includes remedial investigation with risk assessment, feasibility study, proposed plans, and records of decision
- Remedial investigation
  - Work planning documents preparation
  - Soil gas and sub-slab data collection at SS005, SS008, and SS021
  - Interior building surveys
  - Indoor air sampling
  - Risk assessments

Follow-On Contract

- EGLE short term action request
  - IRP SS008, sub-slab soil vapor evaluations within Buildings 5067 and 5068
  - IRP SS021, sub-slab soil vapor evaluations within Buildings 25 and 43
  - IRP SS021, confirmation Building 7009 has no interior enclosed spaces

Follow-On Contract

- **Feasibility Study**
  - **Establish remedial action objectives (RAOs)**
  - **Develop and evaluate remedial alternative to meet RAOs**
- **Proposed Plans**
  - **Group sites requiring no further action and those requiring further action**
- **Records of Decision**
  - **Group sites described in proposed plans**

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