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2020 Corrective Action Implementation Summary Report and 2021 Work Plan
The Dow Chemical Company
Midland Plant

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ΔP	differential pressure
%	percent
μg/kg	microgram per kilogram
μg/L	microgram per Liter
$\mu g/m^3$	microgram per cubic meter
<	less than
>	greater than
≥	greater than or equal to
2Q 2016	2nd Quarter 2016
4Q 2016	4th Quarter 2016
α or AF	attenuation factor
AAC	acceptable air concentration
AC	air conditioning
AOC	area of concern
AEHS	Environmental Health and Sciences Foundation
AOI	analyte of interest
ARM	absolute residual mean
ASTM	ASTM International
BEA	Baseline Environmental Assessment
bgs	below ground surface
$CaCO_3$	calcium carbonate
CA	Corrective Action
CAIP	Corrective Action Implementation Summary Report and Work Plan
CFC	chlorofluorocarbon
CFR	Code of Federal Regulations
cm/sec	centimeter per second
CMI	Corrective Measures Implementation
COC	constituent of concern
COI	constituent of interest
CR	Closure Report
CRREL	Cold Regions Research and Engineering Laboratory
CSM	conceptual site model
CV	coefficient of variation
DC	direct contact
DCA	dichloroethane
DCB	dichlorobenzene
DCC	direct contact criteria
DCE	dichloroethene
DCP	dichloropropane
DEQ	Department of Environmental Quality
DNAPL	dense non-aqueous phase liquid
DOS	Dow On-Site

DU	decision unit
EI	Environmental Indicator
EAC	Environmental Analytical Chemistry
EarthCon	EarthCon Consultants, Inc.
EBS	Expedited Building Summary
ECD	electron capture detector
EDB	1,2-dibromoethane
EDC	1,2-dichloroethane
EGLE	Michigan Department of Environment, Great Lakes, and Energy
EPA	U.S. Environmental Protection Agency
ERDC	Engineer Research and Development Center
EVO	Environmental Operations
EVS	Enterprise Venture Corporation
FID	flame ionization detector
ft	foot, feet
ft^2	square feet
ft/ft	feet per foot
ft/day	feet per day
GC	gas chromatography
GCL	geosynthetic clay liner
GIS	geographic information system
gpm	gallons per minute
GPS	global positioning system
GSI	groundwater-surface water interface
HCBD	hexachlorobutadiene
HDPE	high-density polyethylene
HPT	hydraulic profiling tool
HSWA	hazardous and solid waste amendment
HVAC	heating, ventilation, and air conditioning
IA	indoor air
ID	Identification
IET	Innovative Environmental Technologies, Inc.
IH	Industrial Hygiene
IM	interim measure
IRA	Interim Response Action
ISGS	in-situ (bio)geochemical stabilization
ISM	incremental sampling methodology
ITRC	Interstate Technology and Regulatory Council
kg	kilogram
LEL	lower explosive limit
LTM	long-term monitoring
m^2	square meter
MCL	maximum contaminant level
MDEQ	Michigan Department of Environmental Quality
MDNR	Michigan Department of Natural Resources

MEK	methyl-ethyl ketone
mg/kg	milligram per kilogram
mg/L	milligram per liter
MH	manhole
MIBK	methyl isobutyl ketone
MiHPT	membrane hydraulic profiling tool
MiOps	Michigan Operations
MIOSHA	Michigan Occupational Safety and Health Administration
mL	milliliter
mm	millimeter
MnO_4^-	permanganate
MRO	Maintenance/Repair/Operations
NA	not applicable
NAPL	non-aqueous phase liquid
NAVD	North American Vertical Datum
NAVFAC	Naval Facilities Engineering Command
NC	not calculated
ND	non-detect
NEP	Northeast Perimeter
NFA	No Further Action
nm	nanometer
NOAA	National Oceanic & Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NREPA	Natural Resources and Environmental Protection Act
NRMS	normalized root mean square
OA	outdoor air
OEL	occupational exposure limit
O&M	operation and maintenance
OSHA	Occupational Safety & Health Administration
PAH	polynuclear aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCE	tetrachloroethene
PCOI	potential contaminant of interest
PFOA	perfluorooctanoic acid
PFOS	perfluorooctane sulfonic acid
pg/L	picogram per liter
PID	photoionization detector
PLF	Poseyville Landfill
PMP	Pollution Minimization Program
ppbv	parts per billion by volume
PPE	personal protective equipment
ppm	parts per million
ppmv	parts per million by volume
ppt	parts per thousand
Provectus	Provectus Environmental Products

psi	pounds per square inch
psig	psi gauge
PVC	polyvinyl chloride
RAP	Remedial Action Plan
RCRA	Resource Conservation and Recovery Act
R&D	Research & Development
RGIS	Revetment Groundwater Interception System
RFI	RCRA Facility Investigation
RIASL	Recommended Interim Action Screening Levels
RL	reporting limit
ROI	radius of influence
RPD	relative percent difference
RSL	regional screening level
SAP	Sampling and Analysis Plan
SDF	Sludge Dewatering Facility
SL	screening level
SSSG	sub-slab soil gas
S.U.	standard unit
SVOC	semivolatile organic compound
SWL	static water level
SWMU	solid waste management unit
TAL	target analyte list
TBD	To Be Determined
TCA	trichloroethane
TCB	trichlorobenzene
TCDD	tetrachlorodibenzo-p-dioxin
TCE	trichloroethene
TEC	toxic equivalent concentration
TEQ	toxic equivalent
TMB	trimethylbenzene
TOC	top of casing
TSRIASL	Time-Sensitive Recommended Interim Action Screening Levels
USGS	United States Geological Survey
UV	ultra violet
VI	vapor intrusion
VSIC	Volatile Soil Inhalation Criteria
VOC	volatile organic compound
WMU	waste management unit
WWTP	Wastewater Treatment Plant
XSD	halogen-specific detector

1.0 Introduction

Licensed hazardous waste management facilities are required to conduct corrective action as necessary to protect the public health, safety, welfare, and the environment for all releases of a contaminant from any waste management units (WMUs) at a facility, pursuant to Part 111. The purpose of the Part 111 Corrective Action Program is to address releases of hazardous wastes and hazardous constituents at hazardous waste management facilities in a timely manner. Corrective actions conducted pursuant to Part 111 are designed to be protective of human health and the environment both in the short-term and long-term. Short-term corrective action focuses on the implementation of interim actions to achieve stabilization and to control the source(s) of release to reduce or eliminate, to the extent practicable, further releases of hazardous waste or hazardous constituents that may pose a threat to human health or the environment. To be protective in the long-term, final remedies are designed and implemented to achieve media specific cleanup objectives, either through remediation and/or institutional controls, including identification of specific points of compliance and monitoring.

For the purposes of Part 111, corrective action applies to areas or units described as WMUs or areas of concern (AOCs). WMUs are defined as any discernible unit at which solid wastes have been placed at any time, irrespective of whether the unit was intended for the management of solid or hazardous waste. Such units include any area at the Midland Plant at which solid wastes have been routinely and systematically released. AOCs are areas where hazardous waste, hazardous constituents, or hazardous substances may have been released to the environment on a non-routine basis, which may present an unacceptable risk to public health, safety, welfare, or the environment, and are subject to the corrective action requirements of Part 111 of Act 451 and the remediation requirements of Part 201 of Act 451.

The Michigan Operations Midland Plant is a large industrial site located in Midland, Michigan with an operating history of over 115 years and multiple historical sources of contamination. The site location is identified in Figure 1-1. The entire Midland Plant is designated as a WMU and within the Midland Plant; there are a number of individual WMUs and AOCs. The locations of the WMUs and AOCs at the Midland Plant are shown in Figures 1-2 and 1-3, respectively. A summary of each unit/area is provided on the 2020 update of Table B2-1 of the License - *Summary of Actual or Potential Sources of Contamination* (Table 1-1)[1].

At the Midland Plant, corrective action is performed in a phased approach that focuses on areas that represent the greatest short-term risk to human health and/or the environment, which is consistent with site corrective action objectives.

Corrective action at the Midland Plant focused on five main priorities:

- Site-Wide Containment;
- Worker Exposure Control Program;
- Monitored Natural Attenuation;
- Contaminant Mass Reduction; and
- Off-site Corrective Action.

[1] As agreed to with EGLE in 2019, Table B2-1 was update with identification number changes for the WMUs and AOCs listed in the table. The intent of the renumbering was to ensure that if new areas are added to the table the organization of the table remains intact and that the existing areas are not assigned new numbers moving forward. A crosswalk detailing the new numbers assigned and the corresponding old numbers is included in Table 1-2.

The goals of these activities and programs has been to achieve stabilization of the WMUs, meet the Groundwater Contained Environmental Indicator (EI), manage worker exposure, and address off-site releases. The current phase of corrective action emphasizes meeting the Human Exposure (HE) EI.

This 2020/2021 CAIP is being submitted to summarize the Corrective Action activities completed in 2020 and those that are planned for 2021, in accordance with the Condition XI.R of the Operating License issued September 25, 2015.

As discussed further in Section 2.0, the schedule for the current license period (2015 to 2025) has been updated and is summarized in the updated *Corrective Action Implementation Plan High Level Overview* (Figure 1-4).

2.0 Goals and Objectives for License Period

The current operating license period spans from 2015-2025. At the beginning of the license period, Dow proposed corrective action goals that remained relatively unchanged through the initial years. After five years and substantial changes in policy, regulation, approach and understanding, Dow and EGLE agreed that Dow should revisit these goals to reassess status, make adjustments, and establish measurable milestones to achieve a positive determination that the HE EI has been met for the Soil Direct Contact, Indoor Air and On-site Outdoor Air pathways.

As detailed in Section 1.0, the current phase of corrective action work at the Midland Facility prioritizes achieving the HE EI met determination. Measurable milestones for this goal are necessary to ensure that once the appropriate milestones have been achieved, there will be concurrence that the HE EI can be considered “under control.” A positive HE EI determination indicates that there are no “unacceptable” human exposures to “contamination” (i.e., contaminants in concentrations in excess of appropriate risk-based levels) that can be reasonably expected under current land- and groundwater-use conditions (for all “contamination” subject to RCRA Corrective Action at or from the identified facility [i.e., site-wide]).

The 2020 updated primary goals for the License period, defined and discussed in more detail in the subsequent sections, are as follows:

- Maintain “under control” for the Migration of Contaminated Groundwater EI
- Reach “under control” status for the HE EI for the Direct Contact (DC) to Soil Pathway at the Midland Plant.
- Reach “under control” status for the HE EI for the On-Site Outdoor Air Pathway at the Midland Plant.
- Reach “under control” status for the HE EI for priority buildings (Category 1 and Category 2 buildings) within the Midland Plant for Vapor Intrusion (VI)
- Develop plan for HE EI VI assessment of Category 3/Deferred Buildings
- Define and initiate management strategies as required at AOCs located along the Midland Plant perimeter not contained by the Revetment Groundwater Interception System (RGIS)
- Implement additional Source Control measures where mobile free phase liquids are identified, with priority given to those areas with potential to impact human health and the environment beyond the source area.

Each of the goals is discussed further below.

2.1 Achieve Control of Human Exposures

As part of the License Reapplication for the current operating license, Dow completed the Resource Conservation and Recovery Act (RCRA) EIs for Human Health for the Midland Facility. Based on the conclusions of the EI, the following exposure pathways warrant further evaluation to achieve “under control” status under the EI:

- Soil Direct Contact (DC)
- Indoor Air
- On-Site Outdoor Air

The conclusions of the EI determination found that soils (surface and subsurface soils) were known to be contaminated above appropriately protective risk-based levels. The EI conclusions indicated that it was unknown whether or not indoor air due to VI was contaminated above appropriately protective risk-based levels. Based on the ongoing ambient air monitoring program, no significant impact has been identified at the facility; however, Dow will continue to evaluate the ambient air pathway (on-site outdoor air) as data is collected for the DC assessment.

In order to reach the overall HE EI under control status for the Midland Plant, it is necessary to reach this determination for each of the remaining inconclusive pathways independently. Measurable milestones have been developed to establish when HE EI will be considered met for portions of or each of the three remaining pathways. Dow has also developed a high-level conceptual schedule to meet these milestones.

The revised schedule as well as the associated proposed milestones are subject to change given the adaptive management approach. This approach is employed to use sound science and technology to re-evaluate and prioritize site activities to account for new information and changing site conditions to target management and resource decisions with the goal of reducing site uncertainties and continuing site progress.

The following subsections present further discussion on the soil DC, indoor air, and on-site outdoor air exposure pathways and an overview of how Dow plans to achieve “under control” status for each of these medium.

2.1.1 Soil Direct Contact

Surface soil (< 2 ft deep) contamination is generally present throughout the Facility as a result of historical releases from former combustion units and manufacturing units and largely contains persistent compounds with low solubility that are strongly sorbed to soil particles. Subsurface soil (> 2 ft deep) contamination is generally present throughout the Facility as a result of historical releases from manufacturing or WMUs and may also include volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), and metals, in addition to the persistent compounds also found in surface soil.

The soil DC pathway includes exposure via long-term dermal contact with and ingestion of soils throughout the soil column, regardless of depth. For potential on-site receptors, this exposure pathway is complete. Aerial dispersion, wind-blown dust, and operations of the facility over time have yielded some detected soil concentrations near or at the surface that are greater than the soil DC non-residential generic criteria. Exposure to soils at depth is not reasonably expected to be significant since the exposure routes are managed by the required use of personal protective equipment (PPE) specified in the Worker Exposure Control Plan (Appendix C of Attachment 19 of the License).

Beginning in 2001, presumptive remedy was performed at the site in the form of surface cover enhancements in areas prioritized for early action to address elevated levels of dioxins and furans in surface soils under the Enhanced Exposure Control Program for Phase I Areas. Areas were prioritized using results from the 1996 and 1998 trace organic analysis of surface soils for dioxins and furans. In addition to the improvements to Phase I Areas, an additional 100 acres of vegetative storm water detention areas have been constructed from 2009 to 2011 which also provided a direct contact (DC) barrier to the existing soils.

While significant work was completed to improve surface cover at the Midland Plant prior to the current license period there was still a large area eligible for assessment to determine if additional surface improvements were warranted. That remaining area of the Midland Plant, including gravel or grassed areas that had not been addressed or assessed prior to the license period have been the focus of the DC evaluation for enhanced surface cover. From 2016-2020 Dow has completed sampling and assessment on an additional 644 acres within the facility boundary.

In order to achieve "under control" status for the HE EI for DC, Dow is evaluating the site in a phased approach, primarily referred to as Zones (Figure 2-1), and will continue to complete surface improvements in the remaining areas of the facility, as necessary. Section 6.0 summarizes the work that was completed prior to 2020, details the work completed in 2020, and presents the work that will be completed in 2021.

As discussed in the 2019 November Dow/EGLE Corrective Action status meeting, HE EI will be considered met for the DC pathway when:

- All unpaved areas are assessed in accordance with the approved DC methodology described in Section 6.0

- All areas determined to have dioxins and furans toxic equivalent (TEQ) results above the non-residential direct contact criteria (DCC) (990 parts per thousand [ppt]) or approved alternative SSC have interim measures or long-term remedy employed to limit exposure

- All areas determined to have a concentration of any other hazardous substance above non-residential DCC for soil have interim measures or long-term remedy employed to limit exposure

Dow believes milestones can be achieved in the coming years following tentative scheduled laid out below and the adaptive management process:

<u>2020 - Completed</u>

- Completed Zone 5 Tittabawassee Floodplain Sampling

- Completed additional sampling in Category 3, 4, and 6 areas for dioxins and furans

<u>2021</u>

- Assess Category 9 Railyard and Electrical Substation areas

<u>2022</u>

- Finalize implementation of interim measures and long-term remedies necessary to limit exposure

<u>2023</u>

- HE EI under control for DC Pathway

2.1.2 Indoor Air

Indoor air at the facility is primarily evaluated through the industrial hygiene (IH) program. The IH program evaluates and measures those analytes that are relevant for occupational industrial exposure; however, the specific potential influence of VI on the indoor air is not determined through the IH program. VI can occur from groundwater volatilization to indoor air and soil volatilization to indoor air. Like the DC pathway, in order to achieve "under control" status for the EI, Dow is evaluating VI at the facility in a phased approach including the definition of zones (Figure 2-2). Section 5.0 summarizes the work that was completed prior to 2020, details the work completed in 2020, and presents the work that will be completed in 2021.

The groundwater volatilization to indoor air exposure pathway addresses vapors emanating from groundwater that could move through the soil vadose zone and migrate to indoor air at the Midland Plant and is only applicable to volatile compounds. The soil volatilization to indoor air exposure pathway addresses vapors that could move through the soil vadose zone and migrate to indoor air in buildings at the facility. This exposure pathway is potentially complete for on-site workers through the inhalation of vapors in indoor air of buildings where they work or routinely visit. On-site worker protection and compliance with Michigan Occupational Safety and Health Administration (MIOSHA) standards is monitored through plant specific IH monitoring programs.

Currently, the facility has approximately 700 buildings and structures on-site. The phased approach for VI uses a building categorization procedure to prioritize worst case buildings for investigation and uses a weight of evidence framework for assessing the VI pathway. The building categorization flowchart is presented on Figure 2-3.

Category 1 and 2 buildings are priority buildings and are being sampled throughout the facility during the initial phased approach. Category 3 buildings are deferred until all priority buildings are sampled and evaluated. Category 4 and 5 buildings are not sampled or included in the VI investigation. Following the *Process for Evaluating VI and Determination of Path Forward Flowchart* on Figure 2-4 all sampled buildings are then placed into groups determined by investigative results.

As discussed in the 2019 November Dow/EGLE Corrective Action status meeting, the VI pathway can be broken down by these building categories and groupings to describe how milestones can be met towards achieving “under control” status for the HE EI VI within the license period. While it is not anticipated that the HE EI will be met for this pathway in the current License period, it is the intent that is can be considered met for specific Categories of buildings within the License period as Dow works through the phased approach on the site.

After completion of initial investigations of all Category 1 and Category 2 buildings within the Midland facility boundary and completion of seasonal evaluation and/or building specific investigations of these priority buildings as necessary to finalize the VI path forward grouping classification, the determination that no unacceptable human exposures to contamination from VI can be reasonably expected under current land- and groundwater use conditions will be determined based on the building grouping as such:

- Group 1 and 3 Buildings – HE EI Met once grouping is determined
- Group 2 and 4A Buildings (OELs) – HE EI Met upon initiation of interim monitoring
- Group 4B Buildings – HE EI Met once interim measures are complete

Once all Category 1 and Category 2 buildings within the facility have been assessed, the Category 3/Deferred buildings assessment will be the next priority. Dow will then incorporate the site knowledge gained through the Category 1 and Category 2 building assessment and propose a process to assess this group of buildings.

Dow believes milestones can be achieved in the coming years following tentative scheduled laid out below and the adaptive management process.

<u>2020 - Completed</u>

- Initiate Z3P3 Priority Building Sampling in Fall

2021

- Initiate Add-on Priority Building Sampling in Fall

2022

- Initiate Z4 Campus Area Priority Building Sampling in Fall

2023

- Start Z5 West of Tittabawassee River Priority Building in Fall

2024

- Finish Z5 West of Tittabawassee River Priority Building Sampling
- Complete IMs on any 4B Buildings
- HE EI Met for Category 1 and Category 2 Buildings
- Propose Plan for Category 3 Building Assessment

2.1.3 On-Site Outdoor Air

In order to achieve "under control" status for the EI, Dow will maintain current ambient air and fugitive dust monitoring programs. The soil volatilization to ambient air and particulate soil inhalation pathways will be considered as relevant data is collected to support the DC pathway evaluation during this license period.

Once all the areas subject to investigation for the DC pathway have been assessed and results have been confirmed to be less than the EGLE screening values for soil volatilization to ambient air and particulate soil inhalation HE EI will be considered met for this pathway. The schedule for meeting HE EI for this pathway is the same as the DC Pathway.

2.1.4 Soil Volatilization to Ambient Air

The soil volatilization to ambient air exposure pathway applies to all land uses where hazardous substance vapors may emit from soils to ambient air. The outdoor air at the facility is monitored by the Ambient Air Monitoring Program (Attachment 16 of the License). Dow will continue to monitor and review ambient air as part of future corrective action efforts (Appendix G of Attachment 19 of the License).

Construction workers can potentially encounter vapors when working with subsurface soils or in a trench scenario; however, exposure is not reasonably expected to be significant since the exposure routes are managed by the required use of PPE and air monitoring specified in the Worker Exposure Control Plan, Appendix C of Attachment 19 of the License.

2.1.5 Particulate Soil Inhalation

The particulate soil inhalation exposure pathway addresses the emission and dispersion of contaminated soil particles into the ambient air (inhalation of fugitive dust particles). Exhaust constituents from process vents, power generation, and thermal incineration processes may have deposited onto plant soils. During dry periods, these soils may have been disturbed by equipment or vehicles and blown by the wind, resulting in fugitive dust emissions.

Fugitive dust control has been in progress at the Midland Plant since 1986. Dow is currently required by the 2015 Operating License and its Renewable Operating Permit (Section 1, IX.5) to provide and regularly update an operating program to control fugitive dust sources or emissions. The current fugitive dust control program requires semi-annual review and updates. In addition, fugitive dust emissions from the facility are monitored for dioxin emissions on an ongoing basis along the plant perimeter pursuant to the "Soil Box Data Evaluation Plan," approved by Michigan Department of Environmental Quality (MDEQ) on September 25, 2015. Monitoring began in 2002 and continues to show the fugitive dust control program for the facility is effective.

In order to limit the generation of fugitive dust and particulates, Dow has placed surface cover on surface soil in certain areas of the facility. The covers include clean topsoil and vegetation, gravel, and/or asphalt. Existing covers are managed and maintained. Based on current conditions, this pathway is likely to be adequately controlled.

2.2 Sustain Control of Contaminated Groundwater

To maintain the status as “under control” for the Migration of Contaminated Groundwater (GW) EI, corrective action includes activities such as maintaining RGIS and other corrective action systems, completing system upgrades as necessary, monitoring groundwater, investigation and other remedial actions to address increasing trends in contaminants or indicator parameters identified during environmental monitoring. Substantial work was completed in 2020 to maintain the under-control status of the GW EI.

Based on the results of pilot project was conducted within Cell 1 of the closed Sludge Dewatering Facility (SDF) during 2019 design plans have been prepared in 2020 to restore the intended functionality to the cell and assess the effectiveness of a cell upgrades to noted head concerns. Details of the plans are discussed in detail in Section 8.0.

Work also continued at Poseyville Landfill (PLF) to enhance containment of contaminated groundwater. In 2020, an additional leachate collection tile system upgrade in the southern portion of the landfill was completed. The Purge Well Pilot Optimization study also continued at PLF in 2020 to better manage the plume in the northeast corner of the landfill. Greater detail regarding work at PLF is provided in Section 9.0.

At locations where engineering controls are not in place, such as Northeast Perimeter (NEP) and Chemical Disposal Well 3, additional corrective actions were also taken during 2020 to better understand and manage these sites. These efforts are and next steps for these areas are found detailed in Sections 10.0 and 11.0, respectively.

A project to upgrade the RGIS from Lift Station #4 to Lift Station #5 is planned for future construction and discussed in Section 3.0.

2.3 Remedy Implementation for AOCs

By 2025, Dow intends to define and initiate management strategies as required at AOCs located along the Midland Plant perimeter not contained by the RGIS including, the Former Ash Pond; Overlook Park/Brine Well 13S; Chemical Disposal Well 3; 7th Street Purge Wells (Former Fuel Oil Tank Farm); Pure Oil; US-10 Tank Farm; Mark Putnam AOC; and Brine Spill Sites 4M, 32S and 6 Pond Purge Wells. Background information on each of these AOCs can be found in the 2016 Corrective Action Implementation Work Plan (12/30/2015).

During 2020, corrective actions were conducted at the following sites:

- 1925 Landfill (Section 4.0)
- Chemical Disposal Well 3 (Section 11.0);
- 7th Street Purge Wells (Section 12.0);
- Mark Putnam AOC (Section 13.0); and
- Former Ash Pond (Section 14.0).

Continued work at these AOCs in 2020 is detailed in each respective section. The remaining AOCs will be addressed according to the updated Corrective Action Implementation Plan High Level Overview (Figure 1-4).

2.4 Additional Source Control Measures for Mobile Free Phase Liquids

Dow has identified 17 areas of free product, consistent with the Compliance Schedule H-8 of the 2003 Operating License. In 2014, Dow installed a free-product recovery system in localized elevated levels (LEL) III. Since installation, approximately 36,429 gallons of free product were recovered through the end of September 2020. Manual recovery operations conducted at additional wells recovered approximately 11 gallons of dense non-aqueous phase liquid (DNAPL) in 2020.

During 2021, work will consist of on-going operation of the manual recovery and free product recovery system installed in LEL III.

2.5 2020 Releases to Soil

In September 2019, EGLE requested that Dow include information regarding any occurrence of sewer overflow events within the facility in the annual CAIP. This topic was then added to the Dow/EGLE Corrective Action monthly coordination meeting for September and it was agreed that the overflows would be documented on the annual update of the B2-1 Table submitted with the CAIP (Table 1-1). It was then subsequently clarified during the November Corrective Action monthly coordination meeting that a new table, created solely for the sewer releases, would have to be created and would be referenced in the B2-1 Table in the F41 AOC (the Wastewater Treatment Plant) line item. The new table created to document the sewer releases within the facility is Table B2-4; it will be updated annually. It is included in this CAIP as Table 2-1.

In 2020, there were three overflow events which occurred in May, September, and December of 2020. Information regarding each one of these releases a summary of the release, an assessment of actual or potential hazard, immediate actions taken, and the status of the area are included on Table 2-1. Maps showing the locations of the overflow areas are provided as Figures 2-5 through 2-11.

2.6 Priority Actions Completed in 2020

Dow completed the following priority activities during 2020:

<u>VI Pathway</u>

- Further defined areas of the facility for the phased approach
- Conducted building occupancy assessments for all buildings previously sampled
- Created a sampling plan for each priority building to be sampled in Zone 3 Phase 3
- Submitted Expedited Building Summaries for 2 buildings and provided email updates for all buildings that required notification
- Conducted soil-gas, indoor air and outdoor air sampling at the Category 1 and 2 buildings within Zone 3 Phase 3, and select buildings in Zone 4
- Conducted seasonal confirmation sampling for VI Path Forward Group 2 and 4 buildings in Zones 1, 2 and 3

- Conducted follow-up Further Investigation activities at 6 buildings with a mobile gas chromatography (GC) to determine the source(s) of indoor air exceedances and submitted Summary of Investigative Findings documenting the event
- Completed seasonal confirmation sampling, implemented interim monitoring at 62 buildings and proposed interim monitoring plans for an additional 6 buildings in the CAIP
- Continued interim action plans and implemented interim measures at Buildings 680 and 941

DC to Soil Pathway

- Performed interim measures/installed long-term barriers at 5 decision units (DUs) to address elevated concentrations of dioxins and furans;
- Conducted soil sampling of decision units (DUs) in Zone 5
- Conducted confirmation sampling in Zone 4
- Conducted soil sampling at the greenbelt and areas with imported topsoils across the site to update the Direct Contact Conceptual Site Model (CSM) for the Midland facility
- Conducted 10% triplicate sampling for vegetated caps closed by Dow
- Arsenic triplicate sampling for DUs with arsenic results that exceeded the projected lower confidence level based on dioxins and furans results
- Completed barrier design clarification sampling to further delineate impacts observed during initial sampling event or confirmation sampling event
- Baseline sampling for remedy areas to establish new baseline concentrations where remedy was completed
- Evaluated results and identified a path forward based on the results

On-site Outdoor Air Pathway

- Completed Soil Volatilization to Ambient Air evaluation for all DC Zones 1 - 5
- Completed Particulate Soil Inhalation evaluation for all DC Zones 1 - 5

SDF

- Completed design plans for Cell 1 Drainage Restoration Work
- Completed design of monitoring system to evaluate results and leachate levels vs. outside compliance well static water levels (SWLs)

Poseyville Landfill

- Conducted plume analytics to provide further clarification and delineation of the northeast plume
- Modified pump rates in response to observed environmental conditions and completion of slurry wall
- Continued additional monitoring of wells 2549, 5924, and 5923 to support plume modeling

- Continued well monitoring program to ensure proper well conditions in 2690A and 2917
- Analyzed pump and chemical data to assist in optimization 2690A and 2917
- Completed upper section of tile to along the southern perimeter
- Elevated electrical equipment controlling LS#201
- Investigated and conducted remedy at areas impacted by flood event

Northeast Perimeter

- Completed high-resolution conceptual site model (HRCSM) using Environmental Sequence Stratigraphic (ESS) analysis to provide further clarification on the plume areas and pathways prior to finalizing the workplan for the next phase of the field effort
- Completed analysis of groundwater analytical results to assess status of reductive chlorination in 6175 and 6178 plume areas
- Completed basis for fieldwork necessary to complete data gaps and move forward with monitoring network redesign

CD3

- Conducted bi-monthly investigation including sampling at 5 groundwater wells, and SWLs at 6 groundwater wells to assess potential off-site concentrations above GSI criteria

7th Street Purge Wells Area (Fuel Oil Tank Farm)

- Continued monitoring MW-18 and additional support wells in order to further assess noted GSI exceedances

Mark Putnam AOC

- Measured groundwater elevations from January – March
- Performed comparison of 2019 soil metals results to soil background values
- Incremental composite sample results were evaluated with a comparison to the Michigan Part 201 Soil Direct Contact criteria.

Former Ash Pond AOC

- Conducted project specific meetings with EGLE to explain site characteristics, data screening and recommended path forward
- Prepared additional sampling workplan including to address the shallow groundwater to the wetland GSI pathway
- Completed Part II of Remedial Action Plan (RAP)/Corrective Measures Implementation (CMI)

The following sections describe the work conducted in 2020 and planned 2021 priority corrective actions that will be implemented:

- Section 3.0 Revetment Groundwater Interception System
- Section 4.0 1925 Landfill
- Section 5.0 Midland Plant Facility-Wide Vapor Intrusion Pathway
- Section 6.0 Midland Plant Facility-Wide Direct Contact to Soil Pathway
- Section 7.0 On-Site Outdoor Air Pathway
- Section 8.0 Sludge Dewatering Facility
- Section 9.0 Poseyville Landfill
- Section 10.0 Northeast Perimeter
- Section 11.0 Chemical Disposal Well 3
- Section 12.0 7th Street Purge Wells Area (Fuel Oil Tank Farm)
- Section 13.0 Mark Putnam Road AOC
- Section 14.0 Former Ash Pond AOC
- Section 15.0 2021 Conceptual Schedule

3.0 RGIS Upgrades

The RGIS was originally installed between 1980 and 1992 along the banks of the Tittabawassee River and around the Tertiary Pond in Midland Plant. Starting in 1994, sections of RGIS were upgraded to enhance performance and extend their operational life. The last upgrade was in 2016 and included tile replacement between LS#13 and MH3A as well as riverbank capping from LS#102 through the area of tile replacement.

The next planned upgrade project is designated as the RGIS LS #104 to LS #105 Tile Upgrade Project (Figure 3-1). Major tasks to support this work were completed in 2016 to support the design and planning of these construction activities including a hydrogeological soils investigation and chemical characterization of soils. Chemical characterization data was also collected and submitted in previous quarterly environmental reports. Soils were investigated by completing 10 geotechnical soil borings ranging in depth from 18 to 38 ft below ground surface (bgs). A field geologist identified the soils by logging with continuous split-spoon sampling. Soil boring logs were included in the *2017 Annual Corrective Action Implementation Summary Report and 2018 Work Plan* (2017 CAIP). Twenty-three soil samples were obtained using split-spoon liners and tested for index properties to establish ranges of key design parameters.

All work will be performed in accordance with the detailed specifications that have been used and approved by the MDEQ on past RGIS upgrade projects, as well as Appendix A of Attachment 19 of the Operating License issued September 25, 2015.

The major scope items proposed for this project include:

- Installation of a new concrete sump/lift station to replace existing Lift Station #105;
- Installing just under 2,300 ft of new 8-inch diameter, SDR 21, perforated, high-density polyethylene (HDPE) pipe and drainage media;
- Constructing four new piezometer clusters, including automated primary piezometers;
- Installation of a composite cap and access roadway over the drainage media; and
- Use of a temporary gravel construction roadway outboard the existing sheet piling for access during construction.

Dow currently anticipates initiating construction in the near term; however, that is dependent upon other projects, including the work at 1925 landfill described in Section 4.0. Dow expects to complete this work over two construction seasons. The first year will likely include installation of the new lift station and approximately 30% of the drainage media and perforated pipe, composite cap and relevant piezometer clusters. The second year of construction will complete the installation of the drainage media, composite cap and relevant piezometer clusters. At both the end of the first construction season and the end of the project, the site will be restored prior to the winter.

The Project Site is located along the Eastern bank of the Tittabawassee River, approximately 940 ft downstream of the Dow Dam in Section 28 of Midland Township (T14N, R2E), Michigan (Figure 3-1). The Site includes an approximately 2,277-foot (ft) excavation beginning roughly at existing LS #104 and extending southeast to new LS #105, being the new proposed downstream leg for LS #104 and upstream leg for LS #105. The site ranges in elevation from 595 to 598 ft (referenced to North American Vertical Datum [NAVD] 29). This project will help prevent upland groundwater from migrating to the Tittabawassee River.

A new groundwater collection tile and permeable cutoff wall (french drain) will be installed by excavating an approximately 30-inch wide trench and installing filter stone (drainage media) and an 8-inch perforated HDPE collection pipe (tile). The upper portion of the trench will be backfilled with natural soils that were excavated and stockpiled from the trench. The natural soils backfill portion of the system will be isolated from the drainage media by a geosynthetic clay liner (GCL). Design drawings were previously included in the 2017/2018 CAIP.

4.0 1925 Landfill

The Dow Chemical Company's (Dow's) 1925 Landfill is located within the Dow Midland Plant Site in Midland, Michigan, and was used for general landfill operations and wastewater solids management prior to the present-day landfill sites. 1925 Landfill is within the contiguous property boundary of Dow, located on the south side of the main Dow industrial complex located in Midland, Michigan. The landfill is bordered on the south by the Tittabawasse River, and by the Dow manufacturing facility to the north (Figure 4-1).

The 1925 Landfill is underlain by naturally-occurring, low-permeability lacustrine clay and glacial tills which serve as a barrier to vertical migration of waste constituents, and is located upgradient of the Midland Plant's RGIS along the north (or east) bank of the Tittabawassee River. The RGIS lowers the groundwater elevation below river level and therefore collects groundwater from the Midland Plant Site, including any groundwater flowing from the 1925 Landfill.

The areal extent of the Landfill covers several distinct areas: the 8-Pond; the former Diversion Basin; the 1005 Hill; and Michigan Operations' Environmental Operations area that includes the current 32 Incinerator. These areas, depicted on Figure 4-2, were utilized for varying purposes and were closed and brought to grade, then covered with clay, asphalt, or concrete to minimize infiltration. The areas covered with earthen caps were closed as landfills in the late 1960s to early 1980s utilizing a minimum of two (2) feet of compacted clay. Additionally, there is an area where Localized Elevated Levels (LELs) of 2,3,7,8 – TCDD (TCDD) were identified by a study conducted in 1984 within the 1925 Landfill area called LEL III (and two additional areas identified and named LEL I and LEL II adjacent to the landfill area).

EGLE periodically inspects Final Cover over capped areas at the Dow facility including 1925 Landfill. On June 27, 2007, MDEQ (now EGLE) conducted a Final Cover Inspection of the LEL Sites II and III and portions of 1925 Landfill and provided subsequent written documentation of the inspection dated September 28, 2007. As part of that inspection MDEQ recommended corrective measures to address an area of apparent seepage in the 1925 Landfill. As a response Dow initiated a hydraulic investigation to determine the source of the seepage and in November 2008 submitted the 1925 Landfill Pilot Corrective Action Study documenting the results of the hydrogeologic evaluation and proposed corrective actions to address the seepage. The study noted that while the active seepage from this area appeared to be under control, excess hydraulic head was observed in this area and the underlying cause of the seepage would be addressed and the focus of a Pilot Corrective Action Study. The study design and implementation is discussed further in Section 4.1.

Subsequently, in 2010, in accordance with the Part XII Compliance Schedule attached to Dow's Facility Operating License issued on June 12, 2003, Dow prepared an updated Corrective Action Monitoring and Maintenance Program (CAMMP) for the 1925 Landfill. The CAMMP provides a plan for long-term monitoring and maintenance of the 1925 Landfill, including routine inspection of the landfill cap for erosion and settlement, and hydraulic monitoring in accordance with the requirements of the pilot study. Monitoring and maintenance of LEL III specifically is addressed in a separate Post-Closure Maintenance and Monitoring Plan (PCLMP) that was also developed pursuant to the Part XII Compliance Schedule attached to Dow's 2003 Facility Operating License.

4.1 Summary of 2008 Pilot Corrective Action Study

The objective of the 2008 Pilot Corrective Action Study was to reduce the hydraulic head within the 1925 Landfill pilot study area to an elevation below the ground surface. The plan to accomplish the reduction in head was the installation of a willow and aspen tree plot planted to supplement existing vegetation. It was expected that the trees would increase transpiration and reduce the volume of water infiltrating into the landfill. It was anticipated that the piezometers in and adjacent to the phytoremediation plot would show a long-term downward trend in groundwater elevations.

Eleven (11) soil borings were completed, with installation of 17 piezometers, including 6 vertical clusters (see Figure 4-3) and water levels readings taken from the piezometers. A groundwater contour map was prepared utilizing these data, and it is presented as Figure 4-4. To observe vertical hydraulic gradients, a hydrologic cross section was also prepared, and is presented as Figure 4-5.

Groundwater contour data and the hydraulic cross section prepared for the study indicate two distinct areas of ground water recharge. The data found that water is migrating downward both to the north and south from these recharge areas. Groundwater seeping to the south is captured by the Revetment Groundwater Interception System (RGIS). Groundwater seeping to the north appeared to be migrating in the direction of one of the plant sewer lines (Figure 4-6).

The first area of groundwater recharge identified was immediately adjacent to MW-3 vertical piezometer cluster at the apex of the 1925 Landfill Cap. This is expected and represents a normal condition for this type of closed waste management unit. A second area of groundwater recharge was located just to the north of MW-4 vertical piezometer cluster. This area of recharge was likely the underlying cause of historical seepage adjacent to piezometer PZ-2 (the area identified during the June 27, 2007 Final Cover Inspection and area of concern in the September 30, 2020 Final Cover Inspection).

A simplified conceptual site model of the 1925 Landfill in this area was prepared (Figure 4-7). This model indicates that potential sources of inflow into the landfill area are from other groundwater seepage and infiltration through the cap. Based on the downward vertical gradients within most of the landfill area, it was considered unlikely that seepage from beneath the landfill area significantly contributed to the hydraulic head within the landfill. Therefore, infiltration through the cap was hypothesized to provide the main contribution of hydraulic head within the landfill.

Utilizing the conceptual site model, corrective measures to reduce the hydraulic head in the landfill could be accomplished by reducing the main hydraulic inputs to the landfill. This could be accomplished by the following:

- Increasing the runoff
- Increasing the evapotranspiration; and/or
- Decreasing the infiltration.

The Pilot Corrective Action Plan was proposed to reduce the hydraulic head within the landfill area to an elevation below the ground surface by increasing evapotranspiration in the area of PZ-2. This would effectively eliminate the potential for seepage through the cap. A stand of approximately 650 willow trees was planned to be installed by planting willow shoots approximately 18" below ground surface on 10-foot centers over approximately 1.5 acre area which overlapped the groundwater recharge area identified adjacent to the MW-4 vertical piezometer cluster (see Figure 4-8). In addition to the tree stand, several piezometers were installed in the area to allow for water level monitoring (Figure 4-9).

4.1.1 Post 2008 Phytoplot Progress

Maintaining and establishing growth of the phyto-remediation plot after 2008 proved more challenging than anticipated, requiring the replanting a significant number of trees each growing season for the first few years after the initial planting. Damage by deer on site killed many initial saplings and in subsequent years more mature trees that also required replacement. Ultimately a fence was installed around the phytoremediation plot to minimize deer damage. In addition, establishing robust growth of the willows within the heavy clay cap and underlying fill proved more difficult than expected. Modifications were made to planting method to provide a larger area of topsoil around the base of planted trees which enabled better tree survival but may have also inadvertently enabled some increased infiltration. Both issues delayed the establishment of a mature phytoremediation-cap.

As identified in the 2008 study a site sewer within the 1925 landfill was believed to be a potential receptor of groundwater within the landfill. In 2013 this sewer was replaced with a lift station and aboveground sewer across the landfill to eliminate a source of contaminated groundwater that infiltrated the sewer within the landfill and caused elevated and undesirable loading of certain contaminates to the site wastewater treatment plant (Figure 4-6). The old sewer within the landfill was plugged and abandoned. Abandonment of the old sewer likely eliminated a conveyance for groundwater removal and reduced ability to manage hydraulic head within the landfill.

When the phytoremediation-cap was established it was anticipated that the piezometers in and adjacent to the phytoremediation plot would show a long-term downward trend in groundwater elevations. The Pilot Corrective Action Plan included a commitment to propose further corrective measures to reduce the hydraulic head within the 1925 Landfill to an elevation below ground surface if it became clear that the objective could not be achieved utilizing the phytoremediation-cap.

Performance monitoring has evolved since initial implementation and the current monitoring program, included in the most recent version of the SAP REV8A, includes quarterly static water level monitoring throughout most of the year, with monthly measurements May thru August. Hydraulic monitoring data has been summarized and reported each quarter in the Quarterly Michigan Operations Environmental Monitoring Report.

Generally, hydrographs for the piezometers in the area, specifically for PZ-2, do not demonstrate an apparent reduction in head since the implementation of the phytoremediation-cap. However, routine inspections since the installation of the phytoplot have found that the active seepage from this area is under control even though the excess hydraulic head which was the underlying cause of the seepage remains. Additional corrective measures to address the hydraulic head are warranted.

4.2 Work in 2020

As a part of routine inspections, EGLE conducted a Final Cover Inspection of the “Sites Northwest” 1925 Landfill Caps, LELs I-III on August 12, 2020, and provided subsequent written documentation of the inspection dated September 30, 2020. Corrective measures identified and required by EGLE included development and submittal of a plan to address the potential for leachate breakouts in the PZ-2 area of the 1925 Landfill Cap. This condition was driven by a review of the hydrographs of the monitored piezometers, specifically for PZ-2, since the installation of the phytoplot. The PZ-2 area noted in the 2020 EGLE inspection report was part of the target area for corrective action identified in the November 2008, 1925 Landfill Pilot Corrective Action Study and does not currently demonstrate a reduction in head.

4.2.1 Interim Measures

Dow provided an initial response to the 2020 Final Cover Inspection Report in December 2020. In the response Dow proposed the following immediate actions to manage the risk of leachate seepage near PZ-2.

- Implementation of monthly visual inspections of the cap in the area surrounding PZ-2 to monthly to monitor for leachate outbreaks;
- Implementation of monthly static water level readings of the 1925 Landfill Hydraulic Monitoring Program monitoring wells and piezometers; and
- Restriction of access in the area north of the phytoplot including the area surrounding PZ-9i, PZ-2, and PZ-6 with temporary fencing until further response activities can be completed.

These actions were implemented beginning in December 2020.

4.3 Path Forward

As described in the initial response to EGLE, Dow has prepared additional tasks as part of a workplan to be completed in 2021 to inform and complete additional corrective actions at 1925 Landifll. Work in 2021 will focus on achieving the following objectives:

- Conduct a comprehensive evaluation of existing site data including known lithology of the installed monitoring wells and piezometers and trends in leachate levels to assess the adequacy of the 2008 CSM;
- Develop a water balance model to assess water infiltration rates through the existing cap;
- Evaluate current conditions and expected versus existing evapotranspiration rates from the existing phytoremediation plot;
- Conduct an overall data gap analysis and collect additional field data as required to close data gaps for completion of the tasks listed above;
- Reassess and propose updates as necessary to the current 1925 Landfill CAMMP and SAP; and
- Based on the results of these evaluations assess the feasibility of potential options to increase evapotranspiration from the phytoremediation plot, increase leachate removal through other means and/or reduce infiltration through the cap in order to reliably prevent the potential for leachate outbreaks near PZ-2.

It is anticipated that some of these tasks will not be able to be completed or begin until 2022 when necessary predecessor tasks are completed. Additional actions will be taken based on this evaluation to either improve performance of the phytoremediation plot or identify and implement an alternative approach to manage leachate level.

Work in 2021 is anticipated to be completed in accordance with the milestone schedule presented in Section 15.0. Unless otherwise necessary or requested plans or findings will be provided during periodic progress meetings, which are scheduled to occur on an approximately monthly basis. Annual updates detailing the work completed and projected for the next year will be presented in the annual CAIP.

5.0 Midland Plant Facility-Wide Vapor Intrusion Pathway

The intent of the vapor intrusion (VI) evaluation process is to achieve the human exposures controlled environmental indicator (EI) determination. A "Current Human Exposure Under Control" determination is a means of evaluating the acceptability of current site conditions and interim milestones met and does not address whether corrective action is complete at the site, whether remedial long-term goals are met or whether site conditions will be protective if land uses change in the future. Furthermore, this evaluation process determines if the VI pathway is considered "complete" for each building. If the evaluation process concludes that there is a complete VI pathway for a building, further analysis is conducted to assess potential human exposure to determine whether there is a basis for undertaking a response action.

As the Midland Plant site is an active chemical production facility with many chemicals stored and/or routinely used in the buildings, it was anticipated that in many cases concentrations of vapor-forming chemicals present in the indoor environment may be primarily due to the active occupational setting. Investigation and assessment using a weight of evidence approach in the VI evaluation process has proven that this is true in 86% of the 77 occupied buildings sampled to date. If it is determined that the chemical concentrations of vapor-forming chemicals present in the indoor environment are due to use or storage within the building or facility, then the Michigan Compiled Laws Section 324.20120a(18) is appropriate to demonstrate compliance with indoor air inhalation criteria. Under these circumstances, the Occupational Exposure Limits (OELs) are the appropriate risk-based levels to assess potential human exposure and will comply with MIOSHA requirements.

If it is determined that the presence of the chemical is related to a historic environmental release, then the VI evaluation process will utilize the June 22, 2018 EGLE 12 hour Site-Specific Volatilization to Indoor Air Criteria (EGLE SSC) and the August 2017 Media-Specific Volatilization to Indoor Air Time-Sensitive Recommended Interim Action Screening Levels ($TSRIASL_{12}$) to further assess potential human exposure to that concentration.

5.1 VI Pathway Methodology and Program Update

Currently, the facility has approximately 700 buildings and structures on-site. Indoor air at the facility is being evaluated in a phased approach by zone using a building categorization procedure to consider a worst-case approach that prioritizes buildings for investigation based on building characteristics and occupancy and uses a weight of evidence framework for assessing the VI pathway.

The facility has been broken up into zones shown on Figure 5-1. The building categorization flowchart is presented on Figure 5-2. Category 1 and 2 buildings are considered “priority buildings” and are being sampled throughout the facility as work progresses in each Zone. Category 3 buildings are deferred until all priority buildings are sampled and evaluated. Category 4 and 5 buildings are not sampled or included in the VI investigation. All buildings categorized to date are listed in Table 5-1. The 2018 Revised VI Workplan (August 2018) documented the general programmatic sampling and evaluation methodology. The updated *Process for Evaluating VI and Determination of Path Forward Flowchart* is presented on Figure 5-3. Table 5-2 shows the *Path Forward Building Group Notification and Reporting*.

A Site-Specific Chemical Facility Potential Features Conceptual Site Model (CSM) is provided as Figure 5-4. This figure illustrates general features that are specific to an active industrial chemical facility, such as potential upwind emission sources and a potential pathway from the chemical waste sewer. Detailed building-specific CSMs were developed for buildings that have completed VI seasonal confirmation sampling and are referenced within the building-specific report sections.

5.1.1 VI Sampling Methodology

Following the *Process for Evaluating VI and Determination of Path Forward Flowchart* on Figure 5-3, and the *Path Forward Building Group Notification and Reporting* in Table 5-2, Group 2 and Group 4 buildings undergo seasonal confirmation sampling, which entails four total sampling events. Seasonal sampling events account for any potential seasonal variability (i.e., spring, summer, fall, and winter). During these seasonal events, confirmation samples are collected at the same locations as the initial event (for all buildings under 43,000 square feet [ft^2]). For large buildings (> 43,000 ft^2), sampling locations may be modified in order to best investigate the subject analyte(s) of interest (AOI(s)). After completion of the four seasonal confirmation sampling events, the data is evaluated and buildings are recommended for interim monitoring, continued sampling, mitigation, or other interim or long-term actions, as necessary.

5.1.2 VI Interim Monitoring Methodology

An Interim Monitoring Plan is implemented once seasonal confirmation sampling is completed at a building until a revised program or more permanent Corrective Action Plan is developed for the site. It is anticipated that interim monitoring will be performed semi-annually for a minimum of two years at each building and then monitoring results will undergo trend analysis. If results continue to be consistent and below EGLE SSC, monitoring will be conducted on an annual basis. If indoor air results are observed to be increasing, further evaluation will be performed, which may include collection of a sub-slab soil gas sample(s) and an increase in monitoring frequency. Results from each monitoring event will shared during routine CA Status meetings with EGLE and will be reported in the annual Corrective Action Implementation Summary Report and Work Plan (CAIP).

For interim monitoring events, only IA is collected and analyzed unless additional sampling is warranted due to an exceedance of EGLE SSC. In the event an indoor air result(s) exceeds EGLE SSC, EGLE will be provided a brief email notification. A collocated indoor air and sub-slab soil gas sample will be then be collected from that location within 45 days. If the results of the collocated sub-slab soil gas and indoor air samples indicate that VI continues to be insignificant, monitoring will continue at an appropriate frequency. If the results indicate that VI is significant and confirm Group 4 conditions, the building will be moved to Group 4 for follow-up actions.

It is anticipated that Dow will propose changes to the frequency or other aspects of this Interim Monitoring Plan based on an evaluation of the data, changes in building use or implementation of other approaches to address the potential VI pathway.

5.1.3 Occupancy Change and New Construction Monitoring

Buildings originally placed in Category 3 (sampling deferred due to limited occupancy) and buildings categorized as unoccupied in Category 5B are monitored for a change in use that requires occupancy (see Figure 5-2). At a minimum, use will be verified on an annual basis. If a building becomes occupied, the building will be surveyed and considered for sampling. If sampling is warranted, the building will be documented as an “Add-on” building within the appropriate Zone.

The buildings listed in the table below have undergone occupancy changes and have been recategorized and identified as “Add-on” buildings that will be sampled and evaluated for VI as scheduling allows. The location of each add-on building is shown in its respective Zone on Figure 5-5.

Table 5.1.3-1. Buildings with Occupancy Changes

Building Number	Building Name	Category	Zone	Phase
31	31 Building	1A	Zone 2	Phase 2 - Add-on
649	Dow Automotive Warehouse	2B	Zone 3	Phase 1 - Add-on
971	Granular Form Plant & Warehouse	2B	Zone 2	Phase 1 - Add-on
1000	Building not named	2A	Zone 2	Phase 1 - Add-on
1015	Storage Warehouse	2B	Zone 2	Phase 1 - Add-on
1139	Site Logistics Warehouse	2B	Zone 2	Phase 1 - Add-on
1200	Corteva Lyte 10 Control Room and Offices	1A	Zone 2	Phase 1 - Add-on
1297	Package Boilers	2A	Zone 2	Phase 2 - Add-on
1381	DuPont – Formerly Dow Solar R&D	2B	Zone 3	Phase 1 - Add-on
1382	DuPont – Formerly Dow Solar R&D	2A	Zone 3	Phase 1 - Add-on
780/1363	Building not named	2B	Zone 2	Phase 2 - Add-on

Additionally, construction of new buildings is also monitored. Dependent upon use and location, future building sites may be initially screened for VI prior to construction. If determined that the future building type may eventually be characterized as a priority building regardless of the short term intended use, soil gas samples are typically collected from the proposed footprint. The number of soil gas samples are determined by the sample density provided in the Michigan Department of Environmental Quality (MDEQ) May 2013 *Guidance Document for the Vapor Intrusion Pathway* and will be sampled according to the methodology described in Section 2.4.2.

5.1.4 2020 VI Program Schedule

As with much of the Corrective Action work planned for 2020, the planned 2020 VI sampling program was delayed due to the unprecedented events of 2020 including the COVID-19 pandemic and the historic May flooding event.

The Spring 2020 sampling event could not be initiated and was rescheduled for Spring 2021. The Summer 2020 sampling event was limited to only include interim monitoring events and seasonal confirmation sampling at 3 buildings. The remainder of the planned Summer 2020 seasonal confirmation sampling was rescheduled for Summer 2021. Fall 2020 VI sampling was abbreviated and did not allow for all of the planned buildings to be initiated during the season.

5.1.5 Site-Wide VI Sampling and Evaluation Program Update

Throughout the program, VI has been evaluated on a building-by-building basis. In early 2019, the available data set was examined to look for findings and trends applicable across the portfolio of buildings. These data findings were presented at the 29th Association for Environmental Health and

Sciences Foundation (AEHS) conference on March 20, 2019 (Eklund, et al). The findings also were summarized in the 2019/2020 CAIP. This site-wide evaluation was updated in late 2020 using the larger data set now available.

The data set examined in 2020 includes 718 unique indoor air sampling locations across 77 buildings (versus 434 locations across 55 buildings in 2019). A total of 1,646 sample pairs (indoor air and sub-slab soil vapor) were available for these 718 locations. The samples generally have been analyzed for 65 individual volatile organic compounds (VOCs), yielding a data set of 106,990 data pairs. This is about twice as much data as was available for the 2019 evaluation.

The findings were compared with the assumptions inherent in the study. These assumptions form the null hypothesis, which in other words is the default or status quo position. The null hypothesis generally is assumed to be true until evidence indicates otherwise.

i. An attenuation factor (α) of 0.03 is appropriate for developing site-specific screening levels for sub-slab soil gas;

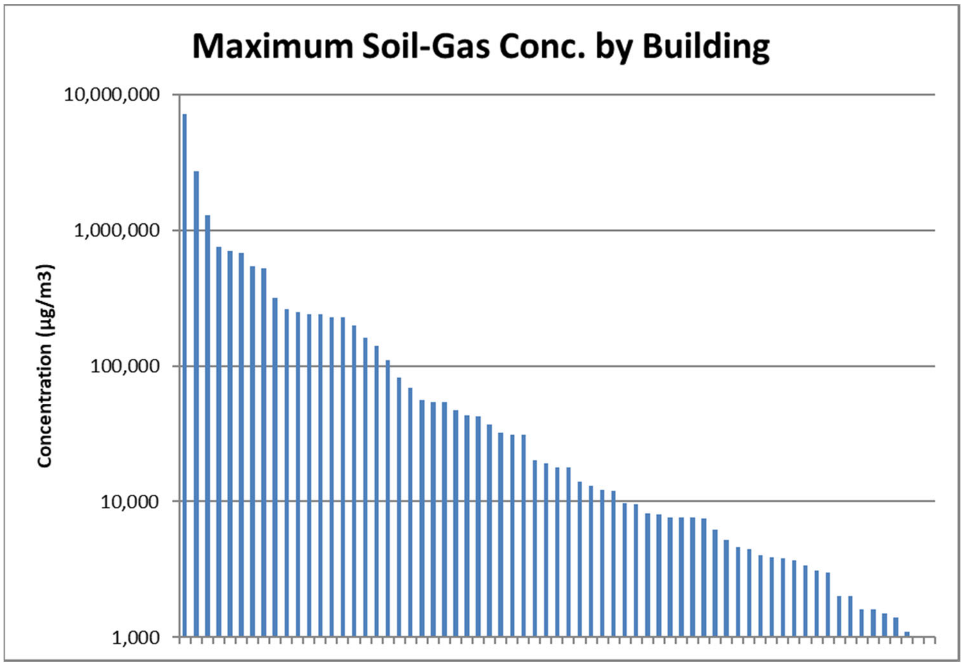
ii. Multiple rounds of testing are needed to characterize sub-slab soil gas;

iii. Paired samples (soil gas & indoor air) are needed to evaluate potential VI; and

iv. Building-specific attenuation factor will exhibit seasonal variability.

The data evaluation focused on compounds detected at a given building in soil vapor at concentrations ≥ 1,000 micrograms per cubic meter ($\mu g/m^3$) at one or more locations. This was done to minimize the upward bias in attenuation factors due to non-VI sources and therefore provide a clearer signal regarding attenuation factors and seasonal variability. This censoring of the data still resulted in a very robust data set. One or more VOCs were detected at ≥ 1,000 $\mu g/m^3$ in soil vapor at 64 of the 77 buildings. Up to 15 individual VOCs were detected at ≥ 1,000 $\mu g/m^3$ for a single building, with an average of five VOCs per building meeting this criterion. The distribution of maximum soil gas concentration is shown in Figure 5.1.5-1.

Figure 5.1.5-1. Distribution of Maximum Soil Gas Concentration by Building



There were similarities in which VOC was detected at the highest concentration for each building. One of the five VOCs listed below was the highest detection at 60 of the 64 buildings:

- Tetrachloroethene (PCE) (24 buildings);
- Chlorofluorocarbon (CFC)-12 (22 buildings);
- Xylenes (7 buildings);
- 1,1,1-Trichloroethane (TCA) (4 buildings); or
- Benzene (3 buildings).

Buildings tended to have one or more “hot spots” or locations with relatively high concentrations whereas other areas were relatively clean; i.e., spatial variability was large. This is consistent with the source of vapors being historical releases at or very near the building rather than the source of vapors being a groundwater plume that has migrated to the vicinity of the building.

The results show that the detected soil-vapor concentrations were relatively constant across all four seasons of testing. Examples for three buildings are shown in Figures 5.1.5-2, 5.1.5-3 and 5.1.5-4, with multiple locations and multiple VOCs shown for each building.

No buildings exhibited an upward trend in soil-gas concentration over multiple rounds of testing. The data were reviewed to determine what the effect would have been if only the first round of testing had been performed. It was generally found that this would introduce a potential bias of a factor of four or less. In other words, subsequent testing did not provide appreciably different information for the vast majority of buildings, where one or more analytes exceeded screening levels by a large amount. This suggests that one or two rounds of testing are sufficient to characterize soil gas and that seasonal variability could be evaluated by testing only indoor air.

Figure 5.1.5-2. Soil-Vapor Concentration vs. Season for Building 1335

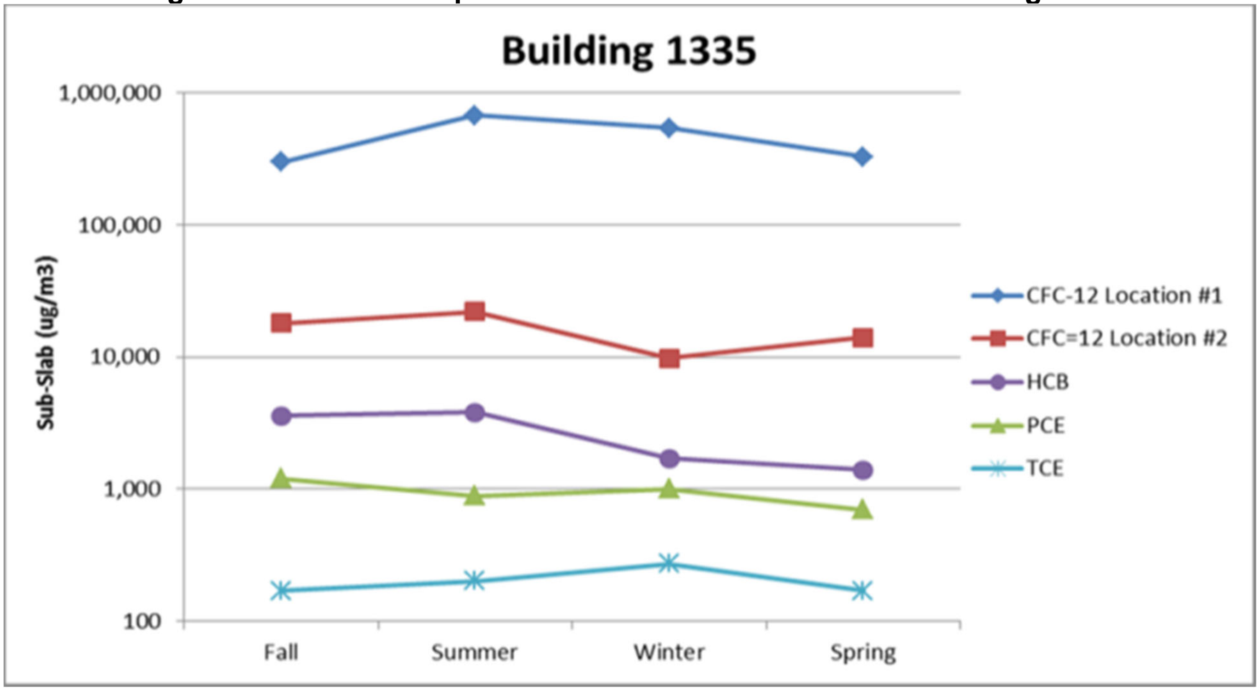


Figure 5.1.5-3. Soil-Vapor Concentration vs. Season for Building 462

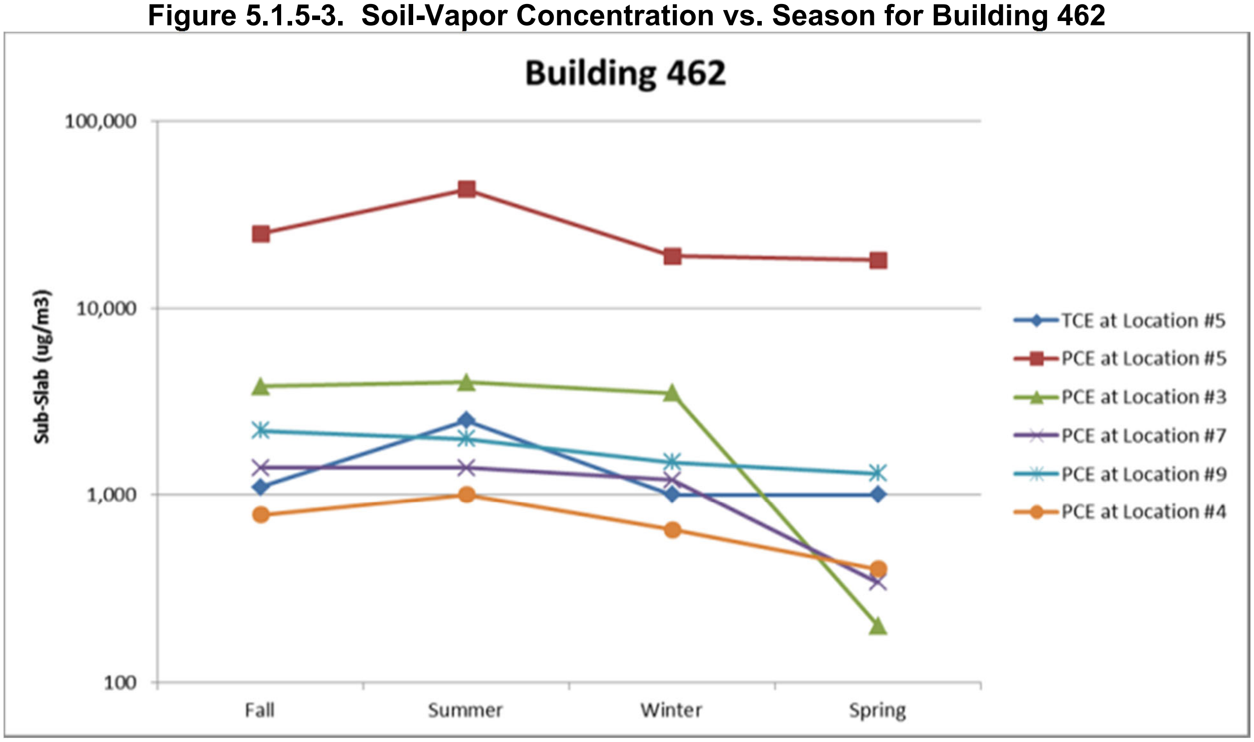
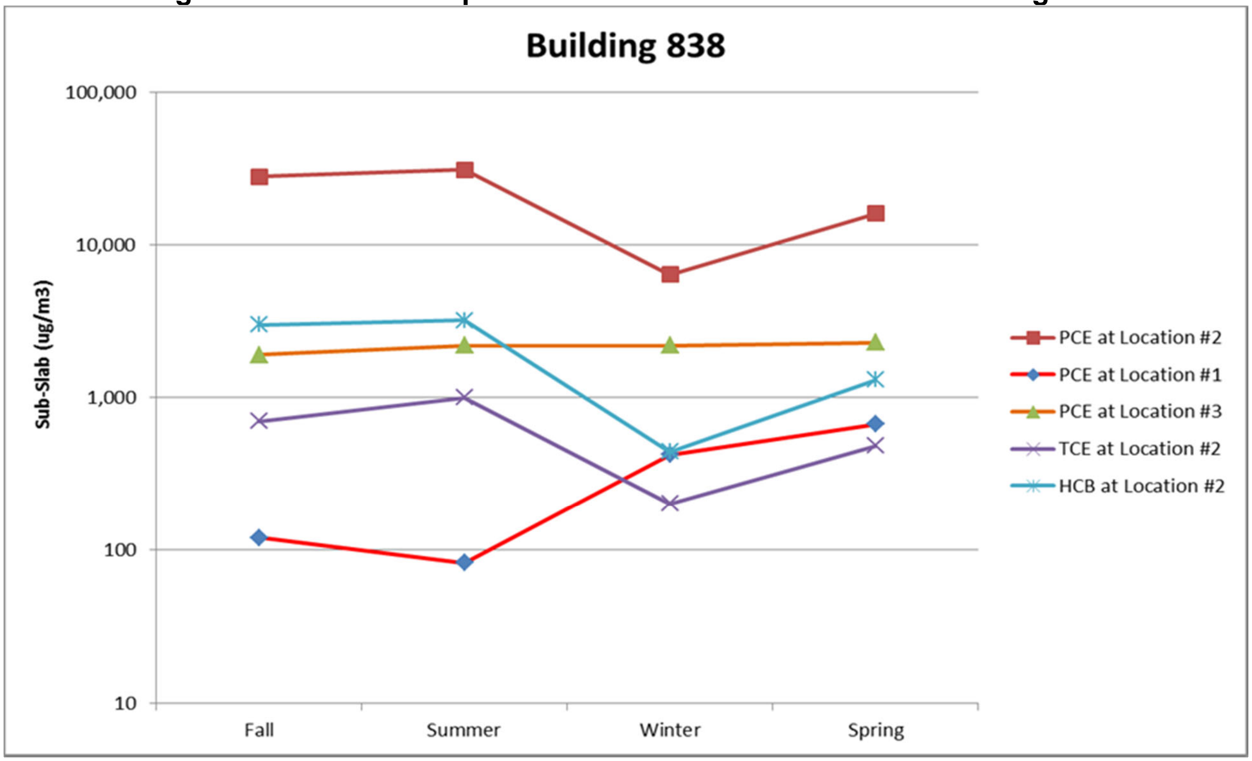


Figure 5.1.5-4. Soil-Vapor Concentration vs. Season for Building 838



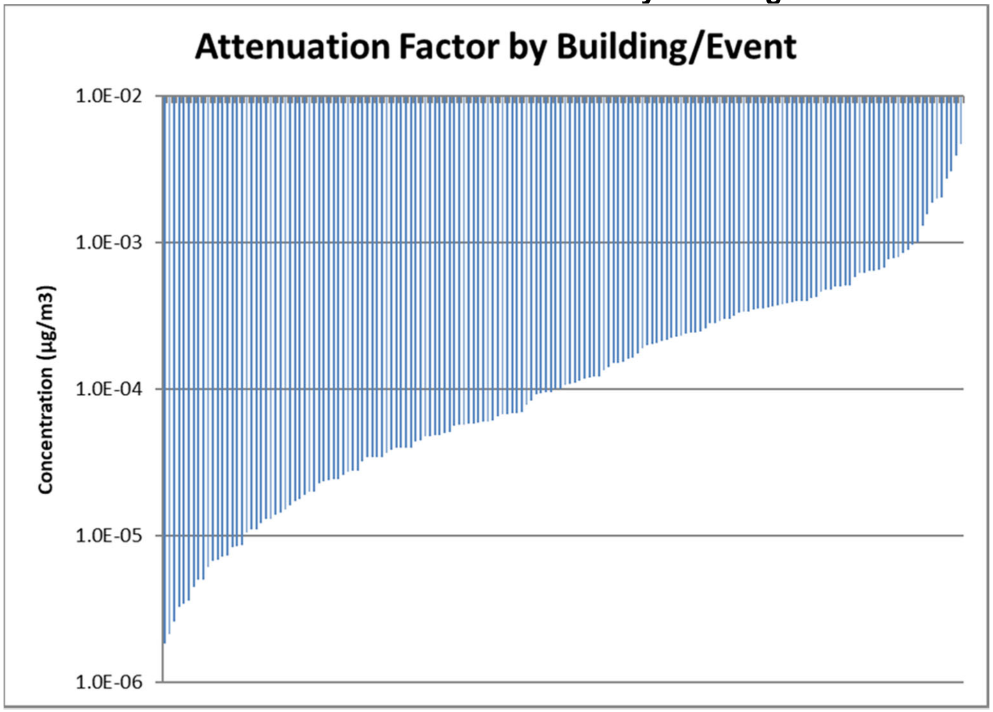
The evaluation of attenuation factor also focused on buildings with soil-gas concentrations ≥ 1,000 μg/m^3. Attenuation factors were calculated for each building using maximum values for the building (other options would have been to use average values or to calculate an attenuation factor for each data pair). This approach avoided issues with varying detection limits and relatively small data sets for a given building. The indoor air results were not adjusted for outdoor air contribution except where obvious bias was introduced by outdoor air. Data for all VOCs were examined and a building-specific attenuation factor was developed for each round of testing.

The data set was reviewed to find the smallest attenuation factor for each building for each round of testing. This value was assumed to best represent the actual attenuation at that building and was termed the "building-specific" attenuation factor. Other VOCs at the same building often exhibited a similar degree of attenuation but where less attenuation was observed this generally appeared to be the result on indoor emission sources.

A total of 166 building-specific attenuation factors were calculated. The results yield the distribution shown in Figure 5.1.5-5. There were no values as high as the default assumption of 0.03 and the few values that were > 1E-03 had identifiable causes (e.g., indoor emission sources). If those suspect values are excluded, the median value was 9.2E-05 (i.e., 326-times more attenuation than the assumed value).

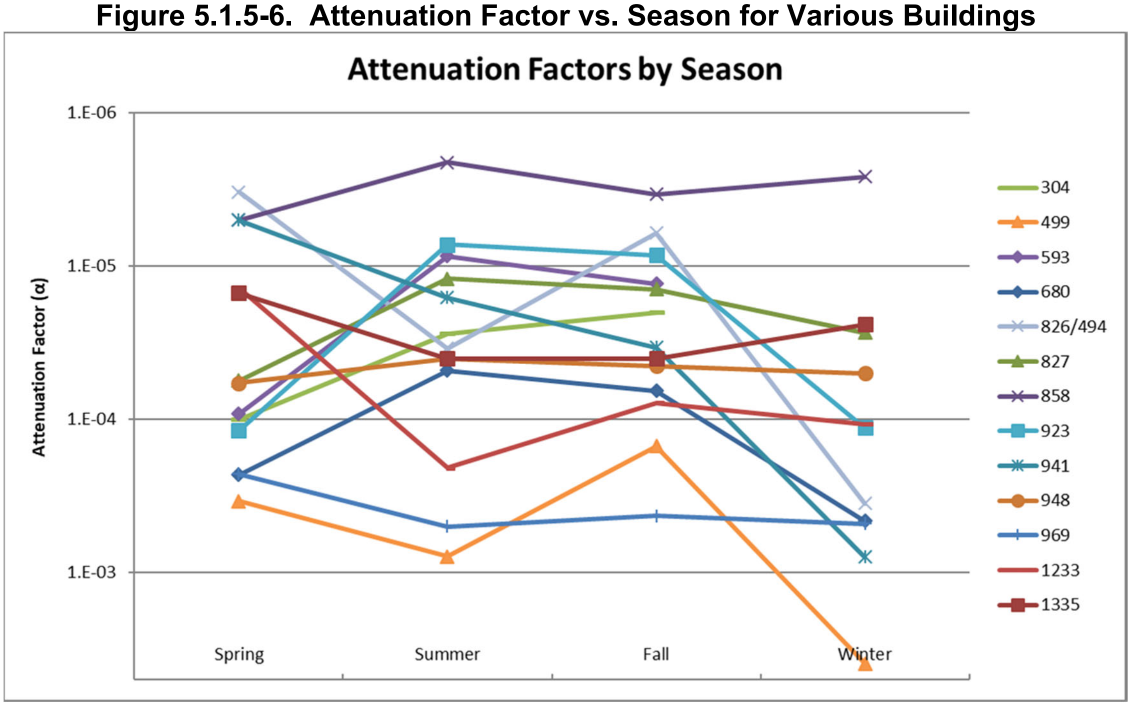
The average value (i.e., 1.8E-04) was similar to the median value (i.e., 9.2E-05) indicating that the data set had a normal distribution and was not skewed. The 95% UCL was calculated to be 2.16E-04.

Figure 5.1.5-5. Distribution of Attenuation Factor by Building & Round of Testing



The attenuation factors as a function of season are shown in Figure 5.1.5-6. There is some evidence of lesser attenuation during wintertime for some buildings. Given that the soil gas concentrations exhibited relatively little variability, this lesser attenuation during winter would be due to higher rates of vapor entering the buildings. The most likely cause would be changes in differential pressure (ΔP) across the building slabs caused by temperature gradients.

Figure 5.1.5-6. Attenuation Factor vs. Season for Various Buildings



The examination of data on a site-wide basis showed that certain findings were consistent across the entire portfolio of buildings. The findings of the site-wide evaluation were:

1. Sub-slab soil vapor is not homogenously distributed beneath buildings;
2. Seasonal variability in soil-vapor concentrations is minimal;
3. Four rounds of testing do not provide substantially more information regarding soil vapor than one round of testing;
4. Attenuation factors of 0.03 over-predict indoor air impacts by orders of magnitude; and
5. Less attenuation observed under wintertime conditions at some buildings.

Additional information about seasonal variability is given in the data trends analysis for Buildings 680 and 941. These are the two buildings with the most rounds of seasonal confirmation sampling. At Building 680 there have been 10 rounds of testing and at Building 941 there have been 11 rounds of testing. For comparison, the next most studied buildings are Building 34 and Building 827, where seven rounds of test results are available.

5.1.6 VI Sampling Status Summary

The following table summarizes the status and path forward building group for each of the priority buildings sampled to date. All buildings that have undergone VI sampling in Zone 1 though Zone 4 are included in Table 5.1.6-1 below.

Table 5.1.6-1. VI Status and Path Forward Summary

Category[A]	Building	VI Path Forward Group[B]	Report Section	Status
Zone 1				
Category 1	1078	1	--	NFA at this time
Category 1	1100	1	--	NFA at this time
Category 1	1358	1	--	NFA at this time
Category 1	3303	1	--	NFA at this time
Category 1	34	2	5.2.1	Seasonal confirmation sampling complete and evaluated in 2018 CAIP. Interim monitoring plan implemented for semi-annual indoor air sample collection.
Category 1	1335	2	5.2.2	Seasonal confirmation sampling complete and evaluated in 2018 CAIP. Interim monitoring plan implemented for semi-annual indoor air sample collection.
Category 2	T1561	1	--	NFA at this time
Category 2	462	2	5.2.3	Seasonal confirmation sampling complete and evaluated in 2018 CAIP. Interim monitoring plan implemented for semi-annual indoor air sample collection.
Category 2	680	4B	5.2.4	Interim action plan/seasonal confirmation sampling continues. Updated trend analysis, summary of further investigation activities (March and May 2019) and interim measures (IMs) complete to date discussed herein.
Category 2	838	2	5.2.5	Seasonal confirmation sampling complete and evaluated in 2018 CAIP. Interim monitoring plan implemented for semi-annual indoor air sample collection.

Category[A]	Building	VI Path Forward Group[B]	Report Section	Status
Category 2	1098	2	5.2.6	Seasonal confirmation sampling complete and evaluation included herein. Interim monitoring plan implemented for semi-annual indoor air sample collection.
Category 2	1159	3	--	Evaluation provided in 2018 CAIP. Further Investigation activities conducted in July 2019. No evidence of VI.
Zone 2 Phase 1				
Category 1	1	1	--	NFA at this time
Category 1	972	1	--	NFA at this time
Category 1	833	3	--	Evaluation provided in 2018 CAIP. Further Investigation activities conducted in July 2019. No evidence of VI.
Category 1	941	4B	5.3.1	Expedited Building Summary (EBS) submitted August 2018. Air filtration unit installed. Interim action plan/seasonal confirmation sampling continues. Trend analysis, summary of further investigation activities (March and May 2019) and IMs complete to date discussed herein.
Category 1	1028	2	5.3.2	Seasonal confirmation sampling complete and evaluated in 2019 CAIP. Interim monitoring plan implemented for semi-annual indoor air sample collection.
Category 1	1233	2	5.3.3	Seasonal confirmation sampling complete and evaluated in 2019 CAIP. Interim monitoring plan implemented for semi-annual indoor air sample collection.
Category 1	827	4A	5.3.4	Further investigation conducted in May and July 2019. Seasonal confirmation sampling complete and evaluated in 2019 CAIP. Interim monitoring plan implemented for semi-annual indoor air sample collection.
Category 2	477	1	--	NFA at this time
Category 2	489	1	--	NFA at this time
Category 2	934	1	--	NFA at this time
Category 2	948	4A	5.3.5	Further investigation conducted in July 2019. Seasonal confirmation sampling complete and evaluated in 2019 CAIP. Interim monitoring plan implemented for semi-annual indoor air sample collection
Category 2	1025	2	--	Building on Demolition List
Category 2	768	2	5.3.6	Seasonal confirmation sampling complete and evaluated in 2019 CAIP. Interim monitoring plan implemented for semi-annual indoor air sample collection.
Category 2	849	2	5.3.7	Seasonal confirmation sampling complete and evaluated in 2019 CAIP. Interim monitoring plan implemented for semi-annual indoor air sample collection.
Category 2	858	4A	--	Building on Demolition List
Category 2	969	2	5.3.8	Seasonal confirmation sampling complete and evaluated in 2019 CAIP. Interim monitoring plan implemented for semi-annual indoor air sample collection.
Category 2	1222	2	5.3.9	Seasonal confirmation sampling complete and evaluated in 2019 CAIP. Interim monitoring plan implemented for semi-annual indoor air sample collection.
Category 2	1377	3	--	Evaluation provided in 2018 CAIP. Further investigation into indoor air sources will be conducted.

Category[A]	Building	VI Path Forward Group[B]	Report Section	Status
Zone 2 Phase 2				
Category 1	1130	1	--	NFA at this time
Category 1	1215	2	--	Building on Demolition List
Category 1	1255	2	5.4.1	Seasonal confirmation sampling complete and evaluated in 2019 CAIP. Interim monitoring plan implemented for semi-annual indoor air sample collection.
Category 1	1314	1	--	NFA at this time
Category 2	304	4A	5.4.2	Further investigation conducted in October 2019. Seasonal confirmation sampling complete and evaluated in 2019 CAIP. Interim monitoring plan implemented for semi-annual indoor air sample collection.
Category 2	388	1	--	NFA at this time
Category 2	499	4A	5.4.3	Further investigation conducted in May 2019. Seasonal confirmation sampling complete and evaluated in 2019 CAIP. Interim monitoring plan implemented for semi-annual indoor air sample collection.
Category 2	593	4A	5.4.4	Further investigation conducted in October 2019. Seasonal confirmation sampling complete and evaluated in 2019 CAIP. Interim monitoring plan implemented for semi-annual indoor air sample collection.
Category 2	779	1	--	NFA at this time
Category 2	826/494	2	5.4.5	Seasonal confirmation sampling complete and evaluated in 2019 CAIP. Interim monitoring plan implemented for semi-annual indoor air sample collection.
Category 2	921	3	--	Evaluation provided in 2018 CAIP. Further Investigation activities conducted in July 2019. No evidence of VI.
Category 2	922	1	--	NFA at this time
Category 2	923	4A	5.4.6	Seasonal confirmation sampling complete and evaluated in 2019 CAIP. Interim monitoring plan implemented for semi-annual indoor air sample collection.
Category 2	935	2	--	Three seasonal confirmation sampling events complete and presented in 2019 CAIP. Final event scheduled for Winter 2020/2021 (final sampling event was delayed due to building construction).
Category 2	1312	1	--	NFA at this time
Zone 3 Phase 1				
Category 1	800	1	--	NFA at this time
Category 1	887	4A	5.5.1	EBS submitted February 2019. Further investigation activities conducted May, July and October 2019. Seasonal confirmation sampling complete and evaluation included herein. Interim monitoring plan implemented for semi-annual indoor air sample collection.
Category 1	954	1	--	NFA at this time
Category 1	1038	2	5.5.2	Seasonal confirmation sampling complete and evaluation included herein. Interim monitoring plan implemented for semi-annual indoor air sample collection.
Category 1	1131	1	--	NFA at this time

Category[A]	Building	VI Path Forward Group[B]	Report Section	Status
Category 2	100	2	5.5.3	Seasonal confirmation sampling complete and evaluation included herein. Interim monitoring plan implemented for semi-annual indoor air sample collection.
Category 2	564	4A	5.5.4	Further investigation activities conducted May 2019. Seasonal confirmation sampling complete and evaluated in 2019 CAIP. Interim monitoring plan will be implemented in Winter 2020/21 for semi-annual indoor air sample collection.
Category 2	881	4A	5.5.5	EBS submitted February 2019. Further investigation activities conducted May and July 2019. Seasonal confirmation sampling complete and evaluation included herein. Interim monitoring plan implemented for semi-annual indoor air sample collection.
Category 2	1037	2	5.5.6	Seasonal confirmation sampling complete and evaluation included herein. Interim monitoring plan implemented for semi-annual indoor air sample collection.
Category 2	1042	2	5.5.7	Seasonal confirmation sampling complete and evaluation included herein. Interim monitoring plan implemented for semi-annual indoor air sample collection.
Zone 3 Phase 2				
Category 1	677		--	Building on Demolition List
Category 1	734	2	5.6.1	Evaluation of Fall 2019 sampling event provided herein. Seasonal confirmation sampling event 2 is scheduled for Winter 2020/2021.
Category 1	938	2	5.6.2	Evaluation of Fall 2019 sampling event provided herein. Seasonal confirmation sampling event 2 is scheduled for Winter 2020/2021.
Category 1	990	2	5.6.3	Evaluation of Fall 2019 sampling event provided herein. Seasonal confirmation sampling event 2 is scheduled for Winter 2020/2021.
Category 1	1018	1	5.6.4	Evaluation of Fall 2019 sampling event provided herein. NFA at this time.
Category 1	1385	2	5.6.5	Evaluation of Fall 2019 sampling event provided herein. Seasonal confirmation sampling event 2 is scheduled for Winter 2020/2021.
Category 1	439/T-1411	1	5.6.6	Evaluation of Fall 2019 sampling event provided herein. NFA at this time.
Category 1	732/1300	2/3	5.6.7	Evaluation of Fall 2019 sampling event provided herein. Seasonal confirmation sampling event 2 is scheduled for Winter 2020/2021.
Category 1	759/1350	2	5.6.8	Evaluation of Fall 2019 sampling event provided herein. Seasonal confirmation sampling event 2 is scheduled for Winter 2020/2021.
Category 2	49	4A	5.6.9	EBS submitted December 2019. Further investigation conducted in October 2019 and February 2020. Samples collected Summer and Winter of 2019 evaluated herein. Next seasonal confirmation sampling events are scheduled for Fall 2020 and Spring 2021.
Category 2	146	2	5.6.10	Evaluation of Fall 2019 sampling event provided herein. Seasonal confirmation sampling event 2 is scheduled for Winter 2020/2021.
Category 2	180	1	5.6.11	Evaluation of Fall 2019 sampling event provided herein. NFA at this time.

Category[A]	Building	VI Path Forward Group[B]	Report Section	Status
Category 2	298	2	5.6.12	Evaluation of Fall 2019 sampling event provided herein. Seasonal confirmation sampling event 2 is scheduled for Winter 2020/2021.
Category 2	374	1	5.6.13	Evaluation of Fall 2019 sampling event provided herein. NFA at this time.
Category 2	464	4B	5.6.14	EBS submitted March 2020. Evaluation of Fall 2019 and Summer 2020 sampling events provided herein. Next seasonal confirmation sampling event is scheduled for Winter 2020/2021. Further investigation activities will be conducted.
Category 2	638	2	5.6.15	Evaluation of Fall 2019 sampling event provided herein. Seasonal confirmation sampling event 2 is scheduled for Winter 2020/2021.
Category 2	774	2	5.6.16	Evaluation of Fall 2019 and Summer 2020 sampling events provided herein. Next seasonal confirmation sampling event is scheduled for Winter 2020/2021.
Category 2	1269	1	5.6.17	Evaluation of Fall 2019 sampling event provided herein. NFA at this time.
Category 2	27/313/803	2	5.6.18	Evaluation of Fall 2019 and Summer 2020 sampling events provided herein. Next seasonal confirmation sampling event is scheduled for Winter 2020/2021.
Category 2	458/963	2/3	5.6.19	Evaluation of Fall 2019 sampling event provided herein. Seasonal confirmation sampling event 2 is scheduled for Winter 2020/2021.
Category 2	542/561	2/3	5.6.20	Evaluation of Fall 2019 sampling event provided herein. Seasonal confirmation sampling event 2 is scheduled for Winter 2020/2021.
Category 2	719/1360	2/3	5.6.21	Evaluation of Fall 2019 sampling event provided herein. Seasonal confirmation sampling event 2 is scheduled for Winter 2020/2021.
Zone 3 Phase 3				
Category 1	25	TBD	5.7.1	Samples collected Fall 2020. Evaluation will be provided in 2021 CAIP. Notification and reporting following Table 5-2 will occur, as necessary, based on results.
Category 1	354	TBD	5.7.2	Samples collected Fall 2020. Evaluation will be provided in 2021 CAIP. Notification and reporting following Table 5-2 will occur, as necessary, based on results.
Category 1	433A	TBD	5.7.3	Samples collected Winter 2020/21. Evaluation will be provided in 2021 CAIP. Notification and reporting following Table 5-2 will occur, as necessary, based on results.
Category 1	574	TBD	5.7.4	Samples collected Fall 2020. Evaluation will be provided in 2021 CAIP. Notification and reporting following Table 5-2 will occur, as necessary, based on results.
Category 1	608	TBD	5.7.5	Samples collected Fall 2020. Evaluation will be provided in 2021 CAIP. Notification and reporting following Table 5-2 will occur, as necessary, based on results.
Category 1	845	TBD	5.7.6	Samples collected Fall 2020. Evaluation will be provided in 2021 CAIP. Notification and reporting following Table 5-2 will occur, as necessary, based on results.

Category[A]	Building	VI Path Forward Group[B]	Report Section	Status
Category 1	1319	TBD	5.7.7	Samples collected Fall 2020. Evaluation will be provided in 2021 CAIP. Notification and reporting following Table 5-2 will occur, as necessary, based on results.
Category 1	1354	TBD	5.7.8	Samples collected Fall 2020. Evaluation will be provided in 2021 CAIP. Notification and reporting following Table 5-2 will occur, as necessary, based on results.
Category 1	1616	TBD	5.7.9	Samples collected Fall 2020. Evaluation will be provided in 2021 CAIP. Notification and reporting following Table 5-2 will occur, as necessary, based on results.
Category 2	695	TBD	5.7.10	Samples collected Fall 2020. Evaluation will be provided in 2021 CAIP. Notification and reporting following Table 5-2 will occur, as necessary, based on results.
Category 2	856	TBD	5.7.11	Samples collected Fall 2020. Evaluation will be provided in 2021 CAIP. Notification and reporting following Table 5-2 will occur, as necessary, based on results.
Category 2	872	TBD	5.7.12	Samples collected Fall 2020. Evaluation will be provided in 2021 CAIP. Notification and reporting following Table 5-2 will occur, as necessary, based on results.
Category 2	1302	TBD	5.7.13	Samples collected Fall 2020. Evaluation will be provided in 2021 CAIP. Notification and reporting following Table 5-2 will occur, as necessary, based on results.
Category 2	433W	TBD	5.7.14	Samples collected Winter 2020/21. Evaluation will be provided in 2021 CAIP. Notification and reporting following Table 5-2 will occur, as necessary, based on results.
Category 2	433B	TBD	5.7.15	Samples collected Winter 2020/21. Evaluation will be provided in 2021 CAIP. Notification and reporting following Table 5-2 will occur, as necessary, based on results.
Zone 4				
Category 1	1710	2	5.8.1	Evaluation of Summer 2020 sampling event provided herein. Sampling will continue Winter 2020/21.
Category 1	1790	2	5.8.2	Further investigation conducted in February. Evaluation of February 2020 sampling event provided herein. Indoor air monitoring will be conducted.

[A] Figure 5-2.
[B] Figure 5-3.
CAIP - Corrective Action Implementation Summary Report and Work Plan.
EBS - Expedited Building Summary.
NFA - No Further Action.
TBD - To Be Determined.
VI - Vapor Intrusion.

5.2 Zone 1 Evaluations and Updates

The Zone 1 buildings were evaluated in the 2017 CAIP (December 2017), the 2018 Vapor Intrusion Rescreen of Zone 1 and Zone 2 Phase 1 Report (August 2018), the 2018 CAIP (January 2019), and in the 2019 CAIP (January 2020). Zone 1 sampling and/or interim monitoring results are presented for the buildings listed below in the following subsections:

- Section 5.2.1 Building 34;
- Section 5.2.2 Building 1335;
- Section 5.2.3 Building 462;
- Section 5.2.4 Building 680;
- Section 5.2.5 Building 838; and
- Section 5.2.6 Building 1098.

5.2.1 Building 34 Interim Monitoring Results Summary

Building 34 is a Category 1 building located within the southwest portion of the facility designated as Zone 1 and is known as the Rotary Kiln Incinerator Admin/Control Room. Building 34 is a Group 2 building that completed seasonal confirmation sampling in May 2018. A full evaluation and trend analysis was provided in the 2018 CAIP. All indoor air analytes were detected below screening levels during each of the seasonal confirmation sampling events. The sub-slab soil gas AOIs are trichloroethene (TCE), 1,2,4-trichlorobenzene (1,2,4-TCB), 1,3-dichlorobenzene (1,3-DCB), 1,4-DCB, hexachlorobutadiene (HCBD), and naphthalene due to exceedances of the EGLE SSC. 1,2,4-TCB also exceeded the $TSRIASL_{12}$ in sub-slab soil gas.

Based on the evaluation of the four seasonal confirmation sampling events, the VI pathway is insignificant for Building 34 and the sub-slab soil gas results demonstrated a decrease in concentrations over time. There was no evidence of increasing concentrations over time for any of the chlorinated hydrocarbons. Sufficient information exists to make a human exposure under control EI determination. However, while currently there is no evidence of potential VI, for future use, long-term monitoring (LTM) was warranted and the building-specific Interim Monitoring Plan was implemented.

Indoor air is monitored at location 34-IA-01 (see Figure 5.2.1-1). This location was selected for continued monitoring since it demonstrated the highest sub-slab soil gas results. Monitoring is performed for TCE, 1,2,4-TCB, 1,3-DCB, 1,4-DCB, HCBD, and naphthalene. Interim monitoring occurs semi-annually and the initial event was conducted in August 2019 and results were reported in the 2019 CAIP (January 2020). The indoor air results for IM Event 2 (December 2019) and IM Event 3 (August 2020) are shown below on Table 34-1.

Table 34-1. Interim Monitoring Indoor Air Results for IM Events 2 and 3 for Building 34

Indoor Air Analyte	Result Value (µg/m³)	Reporting Limit (µg/m³)	EGLE SSC (µg/m³)	NONRES $TSRIASL_{12}$ (µg/m³)	Dow IH OEL (8-hour Time Weighted Average) (µg/m³)
IM Event 2 (December 2019)					
1,2,4-Trichlorobenzene	ND	5.9	6.2	19	37,100
1,3-Dichlorobenzene	ND	0.95	9.2	28	60,100
1,4-Dichlorobenzene	ND	0.19	30	300	60,100
Hexachlorobutadiene	ND	3.4	5.4	NA	213
Naphthalene	ND	0.41	3.6	NA	52,400
Trichloroethene	ND	0.17	4	12	26,850
IM Event 3 (August 2020)					
1,2,4-Trichlorobenzene	ND	6	6.2	19	37,100
1,3-Dichlorobenzene	ND	0.98	9.2	28	60,100
1,4-Dichlorobenzene	ND	0.2	30	300	60,100
Hexachlorobutadiene	ND	3.5	5.4	NA	213
Naphthalene	ND	0.43	3.6	NA	52,400
Trichloroethene	ND	0.18	4	12	26,850

As shown on the table above, all indoor air results from the Winter 2019 and Summer 2020 IM events were non-detect (ND) with reporting limits (RLs) below the indoor air $RIASL_{12}$. The analytical data is presented in Appendix A. Field sampling forms are provided in Appendix B. The next interim measure (IM) event is scheduled for Winter 2020/2021. Semi-annual interim monitoring will continue in the summer and winter of 2021.

5.2.2 Building 1335 Interim Monitoring Results Summary

Building 1335 is a Category 1 building located within the southeast portion of the facility designated as Zone 1. It is known as the 23 Gatehouse or Contractor Gate and is a small building that includes space utilized by security personnel and visitors checking into the facility. Building 1335 is a Group 2 building that completed seasonal confirmation sampling in April 2018. A full evaluation and trend analysis was provided in the 2018 CAIP. All indoor air analytes were detected below screening levels during each of the seasonal confirmation sampling events. The sub-slab soil gas AOIs are CFC-12, HCBD, and TCE due to exceedances of the EGLE SSC. There were no sub-slab soil gas results above the $TSRIASL_{12}$ at Building 1335.

Based on the evaluation of the four seasonal confirmation sampling events, the VI pathway is insignificant for Building 1335 and the sub-slab soil gas results demonstrated relatively stable concentrations and no evidence of increasing over time. Sufficient information exists to make a human exposure under control EI determination. However, while currently there is no evidence of potential VI, for future use, LTM was warranted and the building-specific Interim Monitoring Plan was implemented.

Indoor air is monitored at location 1335-IA-01 (see Figure 5.2.2-1). This location was selected for continued monitoring since it demonstrated the highest sub-slab soil gas results. Monitoring is performed for CFC-12, HCBD, and TCE. Interim monitoring occurs semi-annually and the initial event was completed in August 2019 and results were reported in the 2019 CAIP (January 2020). The indoor air results for IM Event 2 (December 2019) and IM Event 3 (August 2020) are shown below in Table 1335-1.

Table 1335-1. Interim Monitoring Indoor Air Results for IM Events 2 and 3 for Building 1335

Indoor Air Analyte	Result Value (μg/m^3)	Reporting Limit (μg/m^3)	EGLE SSC (μg/m^3)	NONRES $TSRIASL_{12}$ (μg/m^3)	Dow IH OEL (8-hour Time Weighted Average) (μg/m^3)
IM Event 2 (December 2019)					
CFC-12	3.6	--	1,020	NA	4,950,000
Hexachlorobutadiene	ND	9.3	5.4	NA	213
Trichloroethene	ND	0.19	4	12	26,850
IM Event 3 (August 2020)					
CFC-12	6.2	--	1,020	NA	4,950,000
Hexachlorobutadiene	ND	9	5.4	NA	213
Trichloroethene	ND	0.18	4	12	26,850

As shown on the table above, indoor air results from the Winter 2019 and Summer 2020 IM events were detected below the screening levels or ND with RLs below the indoor air $RIASL_{12}$, with the exception of HCBD which had a ND RL slightly above the $RIASL_{12}$. The analytical data is presented in Appendix A. Field sampling forms are provided in Appendix B. The next IM event is scheduled for Winter 2020/2021. Semi-annual interim monitoring will continue in the summer and winter of 2021.

5.2.3 Building 462 Interim Monitoring Results Summary

Building 462 is a Category 2 building located north of the Wastewater Treatment Plant (WWTP) within the southern portion of the facility designated as Zone 1. It is known as the Maintenance/Repair/Operations (MRO)/Investment Recovery Building and is a large warehouse that also contains office space and a shop. Building 462 is a Group 2 building that completed seasonal confirmation sampling in May 2018. A full evaluation and trend analysis was provided in the 2018 CAIP. All indoor air analytes were detected below screening levels during each of the seasonal confirmation sampling events. The sub-slab soil gas AOIs are PCE and TCE due to exceedances of the EGLE SSC and the $TSRIASL_{12}$.

Based on the evaluation of the four seasonal confirmation sampling events, the VI pathway is insignificant for Building 462 and the sub-slab soil gas results exhibited relatively stable concentrations and no evidence of increasing over time. Sufficient information exists to make a human exposure under control EI determination. However, while currently there is no evidence of potential VI, for future use, LTM was warranted and the building-specific Interim Monitoring Plan was implemented.

Indoor air is monitored at locations 462-IA-03 and 462-IA-05 (see Figure 5.2.3-1). These locations were selected for continued monitoring since they demonstrated the highest sub-slab soil gas results. Monitoring is performed for PCE and TCE. Interim monitoring is performed semi-annually and the initial event was conducted in August 2019 and results were reported in the 2019 CAIP (January 2020). The indoor air results for IM Event 2 (December 2019) and IM Event 3 (August 2020) are shown below in Table 462-1.

Table 462-1. Interim Monitoring Indoor Air Results for IM Events 2 and 3 for Building 462

Indoor Air Analyte	Result Value (µg/m³)	Reporting Limit (µg/m³)	EGLE SSC (µg/m³)	NONRES $TSRIASL_{12}$ (µg/m³)	Dow IH OEL (8-hour Time Weighted Average) (µg/m³)
IM Event 2					
Sample 462-IA-03					
Tetrachloroethene	4.7	--	82	82	67,800
Trichloroethene	ND	0.18	4	12	26,850
Sample 462-IA-05					
Tetrachloroethene	1.4	--	82	82	67,800
Trichloroethene	ND	0.17	4	12	26,850
IM Event 3					
Sample 462-IA-03					
Tetrachloroethene	1.4	--	82	82	67,800
Trichloroethene	0.43	--	4	12	26,850
Sample 462-IA-05					
Tetrachloroethene	1	--	82	82	67,800
Trichloroethene	0.41	--	4	12	26,850

Note: One outdoor air sample was collected for IM Event 3. PCE and TCE were both detected at concentrations of 0.51 ug/m3 and 0.25 ug/m3, respectively.

As shown on the table above, all indoor air results from the Winter 2019 and Summer 2020 IM events were ND with RLs below the indoor air $RIASL_{12}$. The analytical data is presented in Appendix A. Field sampling forms are provided in Appendix B. The next IM event is scheduled for Winter 2020/2021. Semi-annual interim monitoring will continue in the summer and winter of 2021.

5.2.4 VI Seasonal Confirmation Sampling Results Evaluation for Building 680

INTRODUCTION

Building 680 is a Category 2 building located within the southwest portion of the facility designated as Zone 1 (see Figure 5.2.4-1). It is known as the Sulfonamides Building. The building was selected for seasonal confirmation sampling events based on the initial evaluation. To date, ten rounds of sampling have been performed as shown below. In additional, real-time measurement studies were performed in 2019 and 2020.

Table 680-1. Summary of Seasonal Confirmation Sampling Events for Building 680

Building 680	
Initial Sampling Event	**Completed**
E1	October 2016 (Fall)
Seasonal Confirmation Sampling Event	**Completed**
E2	August 2017 (Summer)
E3	February 2018 (Winter)
E4	April 2018 (Spring)
E5	February 2019 (Winter)
E6	May 2019 (Spring)
E7	August 2019 (Summer)
E8	October 2019 (Fall)
E9	December 2019 (Winter)
E10	August 2020 (Summer)

The initial sampling event at Building 680 occurred in 2016. Sampling has continued and results evaluations have been presented in the last three annual reports. The evaluations are summarized below:

- 2017 CAIP - The results of the initial sampling event (E1) and the second seasonal confirmation sampling event (E2) were evaluated and Building 680 was placed into VI Path Forward Building Group 2. Group 2 is a designation for buildings that have sub-slab soil gas AOIs, but where initial indoor air results were all less than screening levels.

- 2018 CAIP - The 2018 Rescreen included an evaluation of the seasonal sampling conducted through E4. The findings of the 2018 Rescreen acknowledged that some level of VI was occurring for TCE and Building 680 was moved to VI Path Forward Building Group 4. Group 4 is a designation for buildings that have evidence of potential VI as both sub-slab soil gas and indoor air exceedances were identified. Section 5.2.4 of the 2018 CAIP included an evaluation and trend analysis for all four seasonal confirmation sampling events and a recommended building-specific interim action plan that included the addition of 4 new sampling locations and continued seasonal confirmation sampling.

- Further Investigation activities were conducted with a mobile GC in March and May 2019 and were reported in the June 2019 Summary of Investigative Findings (see Appendix C). The investigation identified joint seams around the perimeter in both the shop and storage/utilities room. Dow implemented an interim action to seal the joint seams in April 2019.

- 2019 CAIP - Four additional seasonal confirmation sampling events were performed in 2019. Section 5.2.4 of the 2019 CAIP included an evaluation and trend analysis of all sampling events to date (i.e., up through E7) and recommended a quarterly building-specific interim monitoring plan with a reduced analyte list. Based on these results and the further investigation activities, Building 680 was moved to Path Forward Group 4B, which is defined as a building with sample result that demonstrate correlated sub-slab soil gas and indoor air exceedances and other lines of evidence indicate VI is likely significant.

- The application of the Retro-Coat™ Vapor Intrusion Coating System was completed, as an interim response action, in July 2020.

Based on EGLE guidance, indoor air and sub-slab soil-gas samples were initially collected during each event at seven locations within the building and concurrent outdoor air samples were collected at one location (see Figure 5.2.4-2). The 17 sub-slab soil gas AOIs due to exceedances of the EGLE SSCs and/or the $TSRIASL_{12}$ are: 1,1,2-trichloroethane (1,1,2-TCA), 1,1-dichloroethane (1,1-DCA), 1,2,4-trichlorobenzene (1,2,4-TCB), 1,2-dibromoethane (EDB), 1,2-dichloroethane (EDC), 1,2-dichloropropane (1,2-DCP), 1,3-dichlorobenzene (1,3-DCB), 1,4-dichlorobenzene (1,4-DCB), benzene, carbon tetrachloride, chloroform, cis-1,2-dichloroethene (cis-1,2-DCE), hexachlorobutadiene (HCBD), tetrachloroethene (PCE), trans-1,2-dichloroethene (trans-1,2-DCE), trichloroethene (TCE), and vinyl chloride.

As stated above, the 2019 CAIP included evaluation of results through E7 (Summer 2019). Since that time, three additional sampling events have occurred. During these three most recent events, 16 sub-slab soil gas analytes had results that exceed the EGLE SSCs. Those analytes include 1,1,2-TCA, 1,1-DCA, 1,2,4-TCB, EDB, EDC, 1,2-DCP, 1,3-DCB, 1,4-DCB, benzene, chloroform, cis-1,2-DCE, HCBD, PCE, trans-1,2-DCE, TCE, and vinyl chloride, which have all been detected in previous seasonal sampling events. Three analytes were detected above EGLE SSCs in indoor air, including cis-1,2-DCE, PCE and TCE. Figures showing results for each sampling event at each sample location are provided for cis-1,2-DCE, PCE and TCE since these analytes have had exceedances in both sub-slab soil gas and indoor air (Figures 5.2.4-3 thru 5.2.4-5, respectively). TCE was the only indoor air analyte detected above the EGLE SSC after the application of the Retro-Coat™ (E10). It was detected at a concentration of 5.9 ug/m3 (EGLE SSC = 4 ug/m3) outside of the Retro-Coat™ application area at 680-IA-03 in the women's locker room (see Figure 5.2.4-2).

VAPOR INTRUSION CONCEPTUAL SITE MODEL

VI is an exposure pathway that involves the migration of volatilized chemicals from the subsurface to indoor air in overlying, occupied buildings. A source, migration route and a human receptor must be present for the VI pathway to be complete. The focus of this building specific investigation is to evaluate the potential VI exposure pathway for Dow employees and contractors at Building 680. The CSM is illustrated in Figure 5.2.4-6.

Building 680 is four stories tall but only has two internal floors. It was constructed in 1960 and contains process areas, office space, a control room, storage areas, a small laboratory, a locker room, and a garage. The building is slab-on-grade construction with a footprint of approximately 8,500 ft^2 (790 m^2). The building has central AC with the air intake at roof level and a steam radiation heating system. There is one bay door left open during the workday in good weather.

The only underground utilities are the sewer lines. There are multiple floor drains and various plumbing fixtures. The land surrounding the building is covered in asphalt and concrete. The depth to groundwater in this area of the facility is approximately 5 ft bgs and the soils are largely fill material. Groundwater flow is towards the south or southwest.

The typical parameters for non-residential exposures are assumed to apply to workers at this building (i.e., 40 hours/week, 50 weeks/year exposure).

The initial building survey was performed on October 14, 2016 and a more in-depth survey and chemical inventory was conducted in 2019. Drains and other openings were screened with a PID and no soil gas entry points were identified. A chemical inventory was completed during the building survey and a wide variety of chemicals were found (e.g., bleach, various cleaners, wasp spray containing 80-90% petroleum distillates). Chemical storage cabinets within the building contain acetone, dichloromethane, hexane, isopropyl alcohol, methanol, methyl-ethyl ketone (MEK), methylene chloride, and toluene.

Further investigation activities were conducted in March and May 2019 using real-time measurement devices to identify potential pathways for vapor intrusion. Findings were reported to EGLE in the June 2019 Summary of Investigative Findings (see Appendix C). The goal of the building-specific investigation for Building 680 was to identify potential sources and achieve better spatial resolution of TCE concentrations in the indoor air. During these activities, potential workplace indoor air sources and various potential preferential pathways were investigated with no significant findings. The investigation led to the identification of joint seams in the shop and the storage room/utilities area where relatively high TCE concentrations were measured. Dow implemented an interim action to seal the joint seams and this activity was completed on April 30, 2019; however, as discussed in the July 2019 Corrective Action status meeting, results indicated that concentrations decreased but not as much as expected.

Additional investigation activities were conducted in February 2020 using real-time measurement devices to gain an understanding of TCE and PCE distribution prior to an interim response action. The sampling was meant to serve as a baseline and TCE concentrations were found to be above the EGLE SSC throughout the building and PCE was found above its EGLE SSC at most locations in the shop. The contribution of various floor cracks and air handling units to indoor air concentrations was investigated. Findings were reported to EGLE in the February 2020 Summary of Investigative Findings (see Appendix C).

Dow submitted the Retro-Coat™ Application Workplan for Buildings 680 and 941 on July 22, 2020. Retro-Coat is a suitable barrier to block contaminated vapors from entering existing structures. The Retro-Coat™ system has been used to effectively mitigate VI in existing buildings. The application of the Retro-Coat™ Vapor Intrusion Coating System was completed as an interim response action in late July 2020.

The floor was first prepared by shot blasting or grinding. The entire floor was then vacuumed and washed. Any divots or gouges were filled. All cracks and expansion joints were filled with a two-part caulking system. After this preparatory work, Retro-Coat™ sealant was applied to the southwest portion of the building floor (see Figure 5.2.4-7).

EVALUATION OF SEASONAL CONFIRMATION SAMPLING EVENTS

This evaluation includes the ten seasonal sampling events (E1-E10) that have been conducted at Building 680. The sampling events encompass four years of time and include sampling during each season of the year. Summary statistics and screening comparison results are presented for sub-slab soil gas on Table 5.2.4-1 and indoor and outdoor air on Table 5.2.4-2. The results from the ten seasonal confirmation sampling events were evaluated with respect to spatial variability, temporal variability, and seasonal trend analysis. Building specific attenuation factors were calculated and compared between events to evaluate temporal variability and determine the best estimate of a building-specific attenuation factor.

This evaluation focused on any analytes detected in the sub-slab soil gas samples that met the criterion for inclusion in one or more of the following categories:

a) Analytes detected in sub-slab soil gas at concentrations that exceeded EGLE SSCs;

b) Analytes detected in sub-slab soil gas at concentrations of 1,000 µg/m^3 or greater in one or more samples. Data for analytes detected above 1,000 µg/m^3 should provide the clearest signal and be the simplest to interpret when assessing data trends. The same data trends observed for these analytes are expected to apply to other similar analytes present at lower concentrations; and

c) PCE and TCE. These two analytes are of particular interest for many VI evaluations at industrial sites.

For this building, the analytes detected in the sub-slab soil gas at concentrations above the EGLE SSCs were the following 17 analytes: 1,1,2-TCA, 1,1-DCA, 1,2,4-trichlorobenzene, EDB, EDC, 1,2-DCP, 1,3-DCB, 1,4-DCB, benzene, carbon tetrachloride, chloroform, cis-1,2-DCE, HCBD, PCE, trans-1,2-DCE, TCE, and vinyl chloride.

Eight other analytes of potential interest were detected at concentrations $\geq$1,000 µg/m^3 in sub-slab soil gas: 1,1-DCE, dichlorodifluoromethane (CFC-12), 1,1,1-TCA, methylene chloride, acetone, ethanol, and 1,2,4-trimethylbenene. These analytes were not included in the evaluation since it was determined that the 17 AOIs were sufficient to support a robust data evaluation without adding in additional analytes, and they were detected at low frequency and far lower concentrations than PCE. Sample results for the 17 analytes included in this evaluation are provided in the data tables below.

Table 680-2 Summary of Results for 1,1,2-Trichloroethane (1,1,2-TCA)

Sample Type	Screening Level (µg/m³)	Sample ID	Measured Concentration (µg/m³)									
			Oct. 2016	Aug./Sept. 2017	Feb. 2018	Apr. 2018	Feb. 2019	May 2019	Aug. 2019	Oct. 2019	Dec. 2019	Aug. 2020
			E1	E2	E3	E4	E5	E6	E7	E8	E9	E10
Outdoor Air	-	680-OA-01	<4.3	<0.17	<0.16	<0.18	<0.18	<0.18	<0.19	<0.18	<0.17	<0.18
Indoor Air	0.62 (EGLE SSC)	680-IA-01	<4.6	<0.17	<0.19	<0.18	<0.18	<0.19	<0.20	<0.19	<0.20	<0.35
		680-IA-02	<4.3	<0.17	<0.18	<0.18	<0.18	<0.18	<0.20	<0.16	<0.20	<0.19
		680-IA-03	<4.3	<0.18	<0.18	<0.18	<0.17	<0.18	<0.19	<0.19	<0.20	<0.19
		680-IA-04	<4.2	<0.18	<0.18	<0.18	<0.34	<0.88	<0.20	<0.19	<0.20	<0.18
		680-IA-05	-	-	-	-	<0.14	<0.16	<0.21	<0.65	<0.37	<0.19
		680-IA-06	-	-	-	-	<0.17	<0.38	<0.19	<0.18	<0.20	<0.18
		680-IA-07	-	-	-	-	<0.17	<0.18	<0.18	<0.24	<0.20	-
		680-IA-08	-	-	-	-	<0.18	<0.18	<0.19	<0.18	<0.19	<0.18
Sub-Slab Soil Gas	20 (EGLE SSC)	680-SS-01	720	1,000	340	550	370	510	940	410	400	-
		680-SS-02	<4.7	<4.4	<4.4	<4.4	<15	<5.8	<4.2	<4.8	<4.4	-
		680-SS-03	<89	<42	<44	<42	<21	<9.6	<43	<44	<43	-
		680-SS-04	<240	<550	<280	<150	<78	<17	<400	<42	<110	<920
		680-SS-05	-	-	-	-	<2,400	<2,100	<9,000	<1,100	<1,500	<15,000
		680-SS-06	-	-	-	-	<550	<380	<540	<450	<440	<740
		680-SS-07	-	-	-	-	<4.3	<4	<4.6	<4.2	<4.4	-
		680-SS-08	-	-	-	-	230	330	300	350	330	-

-	not applicable
(shaded)	EGLE SSC Exceedance

Table 680-3 Summary of Results for 1,1-Dichloroethane (1,1-DCA)

Sample Type	Screening Level ($\mu g/m^3$)	Sample ID	Measured Concentration ($\mu g/m^3$)									
			Oct. 2016	Aug./Sept. 2017	Feb. 2018	Apr. 2018	Feb. 2019	May 2019	Aug. 2019	Oct. 2019	Dec. 2019	Aug. 2020
			E1	E2	E3	E4	E5	E6	E7	E8	E9	E10
Outdoor Air	-	680-OA-01	<3.2	<0.13	<0.12	<0.13	<0.12	<0.13	<0.14	<0.13	<0.13	<0.13
Indoor Air	74 (EGLE SSC) 740 ($TSRIASL_{12}$)	680-IA-01	<3.4	<0.13	<0.14	<0.13	<0.13	<0.13	<0.14	<0.14	<0.15	<0.26
		680-IA-02	<3.2	<0.13	0.13	<0.13	0.18	<0.14	<0.14	<0.12	<0.14	0.14
		680-IA-03	<3.2	<0.13	<0.13	<0.14	0.17	0.22	<0.14	<0.14	<0.15	0.2
		680-IA-04	<3.2	0.2	<0.13	<0.14	<0.13	0.5	<0.14	<0.14	<0.15	<0.14
		680-IA-05	-	-	-	-	0.39	2.3	0.18	1.1	0.38	<0.14
		680-IA-06	-	-	-	-	0.85	<0.12	<0.16	<0.21	<0.15	<0.14
		680-IA-07	-	-	-	-	1	<0.28	<0.14	<0.18	<0.15	-
		680-IA-08	-	-	-	-	0.12	0.15	<0.14	<0.13	<0.14	<0.14
Sub-Slab Soil Gas	2,500 (EGLE SSC) 25,000 ($TSRIASL_{12}$)	680-SS-01	22	24	<11	11	7.4	14	24	11	11	-
		680-SS-02	96	22	33	7.9	350	47	10	23	80	-
		680-SS-03	<66	100	50	45	<15	<7.1	36	57	48	-
		680-SS-04	570	500	<210	<110	93	<12	520	77	<81	<680
		680-SS-05	-	-	-	-	8,600	4,500	17,000	19,000	8,000	13,000
		680-SS-06	-	-	-	-	8,600	4,600	8,500	8,300	6,700	4,300
		680-SS-07	-	-	-	-	7.6	12	38	12	9.5	-
		680-SS-08	-	-	-	-	19	30	34	34	29	-

-	not applicable
(shaded)	EGLE SSC Exceedance
BOLD	$TSRIASL_{12}$ Exceedance

Table 680-4 Summary of Results for 1,2,4-Trichlorobenzene

Sample Type	Screening Level (µg/m³)	Sample ID	Measured Concentration (µg/m³)									
			Oct. 2016	Aug./Sept. 2017	Feb. 2018	Apr. 2018	Feb. 2019	May 2019	Aug. 2019	Oct. 2019	Dec. 2019	Aug. 2020
			E1	E2	E3	E4	E5	E6	E7	E8	E9	E10
Outdoor Air	-	680-OA-01	<24	<5.9	<5.4	<6.1	<5.4	<6	<6.6	<6	<5.9	<6.2
Indoor Air	6.2 (EGLE SSC) 19 (TSRIASL12)	680-IA-01	**<25**	<5.9	<6.5	<6	<6.1	<6	<6.5	<6.5	<6.8	<12
		680-IA-02	**<23**	<5.8	<6	<6.1	<6	<6.4	<6.6	<5.3	<6.6	<6.4
		680-IA-03	**<23**	<6	<6	<6.2	<6.2	<6.3	<6.6	<6.4	<6.9	<6.4
		680-IA-04	**<23**	<6.3	<6	<6.2	<5.8	<6.2	<6.3	<6.5	<6.8	<6.3
		680-IA-05	-	-	-	-	<12	**<30**	<6.6	**<22**	<13	<6.5
		680-IA-06	-	-	-	-	<4.9	<5.6	<7.3	<6.3	<6.8	<6.3
		680-IA-07	-	-	-	-	<5.9	<13	<6.3	<8.3	<6.8	-
		680-IA-08	-	-	-	-	<5.7	<6.3	<6.2	<6.1	<6.5	<6.3
Sub-Slab Soil Gas	200 (EGLE SSC) 610 (TSRIASL12)	680-SS-01	<160	<95	<80	140	<23	<52	<73	<76	<54	-
		680-SS-02	<25	<24	<24	<24	<80	<32	<23	<26	<24	-
		680-SS-03	<490	<230	<240	<230	<110	<52	<240	<240	<240	-
		680-SS-04	**<1,300**	**<3,000**	**<1,500**	**<800**	<430	<92	**<2,200**	<230	<600	**<5,000**
		680-SS-05	-	-	-	-	**<13,000**	**<12,000**	**<49,000**	**14,000**	**<8,000**	**<81,000**
		680-SS-06	-	-	-	-	**<3,000**	**<2,100**	**<2,900**	**<2,400**	**<2,400**	**<4,000**
		680-SS-07	-	-	-	-	<23	<22	<25	<23	<24	-
		680-SS-08	-	-	-	-	<31	<120	<100	<190	<92	-

-	not applicable
(shaded)	EGLE SSC Exceedance
BOLD	TSRIASL12 Exceedance

Table 680-5 Summary of Results for 1,2-Dibromoethane (EDB)

Sample Type	Screening Level (µg/m³)	Sample ID	Measured Concentration (µg/m³)									
			Oct. 2016	Aug./Sept. 2017	Feb. 2018	Apr. 2018	Feb. 2019	May 2019	Aug. 2019	Oct. 2019	Dec. 2019	Aug. 2020
			E1	E2	E3	E4	E5	E6	E7	E8	E9	E10
Outdoor Air	-	680-OA-01	<6.1	<0.24	<0.22	<0.25	<0.22	<0.25	<0.14	<0.12	<0.12	<0.13
Indoor Air	0.2 (EGLE SSC)	680-IA-01	<6.4	<0.24	<0.27	<0.25	<0.25	<0.25	<0.13	<0.13	<0.14	<0.25
		680-IA-02	<6.1	<0.24	<0.25	<0.25	<0.25	<0.27	<0.14	<0.11	<0.14	<0.13
		680-IA-03	<6.1	<0.25	<0.25	<0.26	<0.26	<0.26	<0.14	<0.13	<0.14	<0.13
		680-IA-04	<6.0	<0.26	<0.25	<0.26	<0.24	<0.26	<0.13	<0.13	<0.14	<0.13
		680-IA-05	-	-	-	-	<0.48	<1.2	<0.14	<0.46	<0.26	<0.13
		680-IA-06	-	-	-	-	<0.20	<0.23	<0.15	<0.13	<0.14	<0.13
		680-IA-07	-	-	-	-	<0.24	<0.53	<0.13	<0.17	<0.14	<0.13
		680-IA-08	-	-	-	-	<0.24	<0.26	<0.13	<0.13	<0.13	<0.13
Sub-Slab Soil Gas	6.6 (EGLE SSC)	680-SS-01	240	68	68	65	60	45	970	400	93	-
		680-SS-02	<6.6	<6.2	<6.2	<6.1	<20	<8.2	<5.9	<6.7	<6.2	-
		680-SS-03	<130	<60	<62	<59	<29	<14	<61	<62	<61	-
		680-SS-04	<340	<770	<400	<210	<110	<24	<560	<60	<150	<1,300
		680-SS-05	-	-	-	-	<3,400	<3,000	<13,000	<1,500	<2,100	<21,000
		680-SS-06	-	-	-	-	<770	<540	<760	<630	<620	<1,000
		680-SS-07	-	-	-	-	<6.1	<5.7	<6.5	<6	<6.2	-
		680-IA-08	-	-	-	-	<8.1	<30	<26	<48	<24	-

-	not applicable
(shaded)	EGLE SSC Exceedance

Table 680-6 Summary of Results for 1,2-Dichloroethane (EDC)

Sample Type	Screening Level (µg/m³)	Sample ID	Measured Concentration (µg/m³)									
			Oct. 2016	Aug./Sept. 2017	Feb. 2018	Apr. 2018	Feb. 2019	May 2019	Aug. 2019	Oct. 2019	Dec. 2019	Aug. 2020
			E1	E2	E3	E4	E5	E6	E7	E8	E9	E10
Outdoor Air	-	680-OA-01	<3.2	<0.13	<0.12	<0.13	0.15	<0.13	<0.14	<0.13	<0.13	<0.13
Indoor Air	4.6 (EGLE SSC)	680-IA-01	<3.4	<0.13	<0.14	<0.13	0.15	<0.13	<0.14	<0.14	<0.15	<0.26
		680-IA-02	<3.2	<0.13	<0.13	<0.13	0.15	<0.14	<0.14	<0.12	<0.14	<0.14
		680-IA-03	<3.2	0.16	<0.13	<0.14	0.15	<0.14	<0.14	<0.14	0.15	<0.14
		680-IA-04	<3.2	0.2	<0.13	<0.14	0.14	<0.14	<0.14	<0.14	<0.15	<0.14
		680-IA-05	-	-	-	-	<0.25	<0.66	<0.14	<0.48	<0.28	<0.14
		680-IA-06	-	-	-	-	0.18	<0.12	<0.16	<0.14	<0.15	<0.14
		680-IA-07	-	-	-	-	0.18	<0.28	<0.14	<0.18	<0.15	-
		680-IA-08	-	-	-	-	0.16	<0.14	<0.14	<0.13	<0.14	<0.14
Sub-Slab Soil Gas	150 (EGLE SSC)	680-SS-01	320	210	190	260	160	220	380	180	160	-
		680-SS-02	7.9	<3.2	<3.2	<3.2	<11	<4.3	<3.1	<3.5	3.5	-
		680-SS-03	<66	<31	<32	<31	<15	<7.1	<32	<32	<32	-
		680-SS-04	850	<410	<210	<110	61	<12	<300	<31	<81	<680
		680-SS-05	-	-	-	-	<1,800	<1,600	<6,700	<810	<1,100	<11,000
		680-SS-06	-	-	-	-	<410	<280	<400	<330	<320	<550
		680-SS-07	-	-	-	-	<3.2	<3	<3.4	<3.1	<3.2	-
		680-SS-08	-	-	-	-	63	100	94	79	85	-

-	not applicable
(shaded)	EGLE SSC Exceedance

Table 680-7 Summary of Results for 1,2-Dichloropropane (1,2-DCP)

Sample Type	Screening Level (µg/m³)	Sample ID	Measured Concentration (µg/m³)									
			Oct. 2016	Aug./Sept. 2017	Feb. 2018	Apr. 2018	Feb. 2019	May 2019	Aug. 2019	Oct. 2019	Dec. 2019	Aug. 2020
			E1	E2	E3	E4	E5	E6	E7	E8	E9	E10
Outdoor Air	-	680-OA-01	<3.7	<0.74	<0.67	<0.76	<0.67	<0.74	<0.83	<0.74	<0.73	<0.77
Indoor Air	12.2 (EGLE SSC)	680-IA-01	<3.8	<0.73	<0.81	<0.75	<0.76	<0.74	<0.81	<0.81	<0.84	<1.5
		680-IA-02	<3.6	<0.72	<0.74	<0.76	<0.75	<0.8	<0.83	<0.66	<0.83	<0.79
		680-IA-03	<3.6	<0.74	<0.75	<0.77	<0.77	<0.78	<0.83	<0.79	<0.86	<0.8
		680-IA-04	<3.6	<0.78	<0.74	<0.78	<0.72	<0.78	<0.79	<0.81	<0.85	<0.78
		680-IA-05	-	-	-	-	<1.4	<3.7	<0.83	<2.7	<1.6	<0.81
		680-IA-06	-	-	-	-	<0.61	<0.70	<0.90	<0.78	<0.84	<0.78
		680-IA-07	-	-	-	-	<0.74	<1.6	<0.79	<1	<0.84	-
		680-IA-08	-	-	-	-	<0.71	<0.78	<0.78	<0.76	<0.81	<0.78
Sub-Slab Soil Gas	410 (EGLE SSC)	680-SS-01	67	80	29	41	33	41	79	32	35	-
		680-SS-02	34	12	11	<3.7	74	6.2	4.8	9	23	-
		680-SS-03	100	110	57	60	23	<8.2	56	84	70	-
		680-SS-04	<210	60	<240	<120	<66	<14	<340	<36	<93	<780
		680-SS-05	-	-	-	-	<2,000	<1,800	<7,700	1,300	<1,200	<13,000
		680-SS-06	-	-	-	-	1,500	950	1,700	1,500	1,200	880
		680-SS-07	-	-	-	-	<3.6	<3.4	6.5	3.6	<3.7	-
		680-SS-08	-	-	-	-	170	250	280	260	250	-

-	not applicable
(shaded)	EGLE SSC Exceedance

Table 680-8 Summary of Results for 1,3-Dichlorobenzene

Sample Type	Screening Level (µg/m^3)	Sample ID	Measured Concentration (µg/m^3)									
			Oct. 2016	Aug./Sept. 2017	Feb. 2018	Apr. 2018	Feb. 2019	May 2019	Aug. 2019	Oct. 2019	Dec. 2019	Aug. 2020
			E1	E2	E3	E4	E5	E6	E7	E8	E9	E10
Outdoor Air	-	680-OA-01	<4..8	<0.96	<0.87	<0.99	<0.88	<0.97	<1.1	<0.97	<0.95	<1
Indoor Air	9.2 (EGLE SSC) 28 (TSRIASL12)	680-IA-01	<5	<0.95	<1	<0.97	<0.99	<0.97	<1	<1	<1.1	<1.9
		680-IA-02	<4.8	<0.94	<0.97	<0.99	<0.98	<1	<1.1	<0.86	<1.1	<1
		680-IA-03	<4.8	<0.97	<0.98	<1	<1	<1	<1.1	<1	<1.1	<1
		680-IA-04	<4.7	<1	<0.97	<1	<0.94	<1	<1	<1	<1.1	<1
		680-IA-05	-	-	-	-	<1.9	<4.9	<1.1	<3.6	<2	<1
		680-IA-06	-	-	-	-	<0.79	<0.91	<1.2	<1	<1.1	<1
		680-IA-07	-	-	-	-	<0.96	<2.1	<1	<1.3	<1.1	-
		680-IA-08	-	-	-	-	<0.92	<1	<1	<0.99	<1	<1
Sub-Slab Soil Gas	310 (EGLE SSC) 920 (TSRIASL12)	680-SS-01	<33	<19	<16	27	5.4	<10	<15	<15	<11	-
		680-SS-02	<5.1	<4.8	<4.8	<4.8	<16	<6.4	7.1	<5.3	<4.8	-
		680-SS-03	<99	<46	<48	<46	<23	<11	<48	<48	<48	-
		680-SS-04	<270	<600	<310	<160	<86	<19	<440	<46	<120	**<1000**
		680-SS-05	-	-	-	-	**<2,600**	**<2,300**	**<10,000**	**2,800**	**<1,600**	**<16,000**
		680-SS-06	-	-	-	-	<600	<420	<600	<490	<480	<820
		680-SS-07	-	-	-	-	<4.8	<4.4	6.4	<4.6	<4.8	-
		680-SS-08	-	-	-	-	<6.3	<24	<21	<38	<18	-

-	not applicable
(shaded)	EGLE SSC Exceedance
BOLD	TSRIASL12 Exceedance

Table 680-9 Summary of Results for 1,4-Dichlorobenzene

Sample Type	Screening Level (µg/m³)	Sample ID	Measured Concentration (µg/m³)									
			Oct. 2016	Aug./Sept. 2017	Feb. 2018	Apr. 2018	Feb. 2019	May 2019	Aug. 2019	Oct. 2019	Dec. 2019	Aug. 2020
			E1	E2	E3	E4	E5	E6	E7	E8	E9	E10
Outdoor Air	-	680-OA-01	<4.8	<0.19	<0.17	<0.2	0.27	<0.19	<0.22	<0.19	<0.19	<0.2
Indoor Air	30 (EGLE SSC) 300 ($TSRIASL_{12}$)	680-IA-01	<5	<0.19	<0.21	<0.19	<0.2	<0.19	<0.21	<0.21	<0.22	<0.39
		680-IA-02	<4.8	<0.19	<0.19	<0.2	<0.2	<0.21	<0.22	<0.17	<0.22	<0.21
		680-IA-03	<4.8	<0.19	<0.2	<0.2	0.26	<0.2	<0.22	<0.21	<0.22	<0.21
		680-IA-04	<4.7	<0.2	<0.19	<0.2	<0.19	<0.2	<0.2	<0.21	<0.22	<0.2
		680-IA-05	-	-	-	-	<0.38	<0.97	<0.22	<0.71	<0.41	<0.21
		680-IA-06	-	-	-	-	<0.16	<0.18	<0.24	<0.2	<0.22	<0.2
		680-IA-07	-	-	-	-	<0.19	<0.42	<0.2	0.38	<0.22	-
		680-IA-08	-	-	-	-	<0.18	<0.2	<0.2	<0.2	<0.21	<0.2
Sub-Slab Soil Gas	1,000 (EGLE SSC) 10,000 ($TSRIASL_{12}$)	680-SS-01	33	<19	<16	17	9.6	<10	27	<15	<11	-
		680-SS-02	<5.1	<4.8	<4.8	<4.8	<16	<6.4	<4.6	<5.3	<4.8	-
		680-SS-03	<99	130	<48	<46	<23	<11	<48	<48	<48	-
		680-SS-04	<270	<600	<310	<160	<86	<19	<440	<46	<120	<1,000
		680-SS-05	-	-	-	-	<2,600	<2,300	**<10,000**	2,100	<1,600	**<16,000**
		680-SS-06	-	-	-	-	<600	<420	<600	<490	<480	<820
		680-SS-07	-	-	-	-	<4.8	<4.4	<5.1	<4.6	<4.8	-
		680-SS-08	-	-	-	-	<6.3	<24	<21	<38	<18	-

-	not applicable
(shaded)	EGLE SSC Exceedance
BOLD	$TSRIASL_{12}$ Exceedance

Table 680-10 Summary of Results for Benzene

Sample Type	Screening Level (µg/m³)	Sample ID	Measured Concentration (µg/m³)									
			Oct. 2016	Aug./Sept. 2017	Feb. 2018	Apr. 2018	Feb. 2019	May 2019	Aug. 2019	Oct. 2019	Dec. 2019	Aug. 2020
			E1	E2	E3	E4	E5	E6	E7	E8	E9	E10
Outdoor Air	-	680-OA-01	<2.5	0.28	0.65	0.36	2.2	<0.26	0.32	0.45	0.52	<0.26
Indoor Air	15.4 (EGLE SSC) 54 (TSRIASL12)	680-IA-01	<2.7	0.38	0.72	0.56	1.6	0.26	0.28	0.35	0.41	<0.51
		680-IA-02	<2.5	0.42	0.82	0.37	1.8	0.48	<0.28	0.41	0.42	<0.27
		680-IA-03	<2.5	0.48	0.74	0.37	2	0.28	<0.28	0.94	0.46	<0.28
		680-IA-04	<2.5	0.6	0.64	0.31	1.4	<0.27	<0.27	0.39	0.42	<0.27
		680-IA-05	-	-	-	-	1.4	<1.3	<0.28	<0.95	<0.55	<0.28
		680-IA-06	-	-	-	-	1.5	<0.24	<0.31	0.34	0.46	<0.27
		680-IA-07	-	-	-	-	1.8	<0.56	<0.27	<0.36	0.54	-
		680-IA-08	-	-	-	-	1.8	0.29	0.27	0.4	0.43	<0.27
Sub-Slab Soil Gas	510 (EGLE SSC) 1,800 (TSRIASL12)	680-SS-01	67	70	31	37	18	23	34	19	20	-
		680-SS-02	<2.7	3.2	<2.6	<2.6	<8.6	<3.4	<2.4	<2.8	<2.6	-
		680-SS-03	<52	28	<26	<24	<12	<5.6	<25	<26	<25	-
		680-SS-04	<140	<320	<160	<86	<46	<9.9	<230	<25	<64	<540
		680-SS-05	-	-	-	-	<1,400	<1,200	**<5,300**	2,400	1,100	**<8,700**
		680-SS-06	-	-	-	-	<320	<220	<320	<260	<260	<440
		680-SS-07	-	-	-	-	<2.5	<2.4	11	<2.5	<2.6	-
		680-SS-08	-	-	-	-	<3.4	<12	<11	<20	<9.9	-

-	not applicable
(shaded)	EGLE SSC Exceedance
BOLD	TSRIASL12 Exceedance

Table 680-11 Summary of Results for Carbon Tetrachloride

Sample Type	Screening Level (µg/m³)	Sample ID	Measured Concentration (µg/m³)									
			Oct. 2016	Aug./Sept. 2017	Feb. 2018	Apr. 2018	Feb. 2019	May 2019	Aug. 2019	Oct. 2019	Dec. 2019	Aug. 2020
			E1	E2	E3	E4	E5	E6	E7	E8	E9	E10
Outdoor Air	-	680-OA-01	<5.0	<0.20	0.48	0.42	0.53	0.42	0.44	0.4	0.43	0.44
Indoor Air	22 (EGLE SSC)	680-IA-01	<5.2	<0.20	0.46	0.41	0.52	0.46	0.42	0	0.48	<0.4
		680-IA-02	<5.0	<0.20	0.51	0.47	0.54	0.47	0.45	0.49	0.46	0.45
		680-IA-03	<5.0	<0.20	0.46	0.46	0.57	0.51	0.45	0.48	0.49	0.47
		680-IA-04	<4.9	0.68	0.47	0.44	0.49	0.51	0.46	0.47	0.45	0.46
		680-IA-05	-	-	-	-	0.52	<1	0.46	<0.75	0.6	0.43
		680-IA-06	-	-	-	-	0.57	0.42	0.46	0.49	0.45	0.43
		680-IA-07	-	-	-	-	0.95	0.44	0.44	0.49	0.46	-
		680-IA-08	-	-	-	-	0.53	0.48	0.43	0.51	0.46	0.42
Sub-Slab Soil Gas	710 (EGLE SSC)	680-SS-01	1,100	670	2,200	350	230	520	1,300	410	380	-
		680-SS-02	30	8.3	<5.1	<5	130	<6.7	<4.8	8	22	-
		680-SS-03	<100	<49	<51	<48	<24	<11	<50	<51	<50	-
		680-SS-04	680	1,000	<320	<170	<91	<19	600	70	<130	1,000
		680-SS-05	-	-	-	-	<2,800	<2,400	<10,000	<1300	<1700	17,000
		680-SS-06	-	-	-	-	<630	<440	<620	<520	<510	860
		680-SS-07	-	-	-	-	<5	<4.6	<5.3	<4.9	<5.1	-
		680-SS-08	-	-	-	-	280	550	500	700	490	-

-	not applicable
(shaded)	EGLE SSC Exceedance

Table 680-12 Summary of Results for Chloroform

Sample Type	Screening Level (µg/m³)	Sample ID	Measured Concentration (µg/m³)									
			Oct. 2016	Aug./Sept. 2017	Feb. 2018	Apr. 2018	Feb. 2019	May 2019	Aug. 2019	Oct. 2019	Dec. 2019	Aug. 2020
			E1	E2	E3	E4	E5	E6	E7	E8	E9	E10
Outdoor Air	-	680-OA-01	<3.9	<0.16	<0.14	<0.16	0.16	<0.16	<0.17	<0.16	<0.15	<0.16
Indoor Air	5.2 (EGLE SSC) 52 (TSRIASL12)	680-IA-01	<4.1	0.17	0.29	0.21	0.5	0.26	<0.17	0.21	0.28	<0.31
		680-IA-02	<3.8	0.27	0.46	0.36	0.65	0.36	0.39	0.37	0.46	0.52
		680-IA-03	<3.8	0.38	0.45	0.4	1	1.1	0.33	1.4	0.73	0.64
		680-IA-04	<3.8	0.64	<0.16	<0.16	<0.15	0.69	0.21	<0.17	<0.18	<0.17
		680-IA-05	-	-	-	-	0.5	3.4	0.31	1.8	0.7	<0.17
		680-IA-06	-	-	-	-	1	<0.15	0.3	0.4	0.32	<0.17
		680-IA-07	-	-	-	-	3.6	0.6	0.43	0.51	0.57	-
		680-IA-08	-	-	-	-	0.51	0.3	<0.16	0.28	0.26	<0.17
Sub-Slab Soil Gas	170 (EGLE SSC) 1,700 (TSRIASL12)	680-SS-01	1,500	1,500	700	940	790	1,100	**2,600**	910	890	-
		680-SS-02	380	53	120	15	1,100	48	21	69	230	-
		680-SS-03	170	240	120	100	37	15	92	170	140	-
		680-SS-04	**2,000**	**2,000**	<250	140	370	<15	**1,800**	270	130	980
		680-SS-05	-	-	-	-	**3,300**	**1,900**	**<8,100**	**7,300**	**3,200**	**<13,000**
		680-SS-06	-	-	-	-	**7,000**	**4,800**	**8,900**	**7,300**	**5,900**	**3,400**
		680-SS-07	-	-	-	-	12	9.6	25	24	8.5	--
		680-SS-08	-	-	-	-	620	1,000	920	980	870	--

-	not applicable
(shaded)	EGLE SSC Exceedance
BOLD	TSRIASL12 Exceedance

Table 680-13 Summary of Results for cis-1,2-Dichloroethene (cis-1,2-DCE)

Sample Type	Screening Level (µg/m³)	Sample ID	Measured Concentration (µg/m³)									
			Oct. 2016	Aug./Sept. 2017	Feb. 2018	Apr. 2018	Feb. 2019	May 2019	Aug. 2019	Oct. 2019	Dec. 2019	Aug. 2020
			E1	E2	E3	E4	E5	E6	E7	E8	E9	E10
Outdoor Air	-	680-OA-01	<3.2	<0.13	0.36	0.3	0.34	<0.13	<0.14	0.18	<0.12	<0.13
Indoor Air	24 (EGLE SSC) 72 (TSRIASL12)	680-IA-01	<3.3	0.65	3	0.91	3.5	1.2	0.19	1.1	0.64	0.42
		680-IA-02	11	6.1	7.8	6	5.4	2.8	2.2	3	1.5	2.1
		680-IA-03	14	6.9	9.1	5.6	10	8	1.8	3.4	9.2	3.1
		680-IA-04	<3.1	6.1	0.36	0.43	0.46	11	1.1	0.53	0.96	0.55
		680-IA-05	-	-	-	-	23	45	4.6	33	20	0.85
		680-IA-06	-	-	-	-	12	0.36	0.91	2.6	1.9	0.46
		680-IA-07	-	-	-	-	5.5	3	1.5	3.1	2.1	-
		680-IA-08	-	-	-	-	3.5	1.5	0.16	1.5	0.71	0.2
Sub-Slab Soil Gas	820 (EGLE SSC) 2,500 (TSRIASL12)	680-SS-01	30	18	14	16	11	14	20	13	13	-
		680-SS-02	610	380	160	130	100	730	14	200	460	-
		680-SS-03	**13,000**	**20,000**	**7,500**	**7,200**	**3,900**	1,400	**11,000**	**17,000**	**9,400**	-
		680-SS-04	**17,000**	**19,000**	**3,400**	1,900	**4,600**	100	**18,000**	**2,800**	1,400	**10,000**
		680-SS-05	-	-	-	-	**380,000**	**210,000**	**840,000**	**880,000**	**360,000**	**390,000**
		680-SS-06	-	-	-	-	**150,000**	**96,000**	**170,000**	**140,000**	**110,000**	**46,000**
		680-SS-07	-	-	-	-	33	59	30	40	46	-
		680-SS-08	-	-	-	-	12	16	20	<25	14	-

-	not applicable
(shaded)	EGLE SSC Exceedance
BOLD	TSRIASL12 Exceedance

Table 680-14 Summary of Results for Hexachlorobutadiene (HCBD)

Sample Type	Screening Level (µg/m³)	Sample ID	Measured Concentration (µg/m³)									
			Oct. 2016	Aug./Sept. 2017	Feb. 2018	Apr. 2018	Feb. 2019	May 2019	Aug. 2019	Oct. 2019	Dec. 2019	Aug. 2020
			E1	E2	E3	E4	E5	E6	E7	E8	E9	E10
Outdoor Air	-	680-OA-01	<34	<8.5	<7.7	<8.7	<7.8	<8.6	<3.8	<3.4	<3.4	<3.5
Indoor Air	5.4 (EGLE SSC)	680-IA-01	<36	<8.4	<9.4	<8.6	<8.7	<8.6	<3.7	<3.7	<3.9	<6.8
		680-IA-02	<34	<8.3	<8.6	<8.8	<8.7	<9.3	<3.8	<3.1	<3.8	<3.7
		680-IA-03	<34	<8.6	<8.7	<8.9	<8.8	<9.1	<3.8	<3.7	4.1	<3.7
		680-IA-04	<33	<9.1	<8.6	<9.0	<8.3	<9	<3.6	<3.7	<3.9	<3.6
		680-IA-05	-	-	-	-	<17	<43	<3.8	<13	<7.3	<3.7
		680-IA-06	-	-	-	-	<7	<8	<4.2	<3.6	<3.9	<3.6
		680-IA-07	-	-	-	-	<8.5	<18	<3.6	<4.8	<3.9	-
		680-IA-08	-	-	-	-	<8.2	<9.1	<3.6	<3.5	<3.7	<3.6
Sub-Slab Soil Gas	180 (EGLE SSC)	680-SS-01	3,400	2,000	2,100	4,400	1,800	1,200	3,600	2,000	2,000	-
		680-SS-02	170	84	52	47	<110	80	<33	53	120	-
		680-SS-03	4,600	9,600	3,200	4,100	430	790	4,200	5,200	5,300	-
		680-SS-04	<1,900	<4,300	<2,200	<1,200	<610	<130	<3,100	<330	<860	<7,200
		680-SS-05	-	-	-	-	<19,000	<16,000	<71,000	<8,600	<11,000	<120,000
		680-SS-06	-	-	-	-	5,900	13,000	18,000	13,000	5,500	<5,800
		680-SS-07	-	-	-	-	<34	33	38	<33	<34	-
		680-SS-08	-	-	-	-	400	540	610	460	450	-

-	not applicable
(shaded)	EGLE SSC Exceedance

Table 680-15 Summary of Results for Tetrachloroethene (PCE)

Sample Type	Screening Level (µg/m³)	Sample ID	Measured Concentration (µg/m³)									
			Oct. 2016	Aug./Sept. 2017	Feb. 2018	Apr. 2018	Feb. 2019	May 2019	Aug. 2019	Oct. 2019	Dec. 2019	Aug. 2020
			E1	E2	E3	E4	E5	E6	E7	E8	E9	E10
Outdoor Air	-	680-OA-01	<5.4	0.39	4.5	3	0.36	0.48	1.2	0.35	<0.21	0.71
Indoor Air	82 (EGLE SSC) 82 (TSRIASL12)	680-IA-01	<5.7	3.4	25	8.1	36	14	2.8	11	10	2.8
		680-IA-02	26	29	67	54	54	30	36	28	25	36
		680-IA-03	30	33	75	49	54	32	24	36	34	52
		680-IA-04	<5.3	54	4.2	5.8	4.2	**87**	18	6.2	13	8.7
		680-IA-05	-	-	-	-	**230**	**440**	64	**380**	**250**	17
		680-IA-06	-	-	-	-	81	3.5	16	39	37	7
		680-IA-07	-	-	-	-	56	34	26	32	30	-
		680-IA-08	-	-	-	-	36	17	3	15	11	3.2
Sub-Slab Soil Gas	2,700 (EGLE SSC) 2,700 (TSRIASL12)	680-SS-01	2,600	1,800	**6,200**	1,800	1,300	1,700	2,600	1,400	1,400	-
		680-SS-02	1,800	550	470	140	**3,800**	580	160	500	1000	-
		680-SS-03	**11,000**	**17,000**	**7,700**	**6,600**	**3,400**	2,300	**7,700**	**10,000**	**11,000**	-
		680-SS-04	**460,000**	**760,000**	**140,000**	**50,000**	**130,000**	**4,800**	**590,000**	**92,000**	**49,000**	**290,000**
		680-SS-05	-	-	-	-	**2,800,000**	**2,700,000**	**6,400,000**	**7,200,000**	**3,100,000**	**4,000,000**
		680-SS-06	-	-	-	-	**680,000**	**580,000**	**910,000**	**800,000**	**570,000**	**330,000**
		680-SS-07	-	-	-	-	100	100	220	220	130	-
		680-SS-08	-	-	-	-	1,600	2,500	2,400	**2,800**	2,400	-

-	not applicable
(shaded)	EGLE SSC Exceedance
BOLD	TSRIASL12 Exceedance

Table 680-16 Summary of Results for trans-1,2-Dichloroethene (trans-1,2-DCE)

Sample Type	Screening Level (µg/m³)	Sample ID	Measured Concentration (µg/m³)									
			Oct. 2016	Aug./Sept. 2017	Feb. 2018	Apr. 2018	Feb. 2019	May 2019	Aug. 2019	Oct. 2019	Dec. 2019	Aug. 2020
			E1	E2	E3	E4	E5	E6	E7	E8	E9	E10
Outdoor Air	-	680-OA-01	<3.2	<0.63	<0.57	<0.65	<0.58	<0.64	<0.71	<0.64	<0.63	<0.66
Indoor Air	240 (EGLE SSC) 790 ($TSRIASL_{12}$)	680-IA-01	<3.3	<0.63	<0.70	<0.64	<0.65	<0.64	<0.69	<0.69	<0.72	<1.3
		680-IA-02	<3.1	<0.62	<0.64	<0.65	<0.65	<0.69	<0.71	<0.57	<0.71	<0.68
		680-IA-03	<3.1	<0.64	<0.65	<0.66	<0.66	<0.67	<0.71	<0.68	<0.74	<0.68
		680-IA-04	<3.1	<0.67	<0.64	<0.67	<0.62	<0.67	<0.68	<0.69	<0.73	<0.67
		680-IA-05	-	-	-	-	<1.2	<3.2	<0.71	<2.4	<1.4	<0.69
		680-IA-06	-	-	-	-	0.95	<<0.60	<0.78	<0.67	<0.72	<0.67
		680-IA-07	-	-	-	-	<0.63	<1.4	<0.68	<0.89	<0.72	-
		680-IA-08	-	-	-	-	<0.61	0<.67	<0.67	<0.65	<0.69	<0.67
Sub-Slab Soil Gas	8,200 (EGLE SSC) 26,000 ($TSRIASL_{12}$)	680-SS-01	32	32	12	22	13	23	34	26	22	-
		680-SS-02	21	14	5.2	4.4	<11	32	<3	9.7	19	-
		680-SS-03	400	740	270	360	130	55	370	820	550	-
		680-SS-04	1,300	1,800	400	240	340	<12	1,700	230	110	940
		680-SS-05	-	-	-	-	6,500	2,900	19,000	17,000	6,300	<11,000
		680-SS-06	-	-	-	-	8,900	5,400	13,000	11,000	8,400	6,000
		680-SS-07	-	-	-	-	<3.1	3.2	<3.4	<3.1	<3.2	-
		680-SS-08	-	-	-	-	15	20	21	26	31	-

-	not applicable
(shaded)	EGLE SSC Exceedance
BOLD	$TSRIASL_{12}$ Exceedance

Table 680-17 Summary of Results for Trichloroethene (TCE)

Sample Type	Screening Level (µg/m³)	Sample ID	Measured Concentration (µg/m³)									
			Oct. 2016	Aug./Sept. 2017	Feb. 2018	Apr. 2018	Feb. 2019	May 2019	Aug. 2019	Oct. 2019	Dec. 2019	Aug. 2020
			E1	E2	E3	E4	E5	E6	E7	E8	E9	E10
Outdoor Air	-	680-OA-01	<4.3	<0.17	0.3	0.26	0.17	<0.17	<0.19	0.41	<0.17	<0.18
Indoor Air	4 (EGLE SSC) 12 (TSRIASL12)	680-IA-01	<4.5	0.57	3.5	1.1	5	1.9	0.38	1.4	1.4	1.8
		680-IA-02	5	4.8	8.9	7.6	7.6	4.1	4.6	3.8	3.5	4
		680-IA-03	5.7	5.3	11	6.9	8.3	4.9	3.2	4.2	5.9	5.9
		680-IA-04	<4.2	3.8	0.24	0.31	0.28	8.7	1.8	0.56	0.97	1.7
		680-IA-05	-	-	-	-	**14**	**40**	5.6	**24**	**20**	0.94
		680-IA-06	-	-	-	-	**16**	0.53	2.2	6.3	6.8	0.7
		680-IA-07	-	-	-	-	7.2	4.5	3.4	4.1	4.3	-
		680-IA-08	-	-	-	-	4.9	2.4	0.39	1.9	1.6	0.36
Sub-Slab Soil Gas	130 (EGLE SSC) 400 (TSRIASL12)	680-SS-01	290	270	140	220	160	220	340	170	180	-
		680-SS-02	220	120	63	38	230	220	22	69	140	-
		680-SS-03	**3,500**	**6,500**	**2,600**	**2,400**	**980**	**470**	**2,500**	**3,700**	**3,300**	-
		680-SS-04	**18,000**	**32,000**	**5,300**	**2,300**	**4,800**	100	**21,000**	**3,000**	**1,600**	**13,000**
		680-SS-05	-	-	-	-	**250,000**	**170,000**	**530,000**	**590,000**	**250,000**	**340,000**
		680-SS-06	-	-	-	-	**140,000**	**100,000**	**170,000**	**150,000**	**120,000**	**64,000**
		680-SS-07	-	-	-	-	20	29	48	31	27	-
		680-SS-08	-	-	-	-	290	**450**	**400**	**470**	390	-

-	not applicable
(shaded)	EGLE SSC Exceedance
BOLD	TSRIASL12 Exceedance

Table 680-18 Summary of Results for Vinyl Chloride

Sample Type	Screening Level (µg/m³)	Sample ID	Measured Concentration (µg/m³)									
			Oct. 2016	Aug./Sept. 2017	Feb. 2018	Apr. 2018	Feb. 2019	May 2019	Aug. 2019	Oct. 2019	Dec. 2019	Aug. 2020
			E1	E2	E3	E4	E5	E6	E7	E8	E9	E10
Outdoor Air	-	680-OA-01	<2	<0.041	<0.042	<0.042	0.1	<0.041	<0.046	0.045	<0.04	<0.042
Indoor Air	28 (EGLE SSC) 280 ($TSRIASL_{12}$)	680-IA-01	<2.1	<0.04	<0.045	<0.041	0.072	<0.041	<0.045	<0.045	<0.047	<0.082
		680-IA-02	<2	<0.04	0.045	<0.042	0.073	<0.044	<0.046	0.058	<0.046	<0.044
		680-IA-03	<2	0.04	0.048	<0.043	0.095	<0.043	<0.046	0.054	<0.048	<0.044
		680-IA-04	<2	0.048	<0.041	<0.043	0.071	<0.043	<0.044	0.067	<0.047	<0.043
		680-IA-05	-	-	-	-	0.19	<0.21	0.048	0.17	0.12	<0.045
		680-IA-06	-	-	-	-	0.094	<0.038	<0.05	0.049	<0.047	<0.043
		680-IA-07	-	-	-	-	0.089	<0.089	<0.044	<0.057	<0.047	-
		680-IA-08	-	-	-	-	0.077	<0.043	<0.043	0.048	<0.048	<0.043
Sub-Slab Soil Gas	910 (EGLE SSC) 9,100 ($TSRIASL_{12}$)	680-SS-01	<14	<8.2	<6.8	<4.1	2.8	6	12	17	5.1	-
		680-SS-02	<2.2	<2	<2	<2	<6.8	<2.7	<2	<2.2	<2	-
		680-SS-03	<42	<20	<20	<20	<9.7	<4.5	<20	<20	<20	-
		680-SS-04	<110	<260	<130	<69	<37	<7.9	<190	<20	<51	<430
		680-SS-05	-	-	-	-	3,200	<990	<4,200	2,400	710	<7,000
		680-SS-06	-	-	-	-	390	<180	480	260	240	<350
		680-SS-07	-	-	-	-	<2	<1.9	<2.2	<2	<2	-
		680-SS-08	-	-	-	-	<2.7	10	<8.8	<16	<7.9	-

-	not applicable
(shaded)	EGLE SSC Exceedance
BOLD	$TSRIASL_{12}$ Exceedance

EVALUATION OF VI DATA TRENDS

Data trends for Building 680 are discussed below for both sub-slab soil gas and indoor air. When data exhibit a narrow range of variability, it is typical practice to express the range as a percentage. When data exhibit a large range of variability, however, it is more useful to express the range in orders of magnitude (i.e., factors of 10). This can be expressed mathematically as the log of the ratio of maximum/minimum values. If the values differ by a factor of 10, the log of the ratio is 1, if the values differ by a factor of 100, the log of the ratio is 2, and so on.

The variability across all locations over all sampling events is the total variability. This encompasses different types of variability, including spatial variability (i.e., how do the results vary from location to location), temporal variability (i.e., how do the results at a given location vary over time), and measurement variability. Measurement variability can be determined by evaluating results of duplicate or collocated samples and includes both sampling variability and analytical variability. The comparison of two data values is typically expressed as a relative percent difference (RPD). The comparison of three of more data values is typically expressed as the coefficient of variation (%CV), which is the standard deviation divided by the mean.

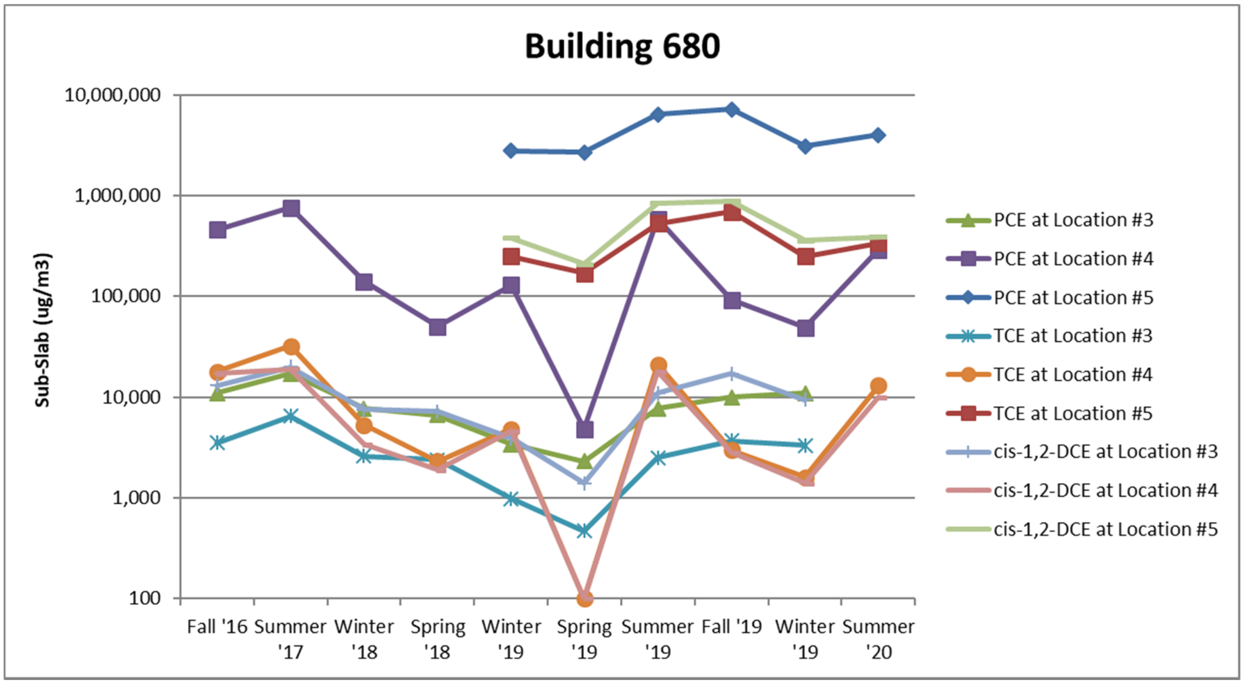
Sub-Slab Soil Gas Data Trends

Spatial Variability of Sub-Slab Soil Gas – The soil gas exhibits over more than four orders of magnitude of spatial variability. For example, sub-slab soil gas detections of PCE vary from 220 to 7,200,000 µg/m^3 (log of max./min. = 4.5) across the eight locations for E8. During that same sampling event, the range for TCE was 31 to 690,000 µg/m^3 (log of max./min. = 4.4). For E7, the range for cis-1,2-DCE was 14 to 840,000 µg/m^3 (log of max./min. = 4.8).

Temporal Variability of Soil Gas – The soil gas exhibits up to two orders of magnitude of temporal variability. For example, sub-slab soil gas concentrations of PCE vary from 4,800 to 760,000 µg/m^3 at location 680-SS-04 (log max/min = 2.2) across all ten sampling events. At that same location, the range for TCE was 100 to 32,000 µg/m^3 (log max/min = 2.5). Measured values for E6 were atypically low. If this event is not included, the temporal variability was about one order of magnitude for PCE and TCE. The variability for PCE and TCE at other locations was less (e.g., about a factor of three). Similarly, the variability for other analytes was relatively small. For the three rounds of sampling performed since the trend analysis summary presented in the 2019 CAIP, the soil-gas concentrations vary by about a factor of three for the locations with the greatest impacts.

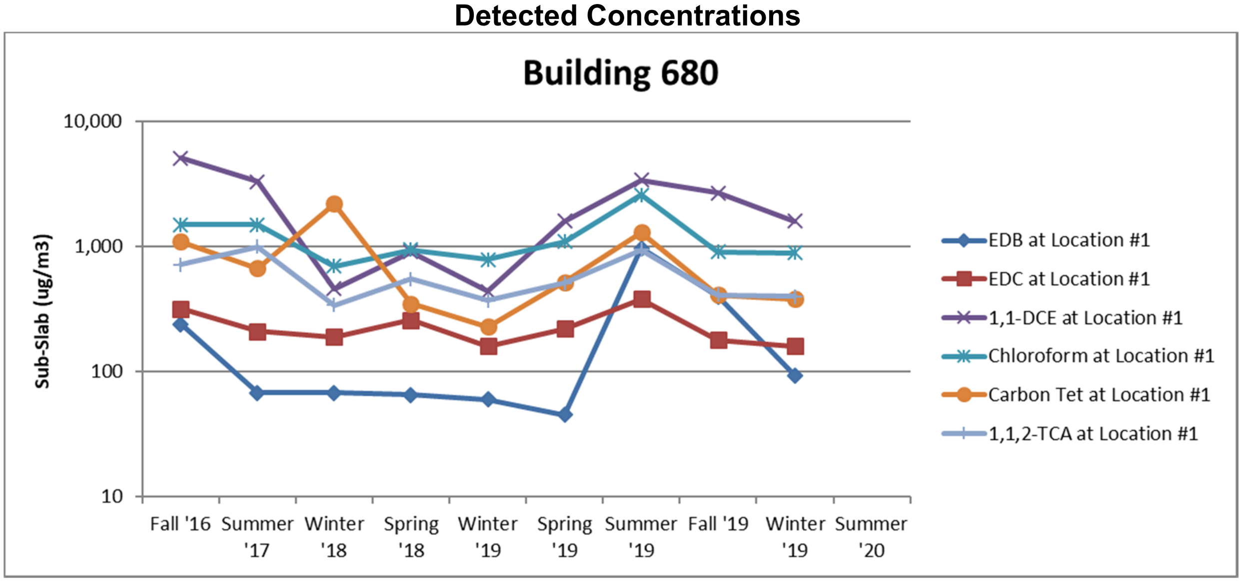
Seasonal Confirmation Sampling Trend Analysis – No formal statistical tests were performed but the sub-slab soil gas data at locations with the highest concentrations do not exhibit any upward or downward trend over the course of the ten sampling events. This is illustrated in the graph below, which shows results for several locations with relatively high concentrations for the three analytes detected at the highest concentrations (i.e., PCE, TCE, and cis-1,2-DCE). Note that the y-axis is a log scale.

Figure 680-1. Seasonal Confirmation Sampling Trend Analysis for Analytes with Highest Detected Concentrations



For analytes with lower sub-slab soil gas concentrations, the values also tended to be stable over time. This is illustrated in the figure below. Data for various analytes at location 680-SS-01 are shown (i.e., the location where the highest concentrations of that analyte generally were detected during the sampling events). Note that the y-axis is still a log scale, but for a lower range of values.

Figure 680-2. Seasonal Confirmation Sampling Trend Analysis for Analytes with Lower Detected Concentrations



The data set was examined to see what the potential consequences would have been had only a single sampling event been performed. For the analytes present at the highest concentrations in the sub-slab soil gas (i.e., PCE, TCE, and cis-1,2-DCE), the maximum sub-slab soil gas concentration was obtained during E2 (summer) for locations sampled in all ten events or E8 (fall) for locations added in early 2019. For PCE at location 680-SS-04, the value increased from 460,000 µg/m^3 during E1 to 760,000 µg/m^3

during E2. If only the first sampling event had been performed, a negative bias of 65% would have been introduced (i.e., the PCE value for E2 was 65% higher than the PCE value for E1).

Indoor Air Data Trends

Spatial Variability of Indoor Air – The indoor air exhibits about two orders of magnitude of spatial variability. For example, PCE was detected in all eight indoor air samples and varied from 3.5 to 440 µg/m^3 during E6 (log max./min. = 2.1). PCE had somewhat lower spatial variability during other sampling events. During E6, TCE was detected in all eight indoor air samples and varied from 0.53 to 40 µg/m^3 (log max./min. = 1.9.). TCE had less spatial variability during the other sampling events.

After the Retro-Coat™ Vapor Intrusion Coating System was applied in July 2020, lower concentrations were measured in indoor air and the spatial variability was lower. For PCE in E10, the indoor air results range from 2.8 to 52 µg/m^3 (log max./min. = 1.3). TCE in E10 ranged from 0.36 to 5.9 µg/m^3 (log max./min. = 1.2). The highest indoor air concentrations of PCE and TCE prior to the Retro-Coat™ application have consistently occurred at location 680-IA-05. For PCE, the average indoor air concentration at location 680-IA-05, prior to Retro-Coat™ application, was approximately 270 ug/m^3. In comparison, the detected concentration of PCE at 680-IA-05 after Retro-Coat™ application was 17 ug/m^3, which is well below the EGLE SSC (82 ug/m^3). For TCE, the average indoor air concentration at location 680-IA-05, prior to Retro-Coat™ application, was approximately 20 ug/m^3. In comparison, the detected concentration of TCE at 680-IA-05 after Retro-Coat™ application was 0.94 ug/m^3, which is well below the EGLE SSC (4 ug/m^3). The TCE indoor air concentration during E10 that was above the EGLE SSC occurred outside of the Retro-Coat™ application area (e.g., sample location 680-IA-03).

Temporal Variability of Indoor Air – The detected values for PCE and TCE exhibit temporal variability of about one order of magnitude over time. For example, PCE was detected during nine of 10 sampling events at locations 680-IA-01 and also at 680-IA-04 and the values ranged from 2.8 to 36 µg/m^3 at location 680-IA-01 (log max./min. = 1.1) and from 4.2 to 87 µg/m^3 at location 680-IA-04 (log max./min. = 1.3). For TCE, the variability over time was similar to that for PCE. For example, TCE was detected during nine of the 10 sampling events at location 680-IA-04, with values ranging from 0.24 to 8.7 µg/m^3 (log max./min. = 1.6).

Additional Analyses

Comparison of Sub-Slab Soil Gas and Indoor Air Data Sets – As expected, the sub-slab soil gas data exhibit greater spatial variability than the indoor air data set. The sub-slab soil gas data had somewhat greater temporal variability than the indoor air data, which is contrary to expectations. This suggests that any indoor emissions of the AOIs do not vary greatly over time if they are in regular use in the building (e.g., routine workplace chemical use).

Seasonal Effects –The data do not support the hypothesis that wintertime will have higher indoor air impacts. The highest sub-slab soil gas concentrations were measured in August (summer) or October (fall), but the highest indoor air concentrations for PCE and TCE were measured in May (spring). The data indicate that at this building, wintertime "stack effects" across the slab are not significant compared with other seasons of the year.

Comparison of Attenuation Factors by Event – Attenuation factors were calculated based on maximum values and are shown in Table 680-19. Events E1 – E7 were presented in the 2019 CAIP and are summarized in the table below. The values in Table 680-19 have not been corrected for any contribution from outdoor air.

Table 680-19. Calculated Attenuation Factors

	E1	E2	E3	E4	E5
Evaluation Based on Maximum Detected Value					
1,1-DCE	NC	4.8E-05	4.6E-04	2.3E-04	1.0E-04
PCE	6.5E-05	7.1E-05	5.4E-04	1.1E-03	8.2E-05
TCE	3.2E-04	1.7E-04	2.1E-03	3.2E-03	6.4E-05
cis-1,2-DCE	8.2E-04	3.4E-04	1.2E-03	8.3E-04	6.1E-05
HCBD	<7.8E-03	<9.5E-04	<2.9E-03	<2.0E-03	<2.9E-03
EDC	NC	9.5E-04	7.4E-04	<5.4E-04	1.1E-03
trans-1,2-DCE	NC	<3.7E-04	<1.8E-03	<1.9E-03	1.1E-04
Chloroform	NC	3.2E-04	6.6E-04	4.3E-04	5.1E-04
1,1,1-TCA	NC	4.4E-04	2.8E-03	<9.5E-04	2.4E-04
Carbon Tetrachloride	NC	6.8E-04	2.3E-04	1.3E-03	3.4E-03
1,1,2-TCA	NC	<1.8E-04	<5.6E-04	<3.3E-04	<9.2E-04

	E6	E7	E8	E9	E10
Evaluation Based on Maximum Detected Value					
1,1-DCE	2.1E-04	1.5E-05	4.8E-05	4.5E-05	No data
PCE	1.6E-04	1.0E-05	5.3E-05	8.1E-05	1.3E-05
TCE	2.4E-04	1.1E-05	3.5E-05	8.0E-05	1.7E-05
cis-1,2-DCE	2.1E-04	5.5E-06	3.9E-05	5.6E-05	7.9E-06
HCBD	<3.3E-03	<2.3E-04	<1.0E-03	<1.2E-03	<1.2E-03
EDC	<3.0E-03	<4.2E-04	<1.0E-03	9.4E-04	<4.7E-04
trans-1,2-DCE	<5.9E-04	<4.1E-05	<1.4E-04	<1.7E-04	<2.2E-04
Chloroform	7.1E-04	4.8E-05	1.9E-04	1.2E-04	1.9E-04
1,1,1-TCA	6.7E-04	6.9E-06	7.6E-05	4.1E-05	No data
Carbon Tetrachloride	9.3E-04	3.5E-04	7.3E-04	1.2E-03	<5.5E-04
1,1,2-TCA	<1.7E-03	<2.1E-03	<1.6E-03	<9.3E-04	<4.7E-04

NC - Not calculated due to elevated detection limits for indoor air.

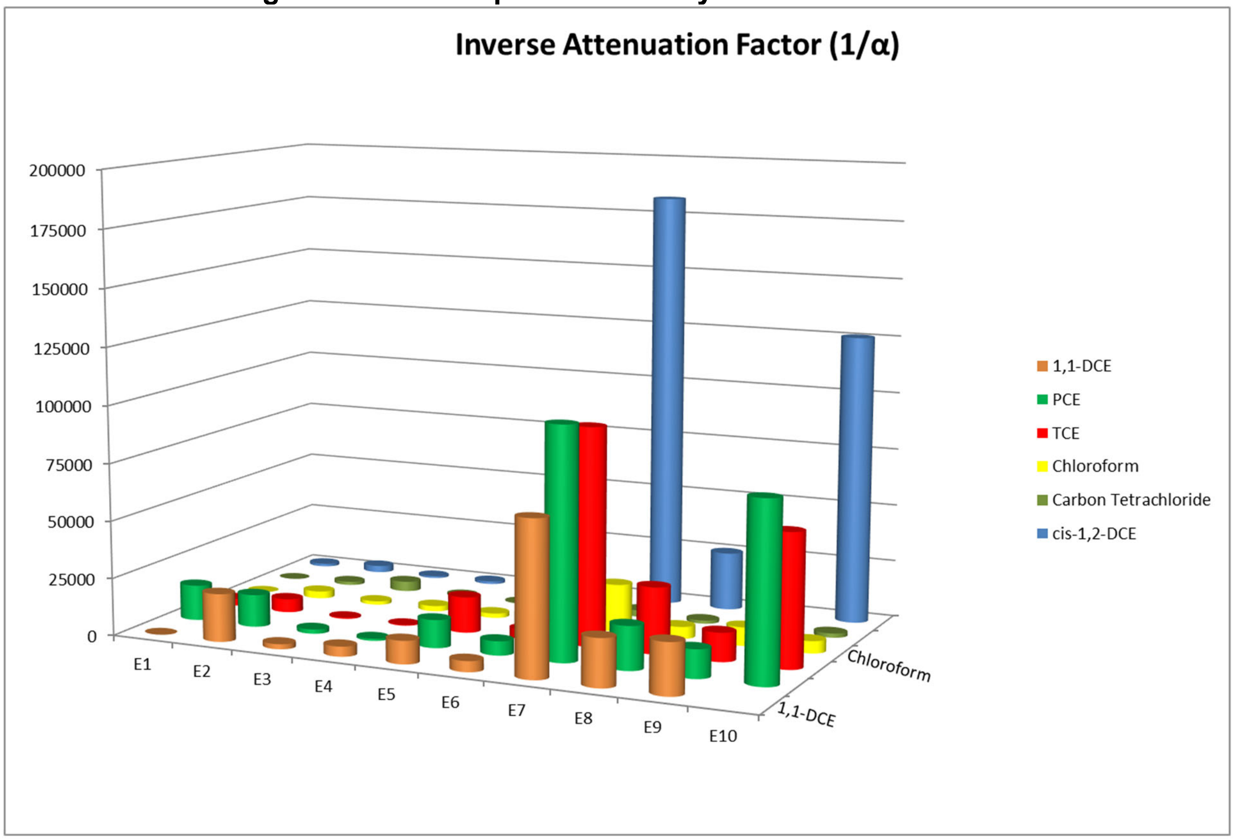
The best conservative estimates of a building-specific attenuation factor for Building 680 are the values for 1,1-DCE and cis-1,2-DCE for each sampling event. These analytes generally have the smallest attenuation factor for each sampling event (i.e., the least bias due to contributions from any indoor or outdoor sources). They are the only analytes detected at relatively high concentrations in the subsurface with all of what was detected indoors likely attributable to VI (i.e., the bias introduced by indoor emission sources and/or outdoor air is believed to be negligible).

Temporal Variability in Attenuation Factor – As shown in Table 680-19, there was slightly more than one order of magnitude in temporal variability in the calculated attenuation factors observed in the data set, with E3 having the least attenuation. E7 and E10 have the greatest attenuation. The E7 sampling event occurred after interim actions were implemented to seal the joint seams that were identified during further investigation activities conducted in March 2019. E10 occurred after the application of the Retro-Coat™ Vapor Intrusion Coating System completed in July 2020. As illustrated in Figure 680-3 (below) that plots the inverse attenuation factor for various analytes for each sampling event, mitigation actions completed to date appear to have reduced levels of VI in Building 680. Taller columns denote greater attenuation (i.e. less VI), so the height of the last sampling event (E10) versus the earlier sampling events provides an indication of the effectiveness of Retro-Coat™ Vapor Intrusion Coating System. Assuming VI was the only source of these analytes in indoor air, all of the columns for each event would be expected to have about the same height. Shorter columns either indicate greater levels of vapor intrusion or greater contribution from indoor workplace chemical use and/or outdoor sources for a given analyte.

The calculated attenuation factors are based on the maximum measured values for each round of sampling. The highest sub-slab soil gas and indoor air concentrations of PCE and TCE have consistently occurred at location 680-XX-05. However, for E10, while the maximum sub-slab soil gas concentrations continued to be at location 680-SS-05, the highest indoor air concentrations occurred outside of the Retro-Coat™ application area. To address the effectiveness of the Retro-Coat™ application, results from

680-XX-05 were evaluated further. For PCE at 680-XX-05, the sample-specific attenuation factor was 4.3E-06 (versus 1.3E-05 based on overall E10 maximum values). For TCE at 680-XX-05, the sample-specific attenuation factor was 2.8E-06 (versus 1.7E-05 based on overall E10 maximum values). This data suggests that the Retro-Coat™ Vapor Intrusion Coating System application yielded results that were about an order of magnitude more effective than the attenuation factors derived from overall maximum measured values, which include indoor air maximum values that occurred outside of the Retro-Coat™ application area.

Figure 680-3. Temporal Variability in Attenuation Factor



NON-DETECT EVALUATION

There were 11 ND analytes in indoor air with RLs that exceeded the indoor air screening level during E1. Of those, only three analytes continued to have ND exceedances in E2 – E10: 1,2,4-TCB, EDB and HCBD. In E4, 1,2,4-TCB ND RLs were all below the indoor air EGLE SSC, but they were above in E5, E6, and E7. EDB and HCBD were already identified as AOIs due to detections in sub-slab soil gas that exceed the EGLE SSCs; however, 1,2,4-TCB was added to that list based on ND sub-slab soil gas values in the 2019 sampling events. For all three analytes, estimated indoor air concentrations are provided below. Furthermore, due to laboratory limitations to achieve low enough RLs that consistently meet screening levels for EDB and HCBD, further investigation for these analytes will be conducted once the facility-wide priority buildings have been sampled and evaluated.

While HCBD, EDB and 1,2,4-TCB are sub-slab soil gas AOIs, there have been no detections of HCBD, EDB, of 1,2,4-TCB in indoor air; however, the ND RLs often exceed the EGLE SSC for HCBD (5.4 $\mu g/m^3$), for EDB (0.2 $\mu g/m^3$), and for 1,2,4-TCB (2.1 $\mu g/m^3$). As shown in Tables 680-3, 680-4, and 680-5, using the selected building-specific attenuation factor, indoor air values due to VI were estimated for events E8, E9, and E10 based on the maximum sub-slab soil gas concentration for each event.

Table 680-20. Evaluation of Estimated Indoor Air Concentrations for HCBD

	E8	E9	E10
Evaluation Based on Maximum Detected Value			
Maximum Detection of HCBD in Sub-Slab Soil Gas (μg/m^3)	13,000	5,500	n/a
Building-specific attenuation factor	3.9E-05	5.6E-05	7.9E-06
Predicted Indoor Air Impacts (μg/m^3)[a]	0.51	0.31	NC
Exceedance of Screening Level of 5.4 μg/m^3?	No	No	No
Evaluation Based on Maximum Detection Limit			
Maximum Detection Limit of HCBD in Sub-Slab Soil Gas (μg/m^3)	<8,600	<11,000	<120,000
Building-specific attenuation factor	3.9E-05	5.6E-05	7.9E-06
Predicted Indoor Air Impacts (μg/m^3)[a]	<0.33	<0.62	<0.95
Exceedance of Screening Level of 5.4 μg/m^3?	No	No	No

[a] Based on the selected building-specific attenuation factor for each sampling event.

Table 680-21. Evaluation of Estimated Indoor Air Concentrations for EDB

	E8	E9	E10
Evaluation Based on Maximum Detected Value			
Maximum Detection of EDB in Sub-Slab Soil Gas (μg/m^3)	400	93	n/a
Building-specific attenuation factor	3.9E-05	5.6E-05	7.9E-06
Predicted Indoor Air Impacts (μg/m^3)[a]	0.02	0.005	NC
Exceedance of Screening Level of 0.2 μg/m^3?	No	No	No
Evaluation Based on Maximum Detection Limit			
Maximum Detection Limit of EDB in Sub-Slab Soil Gas (μg/m^3)	<1,500	<2,100	<21,000
Building-specific attenuation factor	3.9E-05	5.6E-05	7.9E-06
Predicted Indoor Air Impacts (μg/m^3)[a]	<0.06	<0.12	<0.17
Exceedance of Screening Level of 0.2 μg/m^3?	No	No	No

[a] Based on the selected building-specific attenuation factor for each sampling event.

Table 680-22. Evaluation of Estimated Indoor Air Concentrations for 1,2,4-TCB

	E8	E9	E10
Evaluation Based on Maximum Detected Value			
Maximum Detection of EDB in Sub-Slab Soil Gas (μg/m^3)	14,000	n/a	n/a
Building-specific attenuation factor	3.9E-05	5.6E-05	7.9E-06
Predicted Indoor Air Impacts (μg/m^3)[a]	0.55	NC	NC
Exceedance of Screening Level of 2.1 μg/m^3?	No	No	No
Evaluation Based on Maximum Detection Limit			
Maximum Detection Limit of EDB in Sub-Slab Soil Gas (μg/m^3)	<2,400	<8,000	<81,000
Building-specific attenuation factor	3.9E-05	5.6E-05	7.9E-06
Predicted Indoor Air Impacts (μg/m^3)[a]	<0.09	<0.45	<0.64
Exceedance of Screening Level of 2.1 μg/m^3?	No	No	No

[a] Based on the selected building-specific attenuation factor for each sampling event.

As shown in Tables 680-20, 680-21 and 680-22, the ND evaluation demonstrates that the estimated indoor air concentrations for HCBD, EDB, and 1,2,4-TCB attributable to VI are below their respective EGLE SSC for all three recent sampling events based on the maximum detected values and for the maximum detection limits.

WEIGHT-OF-EVIDENCE SUMMARY

A summary of all VI data trends and findings is presented in Table 680-23.

Table 680-23. Summary of Findings of Seasonal Confirmation Sampling

Topic	Finding	Details
Spatial Variability of Sub-Slab Soil Gas	Four orders of magnitude or less	PCE during E8 ranged from 220 to 7,200,000 µg/m^3, log max./min. = 4.5 TCE during E8 ranged from 69 to 690,000 µg/m^3, log max./min. = 4.4 For other sampling events involving eight locations, log max./min. generally were similar
Temporal Variability of Sub-Slab Soil Gas	Two orders of magnitude	PCE at location 680-SS-04 ranged from 4,800 to 760,000 µg/m^3, log max./min. = 2.2 Variability for other analytes was similar. For E8 to E10, variability was about a factor of three.
Seasonal Trend Analysis	Seasonal sampling is appropriate	No observed seasonal dependence and no upward or downward trend in concentration
Spatial Variability of Indoor Air	Two orders of magnitude or less	PCE during E6 ranged from 3.5 to 440 µg/m^3, log max./min. = 2.1
Temporal Variability of Indoor Air	One order of magnitude	PCE at location 680-SS-04 ranged from 4.2 to 87 µg/m^3, log max./min. = 1.3
Comparison of Sub-Slab Soil Gas vs. Indoor Air	Data show the expected trends for spatial variability. Less temporal variability in indoor air than expected.	Spatial variability: sub-slab soil gas > indoor air Temporal variability: sub-slab soil gas >indoor air
Best Estimate of Attenuation Factor	Varies from event to event	Best estimates for attenuation factors are based on 1,1-DCE and cis-1,2-DCE data. Values in last three rounds of sampling vary from a minimum of 7.9E-06 and a maximum of 5.6E-05
Temporal Variability in Attenuation Factor	No definitive trend in seasonal attenuation. Prior to mitigation steps, greatest attenuation occurred during E2 (summer) and E5 (winter)	All calculated attenuation factors fall within about two orders of magnitude The wintertime E9 event had somewhat lower attenuation than the preceding E8 event conducted in the fall.
Overall Summary	**Significant decrease of VI impacts after Retro-Coat™ Vapor Intrusion Coating System application.**	**Overall attenuation factor reduction post-application to approximately 1E-05 for PCE and TCE and approximately 4E-06 for the application area (sample location 680-XX-05).**

SUMMARY AND PATH FORWARD

Building 680 is confirmed as a VI Path Forward Group 4B building. Dow implemented an interim response action in July 2020 and one round of sampling has been performed since that time. The initial sampling results post-application (E10) of the Retro-Coat™ Vapor Intrusion Coating System indicate the effectiveness of the Retro-Coat barrier as a preventative measure against VI.

Quarterly interim monitoring will continue. When data and/or findings are available, updates will be provided to EGLE in the monthly Corrective Action meetings. Results from each monitoring event will be reported in the annual CAIP. Dow may propose changes to the frequency or other aspects of these interim actions based on an evaluation of the data, changes in building use or implementation of other interim response actions to address the potential VI pathway.

5.2.5 Building 838 Interim Monitoring Results Summary

Building 838 is a Category 2 building located within the southwest portion of the facility designated as Zone 1. It is known as the Sulfonamides Shop and contains office space, a shop, storage room, locker room, and a lunch room. Building 838 is a Group 2 building that completed seasonal confirmation sampling in April 2018. A full evaluation and trend analysis was provided in the 2018 CAIP. All indoor air analytes were detected below screening levels during each of the seasonal confirmation sampling events. The sub-slab soil gas AOIs are PCE, TCE, and HCBD due to exceedances of the EGLE SSC. PCE and TCE also exceeded the $TSRIASL_{12}$ in sub-slab soil gas.

Based on the evaluation of the four seasonal confirmation sampling events, the VI pathway is insignificant for Building 838 and the sub-slab soil gas results exhibited relatively stable concentrations and no evidence of increasing over time. Sufficient information exists to make a human exposure under control EI determination. However, while currently there is no evidence of potential VI, for future use, LTM was warranted and the building-specific Interim Monitoring Plan was implemented.

Indoor air is monitored at location 838-IA-02 (see Figure 5.2.5-1). This location was selected for continued monitoring since it demonstrated the highest sub-slab soil gas results. Monitoring is performed for PCE, TCE, and HCBD. Interim monitoring is performed semi-annually and the initial event was conducted in August 2019 and results were reported in the 2019 CAIP (January 2020). The indoor air results for IM Event 2 (December 2019) and IM Event 3 (August 2020) are shown below in Table 838-1.

Table 838-1. Interim Monitoring Indoor Air Results for IM Events 2 and 3 for Building 462

Indoor Air Analyte	Result Value (μg/m^3)	Reporting Limit (μg/m^3)	EGLE SSC (μg/m^3)	NONRES TSRIASL$_{12}$ (μg/m^3)	Dow IH OEL (8-hour Time Weighted Average) (μg/m^3)
IM Event 2					
Hexachlorobutadiene	ND	3.6	5.4	NA	213
Tetrachloroethene	5.3	--	82	82	67,800
Trichloroethene	0.34	--	4	12	26,850
IM Event 3					
Hexachlorobutadiene	ND	3.7	5.4	NA	213
Tetrachloroethene	4.4	--	82	82	67,800
Trichloroethene	0.31	--	4	12	26,850

As shown on the table above, all indoor air results from the Winter 2019 and Summer 2020 IM event were below screening levels or ND with a RL below the indoor air RIASL$_{12}$. The analytical data is presented in Appendix A. Field sampling forms are provided in Appendix B. The next IM event is scheduled for Winter 2020/2021. Semi-annual interim monitoring will continue in the summer and winter of 2021.

5.2.6 VI Seasonal Confirmation Sampling Results Evaluation for Building 1098

INTRODUCTION

Building 1098 is a Category 2 building in Zone 1, located within the southeast portion of the Midland facility (Figure 5.2.6-1). It is known as the Environmental Operations (EVO) Maintenance Shop and it is a small single-story building with an open-air storage loft, and it contains a maintenance shop and two offices.

Building 1098 was initially evaluated in the 2017 CAIP and it was concluded that the VI pathway was an insignificant exposure pathway based on current use. Building 1098 was placed into VI Path Forward Building Group 1 and no further VI evaluation was warranted at that time. The results from the initial sampling event were then rescreened in the August 2018 Rescreen. All indoor air analytes were less than screening levels; however, based on exceedances in sub-slab soil gas, Building 1098 was moved into VI Path Forward Building Group 2. Group 2 is a designation for buildings that have sub-slab soil gas AOIs; however, indoor air results are less than screening levels. Any building placed in Group 2 is scheduled for seasonal confirmation sampling.

The results of the initial sampling event (E1) were evaluated in the 2017 CAIP. The 2019 CAIP evaluated three seasonal sampling events (through E3). The remaining seasonal event (E4) has been completed (see Table 1098-1) and the results of all four sampling events are included and evaluated herein. 1,4-diclrorbenzene (1,4-DCB), benzene, CFC-12, hexane, and TCE were detected above the EGLE SSC in sub-slab soil gas. All indoor air results were less than the EGLE SSC.

Table 1098-1. Summary of Seasonal Confirmation Sampling Events for Building 1098

Building 1098	
Initial Sampling Event	**Completed**
E1	October 2016 (Fall)
Seasonal Sampling Event	**Completed**
E2	April 2019 (Spring)
E3	August 2019 (Summer)
E4	December 2019 (Winter)

Based on the evaluation of the four seasonal confirmation sampling events the VI pathway continues to be insignificant. Sufficient information exists to make a human exposure under control EI determination.

SUB-SLAB SOIL GAS RESULTS EVALUATION

Sub-slab soil gas samples were collected from four locations from within the building. Indoor air samples were collected at four locations corresponding to the soil gas sample locations, along with an outdoor air sample from the main air intake. The sampling locations are shown on Figure 5.2.6-2. Summary statistics and screening comparison results are presented for sub-slab soil gas on Table 5.2.6-1 and indoor and outdoor air on Table 5.2.6-2. The analytical data is presented in Appendix A. Field sampling forms are provided in Appendix B. Table 1098-2 presents the sub-slab soil gas results that exceed the EGLE SSCs. The relatively high concentrations of CFC-12 and hexane in soil gas resulted in elevated detection limits for other compounds at location 1098-SS-03 and, to a lesser extent, at 1098-SS-01 and 1098-SS-02.

Table 1098-2. Summary of Sub-Slab Soil Gas Exceedances for Building 1098

Analyte (Sampling Event)	Detection Frequency	Measured Range of Detects ($\mu g/m^3$)	% Detections > EGLE SSC	EGLE SSC ($\mu g/m^3$)
1,4-Dichlorobenzene (1)	25%	1,800	25%	1,000
1,4-Dichlorobenzene (2)	25%	360	0%	1,000
1,4-Dichlorobenzene (3)	25%	720	0%	1,000
1,4-Dichlorobenzene (4)	25%	840	0%	1,000
Benzene (1)	50%	45 - 410	0%	510
Benzene (2)	25%	19	0%	510
Benzene (3)	50%	590 - 1,900	50%	510
Benzene (4)	25%	260	0%	510
CFC-12 (1)	100%	6,600 - 320,000	50%	34,000
CFC-12 (2)	100%	860 - 12,000	0%	34,000
CFC-12 (3)	100%	4,100 - 290,000	25%	34,000
CFC-12 (4)	100%	71 – 240,000	25%	34,000
Hexane (1)	100%	200 - 15,000	0%	72,000
Hexane (2)	100%	54 - 2,100	0%	72,000
Hexane (3)	75%	1,500 - 260,000	25%	72,000
Hexane (4)	75%	280 – 120,000	25%	72,000
TCE (1)	0%	ND	0%	130
TCE (2)	25%	100	0%	130
TCE (3)	25%	410	25%	130
TCE (4)	25%	180	25%	130

Table 1098-3 summarizes the indoor air results relative to the sub-slab soil gas exceedances, since VI only potentially occurs if the analyte is present in both sub-slab soil gas and indoor air. Therefore, the table below provides the analyte detected above applicable screening levels in sub-slab soil gas as well as the corresponding indoor air sample result. The outdoor air sample result is also provided to determine if the analytes were present in indoor air due to migration from outdoor air.

Table 1098-3. Vapor Intrusion Evaluation for Building 1098

Analyte	Indoor Air Detection Frequency	Indoor Air Measured Range (μg/m³)	Indoor Air Screening Level* (μg/m³)	Outdoor Air Result (μg/m³)
1,4-Dichlorobenzene (1)	0%	ND	30	ND
1,4-Dichlorobenzene (2)	0%	ND	30	ND
1,4-Dichlorobenzene (3)	0%	ND	30	ND
1,4-Dichlorobenzene (4)	0%	ND	30	ND
Benzene (1)	0%	ND	15.4	3.5
Benzene (2)	50%	0.28 - 0.34	15.4	0.38
Benzene (3)	100%	0.44 - 0.72	15.4	0.36
Benzene (4)	100%	0.58 – 0.72	15.4	0.53
CFC-12 (1)	100%	4.4 - 11	1,020	ND
CFC-12 (2)	100%	2.6 - 4.2	1,020	3.1
CFC-12 (3)	100%	4.9 - 10	1,020	2.3
CFC-12 (4)	100%	3.1 – 4.8	1,020	2.6
Hexane (1)	75%	3.5 - 8	2,200	9.9
Hexane (2)	25%	5.2	2,200	ND
Hexane (3)	100%	3.2 - 14	2,200	ND
Hexane (4)	75%	4.6 – 4.9	2,200	ND
TCE (1)	0%	ND	4	ND
TCE (2)	25%	1.0	4	ND
TCE (3)	100%	0.17 - 2.2	4	ND
TCE (4)	50%	0.29 – 0.83	4	ND

In sub-slab soil gas, 1,4-DCB was only detected in one of the four sample locations (1098-SS-02) during each of the seasonal confirmation sampling events and only a single detect was above the sub-slab soil gas EGLE SSC. 1,4-DCB had a 0% detection frequency in indoor air.

While benzene was detected in sub-slab soil gas in at least one sample during each sampling event, only two samples during E3 had detections above the EGLE SSC. Although indoor air concentrations may have been influenced by outdoor air; all indoor air detections of benzene were less than the EGLE SSC.

CFC-12 had a 100% detection frequency in sub-slab soil gas, but only four samples across seasonal confirmation sampling were above the EGLE SSC. While CFC-12 was detected in all indoor air samples, the detections were all far below the EGLE SSC. CFC-12 was also detected in outdoor air at similar concentrations during E2 – E4.

Detections of hexane in sub-slab soil gas exceeded the EGLE SSC in E3 and E4 in a single sample. All hexane results in indoor air are far below the EGLE SSC.

TCE was detected in one sub-slab soil gas sample during E2 – E4 and the results during E3 and E4 exceeded the EGLE SSC. While TCE was detected in indoor air, all results were less than the EGLE SSC.

VAPOR INTRUSION CONCEPTUAL SITE MODEL

VI is an exposure pathway that results from the migration of volatilized chemicals from the subsurface to indoor air in overlying occupied buildings. A source, migration route and a human receptor must be present for the VI pathway to be complete. The focus of this building specific investigation is to evaluate the potential VI exposure pathway for employees and contractors at Building 1098. The CSM is illustrated in Figure 5.2.6-3.

Building 1098 is a Category 2 building and is located within the southeast portion of the facility designated as Zone 1. It is known as the Environmental Operations (EVO) Maintenance Shop and it is a small single-story building with an open-air storage loft, and it contains a maintenance shop and two offices. The building has shop benches, some warehouse-like storage, a garage space, locker rooms, office space, and a kitchen. The building is a maintenance building that supports EVO (the WWTP/kiln). It too was constructed sometime between 1965 and 1982 and is approximately 6,250 ft^2 in size

Occupants at any given time working in the building range in number from 5-15 workers. The typical parameters for non-residential exposures are assumed to apply but likely overestimate exposure for the personnel stationed at this building (i.e., 40 hours/week, 50 weeks/year exposure).

The building survey was completed before the initial sampling event. Drains and other openings were screened with a PID and no soil gas entry points were identified. A chemical inventory was completed during the building survey and a wide variety of chemicals were found to be stored within the building (e.g., various cleaners, stains, degreasers, primers, galvanizers).

EVALUATION OF SEASONAL CONFIRMATION SAMPLING EVENTS

Four seasonal sampling events have been completed at Building 1098. The sampling events encompass more than one year of time and include sampling during each season of the year. The results from the four seasonal confirmation sampling events were evaluated with respect to spatial variability, temporal variability, and seasonal trend analysis.

Building specific attenuation factors (α) were calculated and compared between events to evaluate temporal variability and determine the best estimate of a building-specific attenuation factor. This evaluation serves to confirm that the existing study design is appropriate, and also provides insight for the determination of the path forward for this building.

This evaluation focused on any analytes detected in the sub-slab soil gas samples that met the criterion for inclusion in one or more of the following categories:

a) Analytes detected in sub-slab soil-gas at concentrations that exceeded EGLE SSCs;

b) Analytes detected in sub-slab soil-gas at concentrations of 1,000 $\mu g/m^3$ or greater in one or more samples. Data for analytes detected above 1,000 $\mu g/m^3$ should provide the clearest signal and be the simplest to interpret when assessing data trends. The same data trends observed for these analytes are expected to apply to other similar analytes present at lower concentrations; and

c) PCE and TCE. These two analytes are of particular interest for many VI evaluations at industrial sites.

For this building, the analytes detected in the sub-slab soil gas at concentrations above the EGLE SSC include 1,4-DCB, benzene, CFC-12, hexane and TCE. Three additional analytes had detected concentrations $\geq$1,000 $\mu g/m^3$, 1,1-dichloroethane, CFC-114 and cyclohexane; however, due to minimal detections throughout sampling, these three analytes were excluded from additional evaluation, as was PCE due to low detection frequency. Sample results for 1,4-DCB, benzene, CFC-12, hexane and TCE are provided in the following data tables.

Table 1098-4 Summary of Results for 1,4-Dichlorobenzene

Sample Type	Screening Level (µg/m³)	Sample ID	Measured Concentration (µg/m³)			
			Oct. 2016	May 2019	Aug. 2019	Dec. 2019
			E1	E2	E3	E4
Outdoor Air	-	1098-OA-01	<4.3	<0.2	<0.2	<0.22
Indoor Air	30 (EGLE SSC) 300 ($TSRIASL_{12}$)	1098-IA-01	<5	<0.2	<0.2	<0.22
		1098-IA-02	<5	<0.22	<0.2	<0.21
		1098-IA-03	<4.9	<0.19	<0.22	<0.28
		1098-IA-04	<5	<0.22	<0.19	<0.21
Sub-Slab Soil Gas	1,000 (EGLE SSC) 10,000 ($TSRIASL_{12}$)	1098-SS-01	<340	<93	<420	<4.8
		1098-SS-02	1,800	360	720	840
		1098-SS-03	<2,400	<8	<2,200	<1,500
		1098-SS-04	<74	<92	<260	<62

Table 1098-5 Summary of Results for Benzene

Sample Type	Screening Level (µg/m3)	Sample ID	Measured Concentration (µg/m³)			
			Oct. 2016	May 2019	Aug. 2019	Dec. 2019
			E1	E2	E3	E4
Outdoor Air	-	1098-OA-01	3.5	0.38	0.36	0.53
Indoor Air	15.4 (EGLE SSC) 54 (TSRIASL12)	1098-IA-01	<2.6	0.34	0.59	0.58
		1098-IA-02	<2.7	<0.29	0.47	0.63
		1098-IA-03	<2.6	0.28	0.72	0.72
		1098-IA-04	<2.6	<0.29	0.44	0.69
Sub-Slab Soil Gas	510 (EGLE SSC) 1,800 (TSRIASL12)	1098-SS-01	<180	<50	<220	<2.6
		1098-SS-02	410	<160	<310	<50
		1098-SS-03	<1,300	19	**1,900**	<790
		1098-SS-04	45	<49	590	260

-	not applicable
(shaded)	EGLE SSC Exceedance
BOLD	TSRIASL12 Exceedance

Table 1098-6 Summary of Results for Dichlorodifluoromethane (CFC-12)

Sample Type	Screening Level (µg/m3)	Sample ID	Measured Concentration (µg/m^3)			
			Oct. 2016	May 2019	Aug. 2019	Dec. 2019
			E1	E2	E3	E4
Outdoor Air	-	1098-OA-01	<3.5	3.10	2.30	2.60
Indoor Air	1,020 (EGLE SSC)	1098-IA-01	11	2.9	10	3.1
		1098-IA-02	4.6	4.2	6.1	4
		1098-IA-03	9.4	2.6	10	4.8
		1098-IA-04	4.4	3	4.9	3.7
Sub-Slab Soil Gas	34,000 (EGLE SSC)	1098-SS-01	22,000	6,800	28,000	71
		1098-SS-02	60,000	12,000	30,000	5,400
		1098-SS-03	320,000	860	290,000	240,000
		1098-SS-04	6,600	2,000	4,100	550

Table 1098-7 Summary of Results for Hexane

Sample Type	Screening Level (µg/m3)	Sample ID	Measured Concentration (µg/m^3)			
			Oct. 2016	May 2019	Aug. 2019	Dec. 2019
			E1	E2	E3	E4
Outdoor Air	-	1098-OA-01	9.9	<3	<3	<3.2
Indoor Air	2,200 (EGLE SSC) 6,600 (TSRIASL12)	1098-IA-01	4.8	<2.9	7.6	<3.2
		1098-IA-02	<2.9	5.2	4	4.6
		1098-IA-03	8	<2.8	14	4.9
		1098-IA-04	3.5	<3.2	3.2	4.7
Sub-Slab Soil Gas	72,000 (EGLE SSC) 210,000 (TSRIASL12)	1098-SS-01	7,200	2,100	<250	<2.8
		1098-SS-02	15,000	490	1,500	280
		1098-SS-03	11,000	79	**260,000**	120,000
		1098-SS-04	200	54	3,300	4,000

-	not applicable
(shaded)	EGLE SSC Exceedance
BOLD	TSRIASL12 Exceedance

Table 1098-8 Summary of Results for Trichloroethene (TCE)

Sample Type	Screening Level (µg/m3)	Sample ID	Measured Concentration (µg/m^3)			
			Oct. 2016	May 2019	Aug. 2019	Dec. 2019
			E1	E2	E3	E4
Outdoor Air	-	1098-OA-01	<3.8	<0.18	<0.18	<0.2
Indoor Air	4 (EGLE SSC) 12 (TSRIASL12)	1098-IA-01	<4.5	1	2.2	0.83
		1098-IA-02	<4.5	<0.2	0.24	<0.19
		1098-IA-03	<4.4	<0.17	0.59	0.29
		1098-IA-04	<4.4	<0.2	0.17	<0.19
Sub-Slab Soil Gas	130 (EGLE SSC) 400 (TSRIASL12)	1098-SS-01	<300	<83	<380	<4.3
		1098-SS-02	**<620**	<270	**<520**	<85
		1098-SS-03	**<2,200**	100	**<2,000**	**<1,300**
		1098-SS-04	<66	<83	**410**	180

-	not applicable
	EGLE SSC Exceedance
BOLD	TSRIASL12 Exceedance

EVALUATION OF VI DATA TRENDS

Data trends for Building 1098 are discussed below for both sub-slab soil gas and indoor air. When data exhibit a narrow range of variability, it is typical practice to express the range as a percentage (e.g., relative percent difference [RPD]). When data exhibit a large range of variability, however, it is more useful to express the range in orders of magnitude (i.e., factors of 10). This can be expressed mathematically as the log of the ratio of maximum/minimum values. If the values differ by a factor of 10, the log of the ratio is 1, if the values differ by a factor of 100, the log of the ratio is 2, and so on.

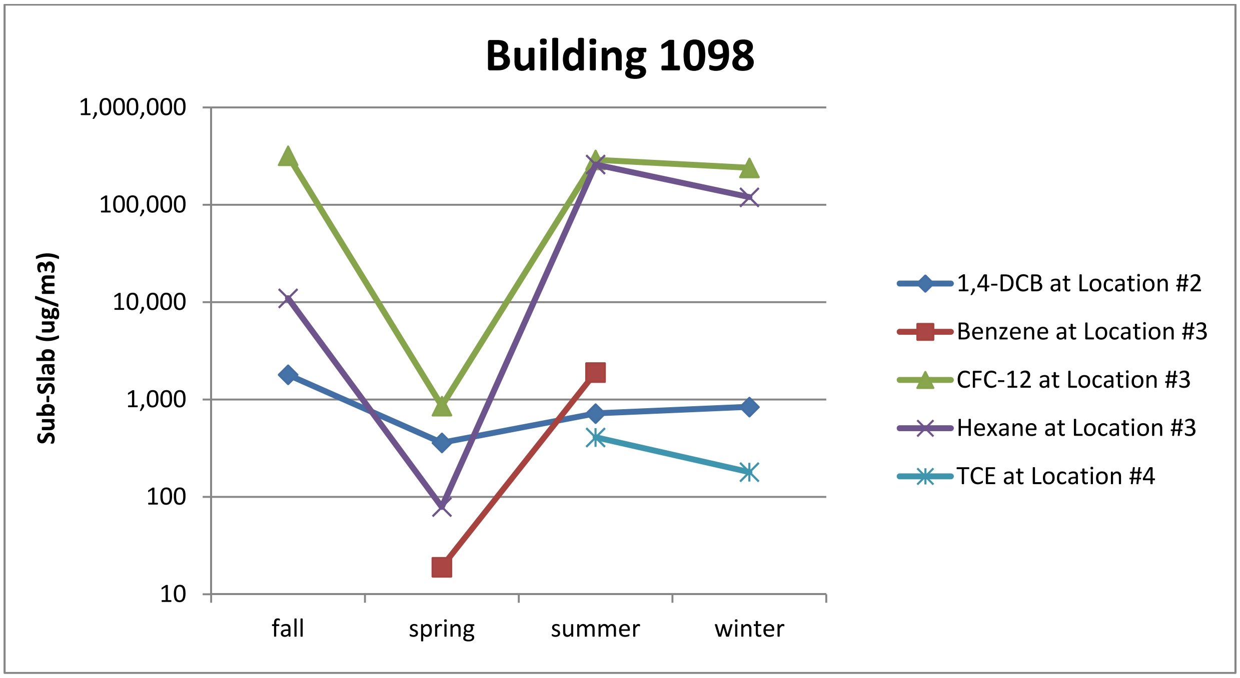
The variability across all locations over all sampling events is the total variability. This encompasses different types of variability, including spatial variability (i.e., how do the results vary from location to location), temporal variability (i.e., how do the results at a given location vary over time), and measurement variability. Measurement variability can be determined by evaluating results of duplicate or collocated samples and includes both sampling variability and analytical variability.

Sub-Slab Soil Gas Data Trends

Spatial Variability of Sub-Slab Soil Gas – The soil gas exhibits up to three orders of magnitude of spatial variability. Sub-slab soil gas detections of CFC-12 vary from 71 to 240,000 µg/m^3 (log of max./min. = 3.5) across the four locations during E4. Other events for CFC-12 have lower variability. Sub-slab soil gas detections of hexane vary from 200 to 15,000 µg/m^3 (log of max./min. = 1.9) across the four locations during E1. Spatial variability was not calculated for 1,4-DCB, benzene or TCE due to low detection frequencies.

Temporal Variability of Soil Gas – The soil gas concentrations exhibit up to three orders of magnitude of temporal variability. For CFC-12, sub-slab soil gas concentrations of vary from 860 to 320,000 µg/m^3 at location 1098-SS-03 (log max/min = 2.6). Hexane at location 1098-SS-03 varies from 79 to 260,000 µg/m^3 (log max/min = 3.5). For 1,4-DCB, sub-slab soil gas concentrations of vary from 360 to 1,800 µg/m^3 at location 1098-SS-02 (log max/min = 0.7). Benzene at location 1098-SS-04 varies from 45 to 590 µg/m^3 (log max/min = 1.1). Other events for hexane have lower variability. Temporal variability was not calculated for TCE due to low detection frequencies. Overall, temporal variability is similar to spatial variability, which is contrary to expectations.

Seasonal Confirmation Sampling Trend Analysis – No formal statistical tests were performed, but the data exhibits relatively consistent results between the seasons. This is demonstrated by the graph below, which shows the five analytes selected above at locations where they were detected at relatively high concentrations. Benzene and TCE had relatively few detected results are the detects are represented on the graph below. Note that the y-axis is a log scale. The Spring results were anomalously low, for reasons that have not been identified, but are thought to be independent of the season of the year.



The data set was examined to see what the potential consequences would have been had only a single sampling event been performed. For 1,4-DCB and CFC-12, the highest sub-slab soil gas concentrations were collected during the fall (E1) and the lowest concentrations occurred during the spring (E2). For benzene, hexane and TCE, the highest sub-slab concentrations were collected during the summer (E3) and the lowest concentrations for benzene and hexane occurred during the spring (E2) for and in the winter (E4) for TCE.

Since two analytes of interest had the highest results occur during E1, there was no negative bias introduced by results from other seasonal sampling events for those analytes. However, for hexane a negative bias of approximately 24-fold would have been introduced (i.e., the hexane value for E3 [260,000 $\mu g/m^3$] was approximately 2,200% higher than the hexane value for E1 [11,000 $\mu g/m^3$]). Also, at the sample location of maximum results for benzene and TCE, the analytes were ND during E1 and the maximum concentrations weren't observed until E3. Therefore, implementing four seasonal confirmation sampling events provided insight regarding maximum concentration levels.

__Indoor Air Data Trends__

Spatial Variability of Indoor Air – The indoor air exhibit up to one order of magnitude of spatial variability. For benzene during E3, indoor air concentrations vary from 0.47 to 0.72 $\mu g/m^3$ (log max./min. = 0.21). For CFC-12, the highest spatial variability occurred during E1 where indoor air concentrations vary from 4.4 to 11 $\mu g/m^3$ (log max./min. = 0.4). TCE had the most spatial variability during E3 where indoor air concentrations vary from 0.17 to 2.2 $\mu g/m^3$ (log max./min. = 1.1). The data suggests the air within the building is well-mixed.

Temporal Variability of Indoor Air – The indoor air has, at most, one order of magnitude of temporal variability. CFC-12 was the only analyte with 100% detection frequency in indoor air. For CFC-12, the highest temporal variability occurred at location 1098-IA-03 varied from 2.6 to 10 μg/m^3 (log of max./min. = 0.59). Temporal variability for all other locations for CFC-12 were less than location 1098-IA-03. For the other analytes where a sample location had detected concentrations for at least 3 of 4 events, temporal variability was around 0.4 (log of max./min. = 0.4). Overall, temporal variability across the four seasons sampled is relatively small.

Additional Analyses

Comparison of Sub-Slab Soil Gas and Indoor Air Data Sets – As expected, the sub-slab soil gas data exhibit greater spatial variability than the indoor air data set. The sub-slab soil gas also exhibits greater temporal variability than the indoor air data set, which is contrary to expectations.

Seasonal Effects – The sub-slab soil gas data exhibit some variability from event to event. Maximum sub-slab soil gas results occurred in fall (E1) and summer (E3). Maximum indoor air values also occurred in fall (E1) and summer (E3). The data does not support the hypothesis that wintertime should have the highest indoor air impacts.

Comparison of Attenuation Factors by Event – Attenuation factors were calculated for CFC-12 based on maximum values. The indoor air maximum concentration was corrected for contribution of outdoor air to indoor air (e.g., outdoor air detected concentration was subtracted from indoor air concentration). The calculated event-specific attenuation factors are shown in Tables 1098-9.

Table 1098-9. Comparison of Building-Specific Attenuation Factors for CFC-12 by Event

	E1 (Fall)	E2 (Winter)	E3 (Spring)	E4 (Summer)
Maximum Values				
CFC-12 in Sub-Slab Soil Gas (μg/m^3)	320,000	12,000	290,000	240,000
CFC-12 in Outdoor Air (μg/m^3)	<3.5	3.1	2.3	2.6
CFC-12 in Indoor Air (μg/m^3)	11	4.2	10	4.8
CFC-12 in Indoor Air (μg/m^3) Corrected for Outdoor Air Contribution	11	1.1	7.7	2.2
Attenuation Factor	3.4E-05	**9.2E-05**	2.7E-05	9.2E-06

These serve as the best estimates of attenuation at this building. The results can vary from day to day due to differences in rates of vapor intrusion and rates of building ventilation. Overall, the most conservative estimate of a building-specific attenuation factor for Building 1098 is 9.2E-05 based on CFC-12 during E2.

Temporal Variability in Attenuation Factor – As shown in Table 1098-9, there was about one order of magnitude of temporal variability in the calculated attenuation factors observed for CFC-12 between the four sampling events. To be as conservative as possible, the maximum values were used in calculating the attenuation factor for each event. The sampling location with the maximum value per event varied. In general, the low spatial variability in indoor air results means that roughly comparable attenuation factors would be obtained whichever indoor air value was used in the calculations.

NON-DETECT EVALUATION

As previously mentioned, the relatively high concentrations of CFC-12 and hexane in soil gas resulted in elevated detection limits for other compounds at location 1098-SS-03 and, to a lesser extent, at 1098-SS-01 and 1098-SS-02. Table 1098-10 below lists the analytes in sub-slab soil gas that have ND RLs greater than the screening levels. The table also includes the indoor air results for each of the analytes. If a sub-slab soil gas analyte has ND RL exceedances, but all results and ND RLs in indoor air are below the screening levels, no further evaluation is warranted. If an analyte was identified as an AOI in sub-slab soil gas (detected results > screening level), it is excluded from the ND evaluation. Also, if an ND analyte has an 0% detection frequency for all sampling events and all ND RLs met the screening level during at least one event, no further ND evaluation is warranted.

Table 1098-10. Non-Detect Evaluation for Building 1098

Soil Gas Analytes with ND RL > SL	Indoor Air Result Summary
1,1,2,2-Tetrachloroethane	0% Detection Frequency, 75% ND RLs < EGLE SSC
1,1,2-Trichloroethane	0% Detection Frequency, 75% ND RLs < EGLE SSC
1,2,4-Trichlorobenzene	0% Detection Frequency, 5 out of 16 samples had ND RLs < EGLE SSC
1,2-Dibromoethane (EDB)	0% Detection Frequency, E3 & E4 ND RLs < EGLE SSC
1,2-Dichloroethane	25% Overall Detection Frequency, All ND RLs < EGLE SSC
1,2-Dichloropropane	0% Detection Frequency, All ND RLs < EGLE SSC
1,3-Dichlorobenzene	0% Detection Frequency, All ND RLs < EGLE SSC
1,4-Dioxane	0% Detection Frequency, All ND RLs < EGLE SSC
2-Hexanone	0% Detection Frequency, All ND RLs < EGLE SSC
alpha-Chlorotoluene	0% Detection Frequency, All ND RLs < EGLE SSC
Bromodichloromethane	0% Detection Frequency, All ND RLs < EGLE SSC
Bromoform	0% Detection Frequency, All ND RLs < EGLE SSC
Bromomethane	0% Detection Frequency, 75% ND RLs < EGLE SSC
Carbon tetrachloride	0% Detection Frequency, All ND RLs < EGLE SSC
Chloroform	0% Detection Frequency, All ND RLs < EGLE SSC
cis-1,2-Dichloroethene	0% Detection Frequency, All ND RLs < EGLE SSC
Cumene	0% Detection Frequency, All ND RLs < EGLE SSC
Dibromochloromethane	0% Detection Frequency, 75% ND RLs < EGLE SSC
Dibromomethane	0% Detection Frequency, 75% ND RLs < EGLE SSC
Ethylbenzene	75% Overall Detection Frequency, All ND RLs < EGLE SSC
Hexachlorobutadiene (HCBD)	0% Detection Frequency, E3 & E4 ND RLs < EGLE SSC
Naphthalene	0% Detection Frequency, Half of ND RLs < EGLE SSC
Vinyl chloride	0% Detection Frequency, All ND RLs < EGLE SSC

WEIGHT-OF-EVIDENCE SUMMARY

Building 1098 was confirmed as a VI Path Forward Group 2 building due to its potential for VI based on sub-slab soil gas exceedances of the EGLE SSC for 1,4-DCB, benzene, CFC-12, hexane and TCE. The following evidence supports the conclusion that VI is insignificant at Building 1098:

- No exceedances of EGLE SSCs in indoor air during all sampling events.
- The sub-slab soil gas data do not show any strong time dependence nor do the data show any strong seasonal effects associated with time periods with higher indoor-outdoor temperature differentials Lower sub-slab concentrations were measured during the Spring sampling event for reasons as yet not understood.
- The data do not support the hypothesis that wintertime should have the highest indoor air impacts. The highest sub-slab soil gas concentrations generally were measured in the fall and summer. Similarly, the highest indoor air concentrations were measured in the fall and summer.
- The indoor air data show relatively little spatial variability, despite the greater spatial variability in the sub-slab soil gas values. This evaluation confirms that the sub-slab soil gas and indoor air

Based on the CSM for Building 1098, VI is an insignificant exposure pathway for current building utilization.

PATH FORWARD

Based on the evaluation of the four seasonal confirmation sampling events and the results of the further investigation, the VI pathway continues to be insignificant for Building 1098 and the sub-slab soil gas results have demonstrated relatively stable concentrations (ignoring the Spring results) and no evidence of increasing over time. Sufficient information exists to make a human exposure under control EI determination. However, while currently there is no evidence of potential VI, for future use, LTM is warranted and the building-specific Interim Monitoring Plan is discussed below.

Building-specific Interim Monitoring Plan

Dow presented an interim monitoring plan for Building 1098 during the April 2020 Corrective Action status meeting. Dow will implement the interim monitoring plan at Building 1098 until a revised program or more permanent corrective action plan is developed for the site.

Indoor air is monitored at locations 1098-IA-03 and 1098-IA-04. These locations were selected for continued monitoring since they demonstrated the highest sub-slab soil gas results. Monitoring is performed for 1,4-DCB, benzene, CFC-12, hexane and TCE. An outdoor air sample is collected at the time of each monitoring event. Interim monitoring occurs semi-annually and the initial event was performed in August 2020. Results are shown below.

Table 1098-11. Interim Monitoring Results (August 2020) for Building 1098

Indoor Air Analyte	Result Value (µg/m³)	Reporting Limit (µg/m³)	EGLE SSC (µg/m³)	NONRES $TSRIASL_{12}$ (µg/m³)	Dow IH OEL (8-hour Time Weighted Average) (µg/m³)
IM Event 1 (August 2020)					
1098-IA-03					
1,4-Dichlorobenzene	ND	0.21	30	300	60,100
Benzene	ND	0.28	15.4	54	1,595
CFC-12	3.1	0.17	1,020	NA	4,950,000
Hexane	ND	3	2,200	6,600	176,000
Trichloroethene	ND	0.18	4	12	26,850
1098-IA-04					
1,4-Dichlorobenzene	ND	0.19	30	300	60,100
Benzene	0.45	0.26	15.4	54	1,595
CFC-12	2.8	0.16	1,020	NA	4,950,000
Hexane	ND	2.8	2,200	6,600	176,000
Trichloroethene	ND	0.17	4	12	26,850

NA – Not available

ND – Not Detected

As shown on the table above, all indoor air results from the Summer 2020 IM event were detected at concentrations below the EGLE SSC or were non-detect (ND) with reporting limits (RLs) below the indoor air EGLE SSC. The analytical data is presented in Appendix A. Field sampling forms are provided in Appendix B. The next interim measure (IM) event is scheduled for Winter 2020/2021.

5.3 Zone 2 Phase 1 Evaluations

The Zone 2 Phase 1 buildings were evaluated in the 2017 CAIP (December 2017), the 2018 Vapor Intrusion Rescreen of Zone 1 and Zone 2 Phase 1 Report (August 2018), and in the 2018 CAIP (January 2019), and in the 2019 CAIP (January 2020). Zone 2 Phase 1 VI sampling and/or interim monitoring results are presented for the buildings listed below in the following subsections:

- Section 5.3.1 Building 941;
- Section 5.3.2 Building 1028;
- Section 5.3.3 Building 1233;
- Section 5.3.4 Building 827;
- Section 5.3.5 Building 948;
- Section 5.3.6 Building 768;
- Section 5.3.7 Building 849;
- Section 5.3.8 Building 969; and
- Section 5.3.9 Building 1222.

5.3.1 VI Seasonal Confirmation Sampling Results Evaluation for Building 941

INTRODUCTION

Building 941 is a Category 1 building located in the central portion of the facility designated as Zone 2 (see Figure 5.3.1-1). It is known as the Specialty Intermediates/Herbicides Inter Control Room and is a large, single story building that includes process area, laboratory, and office space. To date, 11 rounds of sampling have been performed, as shown below in Table 941-1. In addition, further investigation activities with a real-time measurement devices were performed in 2019 and 2020.

Table 941-1. Summary of Seasonal Confirmation Sampling Events for Building 941

Building 941	
Initial Sampling Event	**Completed**
E1	May 2017 (Spring)
Seasonal Confirmation Sampling Event	**Completed**
E2	September 2017 (Fall)
E3	February 2018 (Winter)
E4	August 2018 (Summer)
E5	November 2018 (Fall)
E6	February 2019 (Winter)
E7	April 2019 (Spring)
E8	August 2019 (Summer)
E9	November 2019 (Fall)
E10	December 2019 (Winter)
E11	August 2020 (Summer)

The previous CAIPs have included monitoring results and evaluation updates:

- 2017 CAIP – The results of the initial sampling event (E1) was evaluated and Building 941 was placed into VI Path Forward Building Group 2. Group 2 is a designation for buildings that have sub-slab soil gas AOIs, but where initial indoor air results were all less than screening levels.

- 2018 CAIP – The initial results were re-evaluated in the 2018 Rescreen. An Expedited Building Summary was submitted for Building 941 on August 24, 2018. The 2018 CAIP evaluated seasonal confirmation sampling results through E4 and the findings acknowledged that some level of VI was occurring for PCE and TCE and Building 941 was moved to VI Path Forward Building Group 4. Group 4 is a designation for buildings that have evidence of potential VI as both sub-slab soil gas and indoor air exceedances were identified.

- Further Investigation activities were conducted with a mobile GC in March and May 2019 and were reported in the June 2019 Summary of Investigative Findings (see Appendix C). The investigation identified joint seams immediately outside the conference room and around the perimeter of the glass cleaning shop. Dow implemented an interim action to seal the joint seams in April 2019.

- 2019 CAIP – Five additional seasonal confirmation sampling events were performed in 2019, giving a total of eight seasonal confirmation sampling events that were evaluated in the trend analysis in the 2019 CAIP. The CAIP recommended building-specific interim action plan that included a quarterly building-specific interim monitoring plan with a reduced analyte list. Based on these results and the further investigation activities, Building 941 was moved to Path Forward Group 4B, which is defined as a building with sample result that demonstrate correlated sub-slab soil gas and indoor air exceedances and other lines of evidence indicate VI is likely significant.

- The application of the RetroCoat™ Vapor Intrusion Coating System was completed, as an interim response action, in July 2020.

Based on EGLE guidance, indoor air and sub-slab soil-gas samples were initially collected during each event at nine locations within the building and concurrent outdoor air samples were collected at one location (see Figure 5.3.1-2). The 12 sub-slab soil gas AOIs due to exceedances of the EGLE SSC and/or the $TSRIASL_{12}$ are: 1,1,2-TCA, 1,1-DCE, EDC, bromodichloromethane, bromomethane, cis-1,2-DCE, carbon tetrachloride, chloroform, chloromethane, naphthalene, PCE and TCE.

As stated above, the 2019 CAIP included evaluation of results through E8 (Summer 2019). Since that time, three additional sampling events have occurred. During these three most recent events, ten sub-slab soil gas analytes had results that exceed the EGLE SSCs. Those analytes include 1,1,2-TCA, 1,1-DCE, EDC, bromodichloromethane, cis-1,2-DCE, carbon tetrachloride, chloroform, chloromethane, PCE and TCE, which have all been detected in previous seasonal sampling events. Three analytes were detected above EGLE SSCs in indoor air, including 1,1,2-TCA, chloroform and TCE. Figures 5.3.1-3 and 5.3.1-4 present the sub-slab soil gas and indoor air results for each sampling event at each sample location for 1,1,2-TCA and TCE, respectively, since each of these analytes had exceedances in both media in the most recent sampling events. For chloroform, it was only detected in indoor air at a single location (941-IA-02) during E10 at a concentration of 7.1 ug/m3.

1,1,2-TCA was the only indoor air analyte detected above the EGLE SSC after the application of the Retro-Coat™ (E11). It was detected at a concentration of 0.76 ug/m3 (EGLE SSC = 0.62 ug/m3) outside of the Retro-Coat™ application area at 941-IA-03 in the PPE Area (see Figure 5.3.1-2). 1,1,2-TCA was also detected in the outdoor air sample during E11 at a concentration of 0.22 ug/m3. Therefore, if the indoor air concentration is adjusted to account for outdoor air contribution, the corrected indoor air result

(0.54 ug/m3) is below the EGLE SSC. 1,1,2-TCA has been detected in outdoor air at Building 941 in previous sampling events.

VAPOR INTRUSION CONCEPTUAL SITE MODEL

VI is an exposure pathway that involves the migration of volatilized chemicals from the subsurface to indoor air in overlying, occupied buildings. A source, migration route and a human receptor must be present for the VI pathway to be complete. The focus of this building specific investigation is to evaluate the potential VI exposure pathway for Dow employees and contractors at Building 941. The CSM is illustrated in Figure 5.3.1-5.

Building 941 is a single-story building that contains office space, laboratory, and process area. The building is slab-on-grade construction with a footprint of approximately 10,360 ft^2 (962 m^2). The building has two central AC units with one air intake. There are two bay doors that are only opened to receive materials and equipment.

The only underground utilities are the sewer lines. There are multiple floor drains and various plumbing fixtures. The land surrounding the building is covered in asphalt. The depth to groundwater in this area of the facility is approximately 5 ft bgs and the soils are largely fill material. Groundwater flow is towards the south or southwest.

The typical parameters for non-residential exposures are assumed to apply to workers at this building (i.e., 40 hours/week, 50 weeks/year exposure).

A building survey was performed on March 7, 2017 and a more in-depth survey and chemical inventory was conducted in 2019. Drains and other openings were screened with a PID and no soil gas entry points were identified at that time. As indicated above, subsequent investigations identified floor seams as a point of vapor entry. A chemical inventory was completed during the building survey and identified degreasers, cleaners, motor oil, and insecticides.

Further investigation activities were conducted in March and May 2019 using real-time measurement devices to identify potential pathways for vapor intrusion. Findings were reported to EGLE in the June 2019 Summary of Investigative Findings (see Appendix C). The goal of the building-specific investigation for Building 941 was to identify potential sources and achieve better spatial resolution of TCE concentrations in the indoor air. During these activities, potential workplace indoor air sources and various potential preferential pathways were investigated with no significant findings. The investigation led to the identification of joint seams immediately outside the conference room and along the glass cleaning shop where relatively high TCE concentrations were measured. Dow implemented an interim action to seal the joint seams and this activity was completed on April 11, 2019; however, as discussed in the July 2019 Corrective Action status meeting, results indicated that concentrations decreased but not as much as expected.

Additional investigation activities were conducted in February 2020 using real-time measurement devices to gain an understanding of TCE and PCE distribution prior to an interim response action. The sampling was meant to serve as a baseline and breathing zone concentrations for both PCE and TCE were below the EGLE SSC throughout the building. The contribution of various floor cracks and air handling units to indoor air concentrations was investigated. Findings were reported to EGLE in the February 2020 Summary of Investigative Findings (see Appendix C).

Dow submitted the Retro-Coat™ Application Workplan for Buildings 680 and 941 on July 22, 2020. Retro-Coat is a suitable barrier to block contaminated vapors from entering existing structures. The Retro-Coat™ system has been used to effectively mitigate VI in existing buildings. The application of the Retro-Coat™ Vapor Intrusion Coating System was completed as an interim response action in late July 2020. The floor was first prepared by shot blasting or grinding. The entire floor was then vacuumed and washed. Any divots or gouges were filled. All cracks and expansion joints were filled with a two-part caulking system. After this preparatory work, Retro-Coat™ sealant was applied to the southwest portion of the building floor (see Figure 5.3.1-6).

EVALUATION OF SEASONAL CONFIRMATION SAMPLING EVENTS

This evaluation includes the 11 seasonal sampling events (E1-E11) that have been conducted at Building 941. The sampling events encompass four years of time and include sampling during each season of the year. Summary statistics and screening comparison results are presented for sub-slab soil gas on Table 5.3.1-1 and indoor and outdoor air or Table 5.3.1-2. The results from the 11 seasonal confirmation sampling events were evaluated with respect to spatial variability, temporal variability, and seasonal trend analysis. Building specific attenuation factors were calculated and compared between events to evaluate temporal variability and determine the best estimate of a building-specific attenuation factor.

This evaluation focused on any analytes detected in the sub-slab soil gas samples that met the criterion for inclusion in one or more of the following categories:

a) Analytes detected in sub-slab soil gas at concentrations that exceeded EGLE SSCs;

b) Analytes detected in sub-slab soil gas at concentrations of 1,000 $\mu g/m^3$ or greater in one or more samples. Data for analytes detected above 1,000 $\mu g/m^3$ should provide the clearest signal and be the simplest to interpret when assessing data trends. The same data trends observed for these analytes are expected to apply to other similar analytes present at lower concentrations; and

c) PCE and TCE. These two analytes are of particular interest for many VI evaluations at industrial sites.

For this building, the analytes detected in the sub-slab soil gas at concentrations above the EGLE SSCs were the following 12 compounds: 1,1,2-TCA, 1,1-DCE, EDC, bromodichloromethane, bromomethane, carbon tetrachloride, chloroform, chloromethane, cis-1,2-DCE, naphthalene, PCE and TCE.

Seven other analytes were detected at concentrations $\geq$1,000 $\mu g/m^3$ in soil gas: 1,1,1-TCA, CFC-12, methylene chloride, chloroethane, acetone, 2,2,4-trimethylpentane, total xylenes, and 1,2,4-trimethylbenzene Given that there were already 12 compounds to consider, only 1,1,1-TCA is also included in this evaluation. 1,1,1-TCA had relatively high sub-slab concentrations and was consistently detected in both indoor air and soil gas. The other six analytes are not included in this evaluation due to their low detection frequency and/or relatively low concentrations at many locations. Sample results for the 13 analytes are included in this evaluation are provided in the data tables below:

Table 941-2 Summary of Results for 1,1,2-Trichloroethane (1,1,2-TCA)

Sample Type	Screening Level (µg/m³)	Sample ID	Measured Concentration (µg/m³)										
			May 2017	Sep. 2017	Feb. 2018	Aug. 2018	Nov. 2018	Feb. 2019	Apr. 2019	Aug. 2019	Nov. 2019	Dec. 2019	Aug. 2020
			E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E10
Outdoor Air	-	941-OA-01	<0.18	<0.19	<0.17	<0.18	<0.17	<0.19	0.21	<0.19	<0.19	<0.17	0.22
Indoor Air	0.62 (EGLE SSC)	941-IA-01	0.19	0.24	<0.18	0.44	1.8	0.71	0.83	0.4	<0.2	1.2	0.46
		941-IA-02	1.4	0.24	12	0.3	23	5.1	15	4.2	3* 2.9	4* 6.8	0.36
		941-IA-03	0.99	0.25	1	0.43	4	1.9	9.6	2.9	0.32	3.2	0.76
		941-IA-04	1.1	0.37	10	0.31	16	3	12	3.3	1.5* 0.92	2.8* 2.6	0.49
		941-IA-05	0.58	0.29	0.52	0.32	18	0.68	5.4	1.5	0.32	0.75	0.27
		941-IA-06	1	0.44	5.9	0.34	0.84	2.2	12	3.3	0.56	2	0.44
		941-IA-07	0.54	0.48	5.3	0.35	6.4	2.4	13	3	0.53	2.1	-
		941-IA-08	1	<0.19	5.3	0.33	6.1	2.5	13	2.9	0.61	2	0.47
		941-IA-09	1.8	0.58	3.6	0.41	6	2.7	25	4.1	0.65	2.9	0.52
Sub-Slab Soil Gas	20 (EGLE SSC)	941-SS-01	8.1	25	11	<10	<4.3	<4.2	8.8	<8.6	<4.8	<4.4	-
		941-SS-02	12,000	5,300	8,100	4,600	9,400	<430	17,000	5,300	2,600	5,900	8,700
		941-SS-03	36	20	26	54	32	<4.2	24	36	29	25	-
		941-SS-04	<230	<150	5,700	<210	<240	<200	10,000	<98	7,400	<450	8,300
		941-SS-05	1,600	2,300	2,400	2,500	2,800	<82	2,100	2,400	3,000	3,000	-
		941-SS-06	110	120	130	100	180	<15	260	250	410	120	-
		941-IA-07	<4.6	<5.6	<4.2	<4.1	<4.4	<4.3	<4.1	<4.2	<4.4	<4.5	-
		941-IA-08	15	18	22	<17	18	<4.3	9.7	23	25	5.4	-
		941-IA-09	23	34	17	79	56	<4.4	150	110	<4.5	<4.5	-

-	not applicable
(shaded)	EGLE SSC Exceedance
*	filtered result

Table 941-3 Summary of Results for 1,1-Dichloroethene (1,1-DCE)

Sample Type	Screening Level (µg/m³)	Sample ID	Measured Concentration (µg/m³)										
			May 2017	Sep. 2017	Feb. 2018	Aug. 2018	Nov. 2018	Feb. 2019	Apr. 2019	Aug. 2019	Nov. 2019	Dec. 2019	Aug. 2020
			E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E10
Outdoor Air	-	941-OA-01	0.29	0.14	0.11	0.24	2.5	1.2	3.2	<0.068	0.26	0.55	1.9
Indoor Air	620 (EGLE SSC) 1,900 (TSRIASL12)	941-IA-01	0.41	0.56	0.08	0.27	13	3.2	4.9	0.27	1.1	1.1	2.3
		941-IA-02	1.3	0.8	4.7	0.53	23	15	31	10	35* 39	11* 19	2.6
		941-IA-03	0.88	0.61	0.48	0.32	10	5.2	1.6	0.81	5	3.2	2.7
		941-IA-04	1.1	1.2	14	0.52	27	6.3	13	4.2	15* 12	6.6* 5.8	2.4
		941-IA-05	2	4.4	4.5	3.5	29	8.7	25	8.2	6	4.8	1.9
		941-IA-06	0.89	1.2	2.4	0.54	19	2.7	1.4	1.4	7.7	4.1	2.6
		941-IA-07	0.62	1	2.3	0.52	8.6	5.8	19	6.2	6.9	4	-
		941-IA-08	0.93	4.4	2.3	0.51	7.7	7.2	24	5.4	8.2	3.8	2.6
		941-IA-09	1.2	1.2	1.5	0.86	8.8	7.4	24	5.1	9	4.9	26
Sub-Slab Soil Gas	20,000 (EGLE SSC) 61,000 (TSRIASL12)	941-SS-01	11	38	50	70	100	51	200	160	21	23	-
		941-SS-02	2,100	20,000	800	18,000	3,700	18,000	**120,000**	4,900	51,000	16,000	42,000
		941-SS-03	71	28	72	43	37	20	28	81	44	38	-
		941-SS-04	9,800	9,300	7,200	16,000	9,200	18,000	15,000	14,000	54,000	37,000	31,000
		941-SS-05	4,600	37,000	7,200	53,000	11,000	33,000	12,000	44,000	50,000	39,000	-
		941-SS-06	5,300	1,900	2,000	830	1,500	1,100	1,400	2,400	2,700	600	-
		941-IA-07	17	55	51	9.5	30	9.2	18	52	27	14	-
		941-IA-08	55	160	130	150	22	10	36	780	230	35	-
		941-IA-09	200	220	220	510	530	11	960	1,800	14	10	-

-	not applicable
(shaded)	EGLE SSC Exceedance
BOLD	TSRIASL12 Exceedance
*	filtered result

Table 941-4 Summary of Results for 1,2-Dichloroethane (EDC)

Sample Type	Screening Level (µg/m³)	Sample ID	Measured Concentration (µg/m³)										
			May 2017	Sep. 2017	Feb. 2018	Aug. 2018	Nov. 2018	Feb. 2019	Apr. 2019	Aug. 2019	Nov. 2019	Dec. 2019	Aug. 2020
			E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E10
Outdoor Air	-	941-OA-01	0.54	<0.14	0.24	0.2	0.1	<0.14	0.31	<0.14	<0.14	0.28	0.28
Indoor Air	4.6 (EGLE SSC)	941-IA-01	0.76	0.26	0.3	0.88	1	0.45	0.86	0.4	<0.14	1.2	0.57
		941-IA-02	1.9	0.26	14	0.55	12	2.9	12	3.2	0.86* 1.5	2.7* 3.8	0.42
		941-IA-03	1.5	0.31	1.6	0.81	2.1	1.2	8.3	2.5	0.2	2.7	0.75
		941-IA-04	1.6	0.38	9.5	0.55	8.5	1.8	11	3.1	0.66* .97	2.1* 1.9	0.5
		941-IA-05	1	0.18	0.48	0.41	0.43	0.49	4.8	1.3	0.21	0.63	0.33
		941-IA-06	1.6	0.45	8.2	0.56	3.6	1.4	10	3	0.28	1.6	0.47
		941-IA-07	0.8	0.46	7.4	0.62	3.3	1.6	11	2.8	0.28	1.8	-
		941-IA-08	1.4	0.16	7.4	0.55	3.3	1.7	11	2.7	0.29	1.7	0.5
		941-IA-09	2.4	0.56	4.8	0.63	6.8	1.7	22	3.6	0.31	2.5	0.53
Sub-Slab Soil Gas	150 (EGLE SSC)	941-SS-01	<3.6	<6.4	<4.3	<7.5	<3.2	<3.2	<3.2	<6.4	<3.5	<3.2	-
		941-SS-02	14,000	2,800	16,000	2,800	5,300	8,200	12,000	6,100	<1,100	5,100	3,400
		941-SS-03	<3.1	<3.1	<3.2	<3.1	<3	<3.2	<3	<3.3	<3.2	<3.2	-
		941-SS-04	3,800	1,300	3,700	2,900	4,700	2,800	4,800	2,800	1,800	2,600	3,600
		941-SS-05	670	810	770	690	620	440	310	470	460	450	-
		941-SS-06	<14	<20	<6.8	<12	19	22	22	26	42	12	-
		941-IA-07	4	<4.2	<3.1	<3	<3.3	<3.2	<3	<3.1	<3.2	<3.3	-
		941-IA-08	<8.1	<14	<5.3	<12	5.1	<3.2	7.2	<10	10	<3.4	-
		941-IA-09	4.6	6.3	6.8	16	15	<3.2	34	46	<3.3	<3.3	-

-	not applicable
(shaded)	EGLE SSC Exceedance
BOLD	$TSRIASL_{12}$ Exceedance
*	filtered result

Table 941-5 Summary of Results for Bromodichloromethane

Sample Type	Screening Level (µg/m³)	Sample ID	Measured Concentration (µg/m³)										
			May 2017	Sep. 2017	Feb. 2018	Aug. 2018	Nov. 2018	Feb. 2019	Apr. 2019	Aug. 2019	Nov. 2019	Dec. 2019	Aug. 2020
			E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E10
Outdoor Air	-	941-OA-01	<1.1	<1.2	<1.1	<1.1	<1	<1.2	<1.1	<1.1	<1.2	<1	<1.1
Indoor Air	6.2 (EGLE SSC)	941-IA-01	<1	<1.1	<1.1	<1.1	<1.1	<1.2	<1.1	<11	<1.2	<1.2	<1.2
		941-IA-02	<1.1	<1.1	<1.1	<1.2	<1.1	<2.2	<5.7	<1.2	<1.2* 1.1	<1.2* <1.2	<1.1
		941-IA-03	<1.1	<1.2	<1.1	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.1	<1.2
		941-IA-04	<1.1	<1.1	<11	<1.1	<2.4	<1.1	<2.7	<1.2	<1* 1.1	<1.2* <1.1	<1.1
		941-IA-05	<1.1	<1	<1	<1.2	<2.2	<1.2	<6.9	<1.2	<1.2	<1.1	<1.1
		941-IA-06	<1.1	<1.1	<1.2	<1.1	<1.1	<1.2	<2.2	<1.1	<1.2	<1.1	<1.1
		941-IA-07	<1.1	<1.1	<1.2	<1.1	<1.1	<1.1	<5.8	<1.1	<1.1	<1.3	-
		941-IA-08	<1.1	<1.1	<1.2	<1.1	<1.1	<1.2	<5.6	<1.2	<1.2	<1.1	<1.1
		941-IA-09	<1.1	<1.1	<1.2	<1.2	<1.4	<1.1	<3.7	<1.2	<1.2	<1.1	<1.2
Sub-Slab Soil Gas	200 (EGLE SSC)	941-SS-01	<5.9	<10	<7.2	<12	<5.2	<5.2	<5.3	550	<5.9	<5.4	-
		941-SS-02	290	240	280	<110	490	<530	<13,000	<5.5	<1,800	<360	290
		941-SS-03	<5.2	<5.1	<5.3	<5.2	<5	<5.2	<4.9	230	<5.4	<5.4	-
		941-SS-04	<290	<180	<280	<260	<290	<250	<250	160	<700	<550	200
		941-SS-05	190	220	250	150	200	210	140	<17	<220	<280	-
		941-SS-06	<24	<34	<11	<20	<14	<19	<17	<5.2	<27	<6	-
		941-IA-07	<5.7	<6.9	<5.2	<5	<5.5	<5.3	<5	<17	<5.4	<5.5	-
		941-IA-08	<13	<23	<8.8	<21	7.1	<5.3	<5.3	<12	17	<5.7	-
		941-IA-09	<5.1	<5.4	<4.5	<13	5.7	<5.4	<21	550	<5.5	<5.5	-

-	not applicable
(shaded)	EGLE SSC Exceedance
*	filtered result

Table 941-6 Summary of Results for Bromomethane

Sample Type	Screening Level ($\mu g/m^3$)	Sample ID	Measured Concentration ($\mu g/m^3$) May 2017 E1	Sep. 2017 E2	Feb. 2018 E3	Aug. 2018 E4	Nov. 2018 E5	Feb. 2019 E6	Apr. 2019 E7	Aug. 2019 E8	Nov. 2019 E9	Dec. 2019 E10	Aug. 2020 E10
Outdoor Air	-	941-OA-01	<3.2	<3.4	<3.1	<3.3	<3.1	<3.4	<3.2	<3.3	<3.4	<3.1	<3.3
Indoor Air	30 (EGLE SSC)	941-IA-01	<3	<3.1	<3.2	<33	<3.3	<3.4	<3.2	<3.4	<3.5	<3.4	<3.6
		941-IA-02	<3.2	<3.2	<3.3	<33	<3.2	<6.5	<16	<3.4	<3.6* <3.2	<3.4* <3.4	<3.3
		941-IA-03	<3.2	<3.4	<3.3	<34	<3.5	<3.3	<7.8	<3.5	<3.6	<3.3	<3.4
		941-IA-04	<3.2	<3.3	<33	<32	<7	<3.5	<20	<3.3	<2.9* <3.3	<3.5* <3.3	<3.3
		941-IA-05	<3.3	<3	<3	<34	<6.5	<3.3	<17	<3.6	<3.6	<3.3	<3.3
		941-IA-06	<3.2	<3.2	<3.5	<32	<3.3	<3.5	<16	<3.4	<3.6	<3.3	<3.3
		941-IA-07	<3.3	<3.3	<3.5	<33	<3.1	<3.3	<11	<3.4	<3.2	<3.8	-
		941-IA-08	<3.3	<3.3	<3.4	<33	<3.3	<3.3	<15	<3.4	<3.6	<3.3	<3.2
		941-IA-09	<3.2	<3.1	<3.6	<34	<4.1	<3.5	<27	<3.1	<3.4	<3.3	<3.4
Sub-Slab Soil Gas	1,000 (EGLE SSC)	941-SS-01	<34	<61	<42	<72	<30	<30	<31	<62	<34	<31	-
		941-SS-02	<660	<260	<310	<260	<420	<1,200	32,000	<580	<11,000	<820	<120
		941-SS-03	<30	<30	<31	<30	<29	<30	<28	<32	<31	<31	-
		941-SS-04	<670	<420	<650	<600	<670	<570	<590	<280	<4,100	<1,300	<160
		941-SS-05	<320	<240	<290	<230	<180	<230	<200	<130	<1,300	<660	-
		941-SS-06	<140	<200	<65	<110	<83	<110	<100	<99	<160	<34	-
		941-IA-07	<33	<40	<30	<29	<32	<31	<29	<30	<31	<32	-
		941-IA-08	<78	<130	<51	<120	<31	<31	<31	<96	<33	<33	-
		941-IA-09	<30	<31	<26	<75	<33	<31	<120	<68	<32	<32	-

-	not applicable
(shaded)	EGLE SSC Exceedance
*	filtered result

Table 941-7 Summary of Results for Carbon Tetrachloride

Sample Type	Screening Level (µg/m³)	Sample ID	Measured Concentration (µg/m³)										
			May 2017	Sep. 2017	Feb. 2018	Aug. 2018	Nov. 2018	Feb. 2019	Apr. 2019	Aug. 2019	Nov. 2019	Dec. 2019	Aug. 2020
			E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E10
Outdoor Air	-	941-OA-01	0.69	0.35	0.6	0.51	0.54	0.55	0.63	0.47	0.52	0.54	0.53
Indoor Air	22 (EGLE SSC)	941-IA-01	0.76	0.34	0.47	0.6	0.53	0.69	0.72	0.48	0.52	0.55	0.55
		941-IA-02	2	0.32	4.3	0.67	2.4	1.7	3.9	1.2	2.2* 2.6	1.4* 2.6	1.8
		941-IA-03	1.5	0.29	0.78	0.56	0.65	0.95	1.5	0.8	0.73	0.77	0.57
		941-IA-04	1.6	0.55	4.9	0.53	3.6	1.2	2.5	1.1	1.4* 1.1	0.95* 1.1	0.51
		941-IA-05	1.6	0.52	0.94	0.77	1	0.76	1.4	0.76	0.66	0.65	0.51
		941-IA-06	1.6	0.61	2.3	0.46	1	1	2.6	0.92	0.97	0.82	0.56
		941-IA-07	0.76	0.63	2	0.47	0.85	1.1	3.2	0.88	0.85	0.8	-
		941-IA-08	1.6	0.32	2	0.49	0.95	1.1	2.6	0.9	0.99	0.82	0.56
		941-IA-09	2.3	0.7	1.3	0.49	1.1	1.1	4.1	0.97	1	0.94	0.54
Sub-Slab Soil Gas	710 (EGLE SSC)	941-SS-01	<5.5	<9.9	<6.7	<12	<4.9	<4.9	<5	<10	<5.5	<5.1	-
		941-SS-02	2,000	6,300	4,800	1,700	380	1,100	<13,000	920	4,700	1,400	1,600
		941-SS-03	<4.9	<4.8	<5	<4.8	<4.6	<4.9	<4.6	<5.2	<5.1	<5	-
		941-SS-04	4,800	2,100	2,800	2,400	1,800	1,400	2,100	1,000	1,800	2,300	2,300
		941-SS-05	4,500	4,900	1,900	3,800	1,400	840	860	740	1,000	1,200	-
		941-SS-06	<22	42	150	170	300	210	250	300	280	64	-
		941-IA-07	<5.3	<6.5	6.8	<4.7	12	<5	13	8.3	6.5	<5.2	-
		941-IA-08	<13	23	14	60	38	5	<5	79	38	6.4	-
		941-IA-09	13	13	9.3	17	19	<5.1	34	47	<5.2	<5.2	-

-	not applicable
(shaded)	EGLE SSC Exceedance
*	filtered result

Table 941-8 Summary of Results for Chloroform

Sample Type	Screening Level (µg/m³)	Sample ID	Measured Concentration (µg/m³)										
			May 2017	Sep. 2017	Feb. 2018	Aug. 2018	Nov. 2018	Feb. 2019	Apr. 2019	Aug. 2019	Nov. 2019	Dec. 2019	Aug. 2020
			E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E10
Outdoor Air	-	941-OA-01	0.18	0.33	0.43	0.2	0.22	0.67	0.35	<0.17	<0.17	0.21	0.27
Indoor Air	5.2 (EGLE SSC) 52 ($TSRIASL_{12}$)	941-IA-01	0.3	0.76	0.16	0.85	0.59	0.66	0.72	0.32	0.18	0.58	0.43
		941-IA-02	2.4	1.4	15	0.98	18	4.9	23	6	3.4* 3.2	3.8* 7.1	0.38
		941-IA-03	1.6	1.1	1.4	0.84	2.1	2.6	11	4.2	0.6	1.9	0.68
		941-IA-04	2	3.6	15	1.2	17	3	25	6.2	2.4* 1.8	3* 3	0.53
		941-IA-05	1.8	3.5	1.8	1.6	18	1.3	12	3.4	0.93	1.4	1.8
		941-IA-06	1.8	3.9	7.8	1	3.6	2.3	22	5	1.1	2.1	0.43
		941-IA-07	0.97	4.8	7.2	1.1	5	2.5	26	4.7	1	2.2	-
		941-IA-08	1.8	2.8	7.3	0.95	4.5	2.6	26	4.6	1.1	2	0.43
		941-IA-09	3.4	6.3	5.4	1.5	4.4	3	**60**	6.6	1.3	3.4	0.45
Sub-Slab Soil Gas	170 (EGLE SSC) 1,700 ($TSRIASL_{12}$)	941-SS-01	5.1	25	16	33	20	6.2	24	46	14	47	-
		941-SS-02	**11,000**	**12,000**	**15,000**	**6,700**	**5,900**	**7,900**	**18,000**	**9,000**	**2,900**	**6,400**	**10,000**
		941-SS-03	12	6.2	6.1	12	8.2	4.9	9.7	9.8	9	9	-
		941-SS-04	**11,000**	**5,400**	**9,000**	**8,400**	**11,000**	**7,500**	**11,000**	**6,700**	**6,400**	**7,600**	**10,000**
		941-SS-05	**8,100**	**11,000**	**7,400**	**9,600**	**8,400**	**4,000**	**3,800**	**5,000**	**5,200**	**4,600**	-
		941-SS-06	220	230	560	280	570	440	540	780	840	210	-
		941-IA-07	17	53	79	15	120	9.5	120	65	48	25	-
		941-IA-08	86	320	250	420	420	81	33	640	680	130	-
		941-IA-09	39	110	58	240	290	5.9	380	780	<4	5.8	-

-	not applicable
(shaded)	EGLE SSC Exceedance
BOLD	$TSRIASL_{12}$ Exceedance
*	filtered result

Table 941-9 Summary of Results for Chloromethane

Sample Type	Screening Level (µg/m³)	Sample ID	Measured Concentration (µg/m³)										
			May 2017	Sep. 2017	Feb. 2018	Aug. 2018	Nov. 2018	Feb. 2019	Apr. 2019	Aug. 2019	Nov. 2019	Dec. 2019	Aug. 2020
			E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E10
Outdoor Air	-	941-OA-01	1.7	5.4	<1.6	2.5	<1.6	<1.8	2.8	<1.8	<1.8	<1.6	<1.7
Indoor Air	280 (EGLE SSC) 410 ($TSRIASL_{12}$)	941-IA-01	2.3	4.1	5.6	<1.8	<1.8	<1.8	4.5	2	<1.8	<1.8	<1.9
		941-IA-02	1.8	4.7	6.1	<1.8	2.7	<3.5	230	2.1	4.1* 51	6.4* 4.5	<1.7
		941-IA-03	2.2	3.8	6.5	<1.8	<1.8	<1.7	120	2.3	<1.9	1.9	<1.8
		941-IA-04	1.7	5.9	<17	<1.7	<3.7	<1.8	210	2.2	1.9* 54	2.9* <1.8	<1.7
		941-IA-05	1.9	7	6.3	<1.8	<1.8	<1.7	81	1.9	<1.9	1.8	<1.7
		941-IA-06	1.6	5.6	6.5	<1.7	<1.7	<1.8	190	2.1	<1.9	2.6	<1.8
		941-IA-07	0.76	4.5	6.8	<1.7	<1.7	<1.8	220	2.2	1.7	2.4	-
		941-IA-08	1.7	21	6.8	<1.7	<2.2	<1.8	210	2.1	<1.9	2.6	<1.7
		941-IA-09	1.8	4.4	4.3	<1.8	<1.7	<1.8	**420**	2	1.8	2.9	<1.8
Sub-Slab Soil Gas	9,200 (EGLE SSC) 14,000 ($TSRIASL_{12}$)	941-SS-01	<18	<33	<22	<38	<16	<16	<16	<33	<18	<17	-
		941-SS-02	<350	<140	<160	<140	<220	<660	**700,000**	<310	<5,600	**15,000**	<64
		941-SS-03	<16	<16	<16	<16	<15	<16	34	<17	<17	<16	-
		941-SS-04	<360	<220	<350	<320	<360	<300	1300	<150	<2,200	11,000	<87
		941-SS-05	<170	<130	<160	<120	<96	<120	<110	<69	<690	370	-
		941-SS-06	<72	<100	<34	<61	<44	<58	53	<53	<83	<18	-
		941-IA-07	<18	<21	<16	<15	<17	<16	<15	<16	<17	<17	-
		941-IA-08	<42	<70	<27	<64	<16	<16	240	<51	<17	<17	-
		941-IA-09	<16	<16	<14	<40	<18	<17	<65	<36	<17	<17	-

-	not applicable
(shaded)	EGLE SSC Exceedance
BOLD	$TSRIASL_{12}$ Exceedance
*	filtered result

Table 941-10 Summary of Results for cis-1,2-Dichloroethene (cis-1,2-DCE)

Sample Type	Screening Level (µg/m³)	Sample ID	Measured Concentration (µg/m³)										
			May 2017	Sep. 2017	Feb. 2018	Aug. 2018	Nov. 2018	Feb. 2019	Apr. 2019	Aug. 2019	Nov. 2019	Dec. 2019	Aug. 2020
			E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E10
Outdoor Air	-	941-OA-01	<0.13	<0.14	<0.13	<0.13	<0.12	<0.14	<0.13	<0.14	<0.14	<0.12	<0.13
Indoor Air	24 (EGLE SSC) 72 (TSRIASL12)	941-IA-01	<0.12	0.42	<0.13	<0.13	<0.14	<0.14	<0.13	<0.14	<0.14	<0.14	<0.15
		941-IA-02	<0.13	<0.13	0.14	<0.14	0.21	0.41	<0.67	0.26	0.19* <0.13	0.17* <0.14	<0.13
		941-IA-03	<0.13	<0.14	<0.14	<0.14	<0.14	<0.13	<0.32	0.2	<0.15	<0.14	<0.14
		941-IA-04	0.13	0.23	22	<0.13	27	2.6	1.6	3.9	3.3* 1.5	1.4* 1.4	<0.13
		941-IA-05	<0.13	<0.12	<0.12	<0.14	0.22	0.17	<0.68	0.19	<0.14	<0.13	<0.13
		941-IA-06	<0.13	0.15	1.1	<0.13	3.2	0.59	<0.66	0.55	0.26	0.36	0.45
		941-IA-07	<0.13	<0.13	0.92	<0.13	1	0.64	<0.44	0.36	0.22	0.29	-
		941-IA-08	<0.13	<0.14	0.9	<0.13	0.73	0.86	<0.62	0.36	0.22	0.23	<0.13
		941-IA-09	<0.13	<0.13	0.34	<0.14	1.5	0.64	<1.1	0.39	0.29	0.35	<0.14
Sub-Slab Soil Gas	820 (EGLE SSC) 2,500 (TSRIASL12)	941-SS-01	<3.5	14	<4.2	<7.4	6.2	<3.1	7.9	12	5	5.4	-
		941-SS-02	<170	240	88	110	<110	<320	**<8,000**	<150	<1,100	<210	240
		941-SS-03	27	12	20	17	14	9.5	28	40	15	12	-
		941-SS-04	**9,300**	**9,100**	**10,000**	**12,000**	**7,000**	**9,200**	**9,400**	**6,700**	**8,100**	**8,500**	**7,400**
		941-SS-05	210	310	270	280	300	220	160	220	300	230	-
		941-SS-06	20	28	51	34	86	66	68	97	120	32	-
		941-IA-07	<3.4	<4.1	5.2	<3	4.9	<3.1	3.9	<3	<3.2	<3.2	-
		941-IA-08	<8	<13	<5.2	<12	<3.2	<3.2	<3.1	<9.8	<3.3	<3.4	-
		941-IA-09	40	62	24	120	99	<3.2	200	230	<3.2	<3.2	-

-	not applicable
(shaded)	EGLE SSC Exceedance
BOLD	TSRIASL12 Exceedance
*	filtered result

Table 941-11 Summary of Results for Naphthalene

Sample Type	Screening Level (µg/m³)	Sample ID	Measured Concentration (µg/m³)										
			May 2017	Sep. 2017	Feb. 2018	Aug. 2018	Nov. 2018	Feb. 2019	Apr. 2019	Aug. 2019	Nov. 2019	Dec. 2019	Aug. 2020
			E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E10
Outdoor Air	-	941-OA-01	<0.43	<0.47	<0.42	<0.44	<0.41	<0.46	<0.43	<0.45	<0.46	<0.41	<0.44
Indoor Air	3.6 (EGLE SSC)	941-IA-01	<0.41	0.52	<0.43	0.57	<0.45	<0.46	<0.43	<0.46	<0.47	<0.46	<0.48
		941-IA-02	<0.44	<0.44	<0.44	<0.45	<0.43	1.7	<2.2	<0.46	<0.48* <0.44	<0.46* <0.46	<0.44
		941-IA-03	<0.43	<0.46	<0.45	0.68	<0.47	0.63	<1	<0.47	<0.49	<0.45	<0.46
		941-IA-04	<0.43	<0.45	<4.4	<0.43	<0.94	<0.47	<2.7	<0.44	<0.39* <0.44	<0.47* <0.45	<0.44
		941-IA-05	<0.44	0.47	<0.4	<0.46	<0.45	<0.44	<2.2	<0.48	<0.48	<0.44	<0.44
		941-IA-06	<0.44	<0.44	<0.47	<0.44	<0.42	1.4	<2.2	<0.46	<0.48	<0.45	<0.44
		941-IA-07	<0.44	<0.44	<0.48	<0.44	<0.44	2.4	<1.4	<0.46	<0.43	<0.51	-
		941-IA-08	<0.44	<0.45	<0.46	<0.44	<0.56	0.88	<2	<0.46	<0.48	<0.45	<0.44
		941-IA-09	<0.43	<0.42	<0.48	<0.45	<0.44	1.4	<3.7	<0.42	<0.46	<0.45	<0.47
Sub-Slab Soil Gas	120 (EGLE SSC)	941-SS-01	<9.2	<16	<11	<20	15	<8.2	<8.3	<17	<9.2	<8.4	-
		941-SS-02	<890	<360	<410	<350	<570	<1,700	<42,000	<790	<2,900	<1,100	<160
		941-SS-03	<8.1	<8	<8.3	<8.1	<7.8	<8.2	<7.6	<8.6	<8.4	<8.4	-
		941-SS-04	<900	<560	<880	<820	<910	<780	<800	<380	<1,100	<1,700	<220
		941-SS-05	<430	<330	<400	<310	<240	<310	<280	<180	<350	<890	-
		941-SS-06	<37	<53	55	39	27	<29	<27	<27	<42	<9.3	-
		941-IA-07	16	<11	11	<7.8	16	<8.3	11	<8.1	<8.4	<8.6	-
		941-IA-08	29	<35	130	<32	18	<8.3	<8.3	<26	<8.8	<8.8	-
		941-IA-09	14	<24	<7	<20	<8.9	<8.4	<33	<18	<8.6	<8.6	-

-	not applicable
(shaded)	EGLE SSC Exceedance
*	filtered result

Table 941-12 Summary of Results for Tetrachloroethene (PCE)

Sample Type	Screening Level (µg/m³)	Sample ID	Measured Concentration (µg/m³)										
			May 2017	Sep. 2017	Feb. 2018	Aug. 2018	Nov. 2018	Feb. 2019	Apr. 2019	Aug. 2019	Nov. 2019	Dec. 2019	Aug. 2020
			E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E10
Outdoor Air	-	941-OA-01	2	2.3	13	2.5	5.5	<0.24	<0.22	<0.23	0.42	8	0.3
Indoor Air	82 (EGLE SSC) 82 (TSRIASL12)	941-IA-01	2.1	6.5	0.91	5	2.9	0.74	1.1	2.2	1.1	3.4	0.63
		941-IA-02	2.1	5	2.9	3.8	5.2	2.2	2.9	2.5	2.2* 3.5	6.8* 2.7	0.37
		941-IA-03	2.1	6.2	0.44	3.6	3.6	0.77	<0.54	1.9	0.87	5.4	<0.24
		941-IA-04	2.8	8	**210**	4.1	**220**	12	14	33	26* 16	21* 16	1
		941-IA-05	2.5	5.2	1.5	5.8	6.7	0.95	2.4	7.1	1.1	7.3	0.23
		941-IA-06	2.1	6.6	6.3	4.2	17	2.1	4.7	1.6	1.8	8.6	0.62
		941-IA-07	1.1	5.2	5.9	4.3	8.3	2.8	3.4	4	2	9.8	-
		941-IA-08	2.1	0.94	6	4	7	2.1	3	2.8	1.7	7.7	0.53
		941-IA-09	2.5	5.9	2.5	4.2	10	2.6	2.5	2.8	2.2	7.9	0.28
Sub-Slab Soil Gas	2,700 (EGLE SSC) 2,700 (TSRIASL12)	941-SS-01	270	2,600	1,900	2,600	1,800	840	1,400	2,500	1,200	1,400	-
		941-SS-02	1,400	**4,600**	1,100	2,400	540	1,000		900	**6,300**	1,800	2,400
		941-SS-03	790	600	660	1,200	780	540	650	1,500	810	780	-
		941-SS-04	**160,000**	**170,000**	**250,000**	**210,000**	**160,000**	**150,000**	**170,000**	**120,000**	**150,000**	**140,000**	**140,000**
		941-SS-05	**3,500**	**6,300**	**4,900**	**4,100**	**3,900**	2,500	1,700	2,300	**3,700**	**3,000**	-
		941-SS-06	2,400	**2,900**	**3,100**	1,900	**3,200**	**3,500**	**4,300**	**4,300**	**6,100**	**1,700**	-
		941-IA-07	370	450	620	88	590	110	620	230	290	130	-
		941-IA-08	460	560	470	290	290	58	69	380	400	68	-
		941-IA-09	1,100	1,800	480	**2,700**	1,600	120	**5,200**	**3,600**	<5.6	34	-

-	not applicable
	EGLE SSC Exceedance
BOLD	TSRIASL12 Exceedance
*	filtered result

Table 941-13 Summary of Results for Trichloroethene (TCE)

Sample Type	Screening Level (µg/m³)	Sample ID	Measured Concentration (µg/m³)										
			May 2017	Sep. 2017	Feb. 2018	Aug. 2018	Nov. 2018	Feb. 2019	Apr. 2019	Aug. 2019	Nov. 2019	Dec. 2019	Aug. 2020
			E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E10
Outdoor Air	-	941-OA-01	<0.44	0.35	0.43	0.3	0.26	0.2	0.87	0.32	<0.19	0.35	0.59
Indoor Air	4 (EGLE SSC) 12 (TSRIASL12)	941-IA-01	1	2.5	0.22	0.92	1.8	1.4	2.3	0.57	0.41	1.6	1.6
		941-IA-02	**13**	4.3	**67**	4.2	**71**	**21**	**75**	**24**	**22*** **30**	**23*** **46**	1.3
		941-IA-03	8.4	2.4	3.5	0.93	6	4.7	**22**	10	2.3	6.1	2.2
		941-IA-04	9.3	5.4	**76**	1.4	**80**	11	**48**	**20**	**12*** **9.1**	**12*** **13**	1.6
		941-IA-05	6.8	5.8	6.8	4	**94**	4	**27**	8.6	3.7	5.4	1.1
		941-IA-06	9	6.2	**26**	1.3	9.1	7.4	**45**	**14**	4.5	7.6	1.6
		941-IA-07	4.6	5.8	**22**	1.2	**17**	8.2	**46**	**13**	4.2	8.3	-
		941-IA-08	8.3	2.4	**22**	1.2	**14**	8.4	**46**	**13**	4.5	7.6	1.4
		941-IA-09	**15**	7.2	**12**	1.7	**14**	8.8	**76**	**16**	4.9	10	1.6
Sub-Slab Soil Gas	130 (EGLE SSC) 400 (TSRIASL12)	941-SS-01	25	310	200	300	220	59	150	270	120	140	-
		941-SS-02	**52,000**	**84,000**	**60,000**	**48,000**	**19,000**	**34,000**	**150,000**	**32,000**	**19,000**	**27,000**	**54,000**
		941-SS-03	220	99	140	230	190	100	130	180	150	140	-
		941-SS-04	**65,000**	**45,000**	**83,000**	**63,000**	**56,000**	**44,000**	**53,000**	**41,000**	**42,000**	**44,000**	**54,000**
		941-SS-05	**43,000**	**73,000**	**77,000**	**58,000**	**62,000**	**34,000**	**21,000**	**30,000**	**36,000**	**33,000**	-
		941-SS-06	350	**440**	**580**	**550**	**1300**	**1,200**	**1,500**	**2,100**	**2,600**	**670**	-
		941-IA-07	26	27	44	6.2	49	14	51	28	30	20	-
		941-IA-08	62	120	100	140	160	46	53	190	190	40	-
		941-IA-09	240	370	140	**600**	**550**	18	**1,000**	**1,100**	7.1	13	-

-	not applicable
(shaded)	EGLE SSC Exceedance
BOLD	TSRIASL12 Exceedance
*	filtered result

Table 941-14 Summary of Results for 1,1,1-Trichloroethane (1,1,1-TCA)

Sample Type	Screening Level (µg/m³)	Sample ID	Measured Concentration (µg/m³)										
			May 2017	Sep. 2017	Feb. 2018	Aug. 2018	Nov. 2018	Feb. 2019	Apr. 2019	Aug. 2019	Nov. 2019	Dec. 2019	Aug. 2020
			E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E10
Outdoor Air	-	941-OA-01	<0.18	<0.19	<0.17	<0.18	<0.17	<0.19	0.21	<0.19	<0.19	<0.17	-
Indoor Air	7,000 (EGLE SSC) 7,000 (TSRIASL12)	941-IA-01	0.25	0.31	<0.18	0.3	0.5	0.45	0.49	0.46	0.2	0.29	-
		941-IA-02	2.2	0.54	6.7	0.32	7.3	3.3	0.43	0.43	3.1* 3.6	2.7* 5.9	-
		941-IA-03	2.2	0.39	0.54	0.26	1.1	1	3.8	1.8	0.43	0.89	-
		941-IA-04	1.7	0.9	8.9	0.24	9.9	1.6	<0.36	0.78	1.8* 1.3	1.5* 1.8	-
		941-IA-05	1.7	1.4	0.97	1	1.3	0.61	4	1.4	0.46	0.56	-
		941-IA-06	1.6	1.1	3.2	0.22	2	1.5	7.4	2.4	0.76	1.1	-
		941-IA-07	0.84	0.93	2.7	0.21	1.6	1.7	7.8	2.3	0.71	1.2	-
		941-IA-08	1.6	0.43	2.8	0.21	1.6	1.7	7.7	2.2	0.78	1	-
		941-IA-09	2.8	1.2	1.5	0.26	2.6	1.8	13	2.8	0.85	1.5	-
Sub-Slab Soil Gas	230,000 (EGLE SSC) 230,000 (TSRIASL12)	941-SS-01	79	1,000	360	880	410	97	290	730	270	320	-
		941-SS-02	5,300	12,000	9,500	3,800	2,500	4,700	26,000	4,700	5,400	4,800	-
		941-SS-03	200	150	170	320	230	92	110	300	240	200	-
		941-SS-04	12,000	4,400	6,100	5,300	6,000	4,800	9,600	4,600	5,400	8,000	-
		941-SS-05	11,000	11,000	3,800	8,400	4,300	2,900	3,900	3,400	3,800	3,700	-
		941-SS-06	200	250	540	490	850	590	680	1,000	960	220	-
		941-IA-07	10	23	42	6	72	6	77	55	47	26	-
		941-IA-08	13	100	79	170	140	23	11	390	620	99	-
		941-IA-09	35	39	24	54	62	<4.4	110	210	<4.5	<4.5	-

-	not applicable
(shaded)	EGLE SSC Exceedance
BOLD	$TSRIASL_{12}$ Exceedance
*	filtered result

EVALUATION OF VI DATA TRENDS

Data trends for Building 941 are discussed below for both sub-slab soil gas and indoor air. When data exhibit a narrow range of variability, it is typical practice to express the range as a percentage. When data exhibit a large range of variability, however, it is more useful to express the range in orders of magnitude (i.e., factors of 10). This can be expressed mathematically as the log of the ratio of maximum/minimum values. If the values differ by a factor of 10, the log of the ratio is 1, if the values differ by a factor of 100, the log of the ratio is 2, and so on.

The variability across all locations over all sampling events is the total variability. This encompasses different types of variability, including spatial variability (i.e., how do the results vary from location to location), temporal variability (i.e., how do the results at a given location vary over time), and measurement variability. Measurement variability can be determined by evaluating results of duplicate or collocated samples and includes both sampling variability and analytical variability. The comparison of two data values is typically expressed as a RPD. The comparison of three of more data values is typically expressed as the %CV, which is the standard deviation divided by the mean.

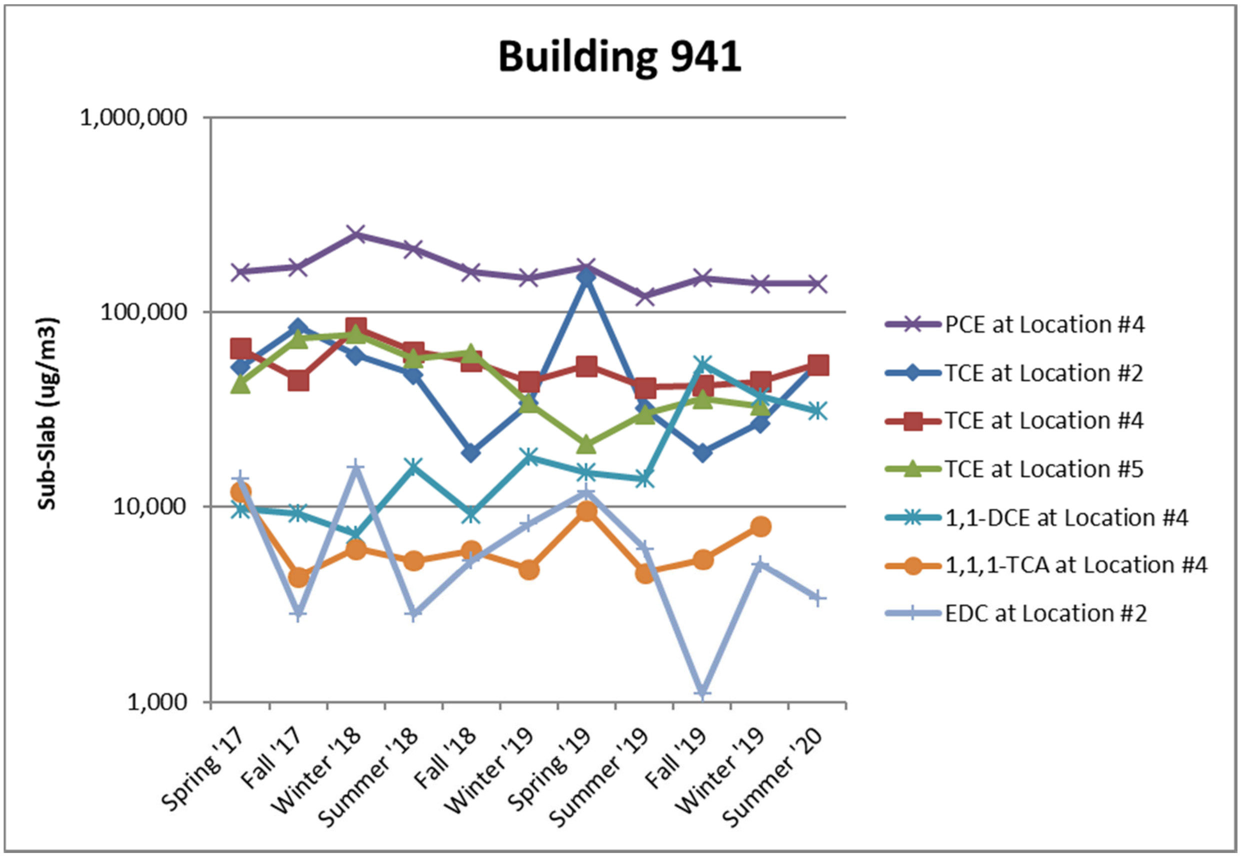
Sub-Slab Soil Gas Data Trends

Spatial Variability of Sub-Slab Soil Gas – The sub-slab soil gas exhibits up to four orders of magnitude of spatial variability. For example, sub-slab soil gas detections of TCE vary from 6 to 63,000 µg/m^3 (log of max./min. = 4.0) across the nine locations for E4. During that same sampling event, the range for PCE was 88 to 210,000 µg/m^3 (log of max./min. = 3.4) and the range for 1,1,1-TCA was 10 to 53,000 µg/m^3 (log of max./min. = 3.7).

Temporal Variability of Soil Gas – At locations with the highest soil gas concentrations, the temporal variability was only about a factor of two across the 11 sampling events. In some cases, however, the data exhibits several orders of magnitude of temporal variability. For example, sub-slab concentrations of 1,1-DCE vary from 800 to 120,000 µg/m^3 at location 941-SS-02 (log max/min = 2.2) across all 11 sampling events. At that same location, the range for TCE was 19,000 to 150,000 µg/m^3 (log max/min = 0.9).

Seasonal Confirmation Sampling Trend Analysis – No formal statistical tests were performed but the sub-slab soil gas data at locations with the highest concentrations do not exhibit any upward or downward trend over the course of the 11 sampling events. This is illustrated in the graph below, which shows results for several locations with relatively high concentrations for analytes detected at the highest concentrations. Note that the y-axis is a log scale.

Figure 941-1. Seasonal Confirmation Sampling Trend Analysis for Analytes with Highest Detected Concentrations



The data set was examined to see what the potential consequences would have been had only a single sampling event been performed. For the chemicals present at the highest concentrations in the sub-slab soil gas (i.e., PCE and TCE), the maximum sub-slab concentration was obtained during E3 (winter) or E7 (spring). For PCE at location 941-SS-04, the value increased from 160,000 ug/m^3 during E1 to 250,000 ug/m^3 during E3. For TCE at location 941-SS-02, the value increased from 52,000 ug/m^3 during E1 to 150,000 ug/m^3 during E7. If only the first sampling event had been performed, a negative bias of 188% would have been introduced (i.e., the TCE value for E7 was 188% higher than the TCE value for E1).

Indoor Air Data Trends

Spatial Variability of Indoor Air – The indoor air exhibits one to two orders of magnitude of spatial variability. For example, PCE was detected in all nine indoor air samples and varied from 2.9 to 220 µg/m^3 during the 5th sampling event (log max./min. = 1.9). PCE had about one order of magnitude or less for nine of the 11 sampling events. TCE also had about two orders of magnitude variability. For example, TCE ranged from 1.8 to 94 µg/m^3 during the 5th sampling event (log max./min. = 1.7).

After the Retro-Coat™ Vapor Intrusion Coating System was applied in July 2020, lower concentrations were measured in indoor air and the spatial variability was lower. For PCE in E11, the indoor air results range from 0.23 to 1 µg/m^3 (log max./min. = 0.6). TCE in E11 ranged from 1.1 to 2.2 µg/m^3 (log max./min. = 0.3). The highest indoor air concentrations of PCE and TCE prior to the Retro-Coat™ application have consistently occurred at location 941-IA-04. For PCE, the average indoor air concentration at location 941-IA-04, prior to Retro-Coat™ application, was approximately 50 ug/m^3. In comparison, the detected concentration of PCE at 941-IA-04 after RetroCoat™ application was 1 ug/m^3, which is well below the EGLE SSC (82 ug/m^3). For TCE, the average indoor air concentration at location

941-IA-04, prior to Retro-Coat™ application, was approximately 25 ug/m^3. In comparison, the detected concentration of TCE at 941-IA-04 after RetroCoat™ application was 1.6 ug/m^3, which is well below the EGLE SSC (4 ug/m^3). The TCE indoor air concentration during E11 that was above the EGLE SSC occurred outside of the RetroCoat™ application area (e.g. sample location 941-IA-03).

Temporal Variability of Indoor Air – The detected values for PCE and TCE exhibit temporal variability of about two orders of magnitude over time. For example, PCE was detected during all 11 sampling events at location 941-IA-04 and the values ranged from 1.0 to 220 µg/m^3. For TCE, the variability over time was similar to that for PCE. For example, TCE was detected during all 11 sampling events at location 941-IA-04, with values ranging from 1.4 to 80 µg/m^3.

<u>**Additional Analyses**</u>

Comparison of Sub-Slab Soil Gas and Indoor Air Data Sets – As expected, the sub-slab soil gas data exhibit greater spatial variability than the indoor air data set. Also as expected, the sub-slab soil gas data had lower temporal variability than the indoor air data.

Seasonal Effects –The data do not show a consistent trend regarding season of the year. This may be due, in part, to the mitigation measures that have been taken which essentially change the baseline. There is some indication of less attenuation during wintertime events, but the highest indoor air concentration for PCE and TCE were measured in the fall.

Comparison of Attenuation Factors by Event – Attenuation factors were calculated based on maximum values and are shown in Table 941-15. The values in Table 941-15 have not been corrected for any contribution from outdoor air.

Table 941-15. Calculated Attenuation Factors

	E1	E2	E3	E4	E5	E6
Evaluation Based on Maximum Detected Value						
PCE	1.8E-05	4.7E-05	8.4E-04	2.8E-05	1.4E-03	8.0E-05
TCE	2.3E-04	8.6E-05	9.2E-04	6.7E-05	1.5E-03	4.8E-04
EDC	1.7E-04	2.0E-04	8.8E-04	3.0E-04	2.3E-03	3.5E-04
1,1,2-TCA	1.5E-04	1.1E-04	1.5E-03	9.6E-05	2.4E-03	NC
1,1-DCE	2.0E-04	1.2E-04	1.9E-03	6.6E-05	2.6E-03	4.5E-04
Chloroform	3.1E-04	5.3E-04	1.0E-03	1.7E-04	1.6E-03	6.2E-04
1,1,1-TCA	2.3E-04	1.2E-04	9.4E-04	1.2E-04	1.7E-03	6.9E-04

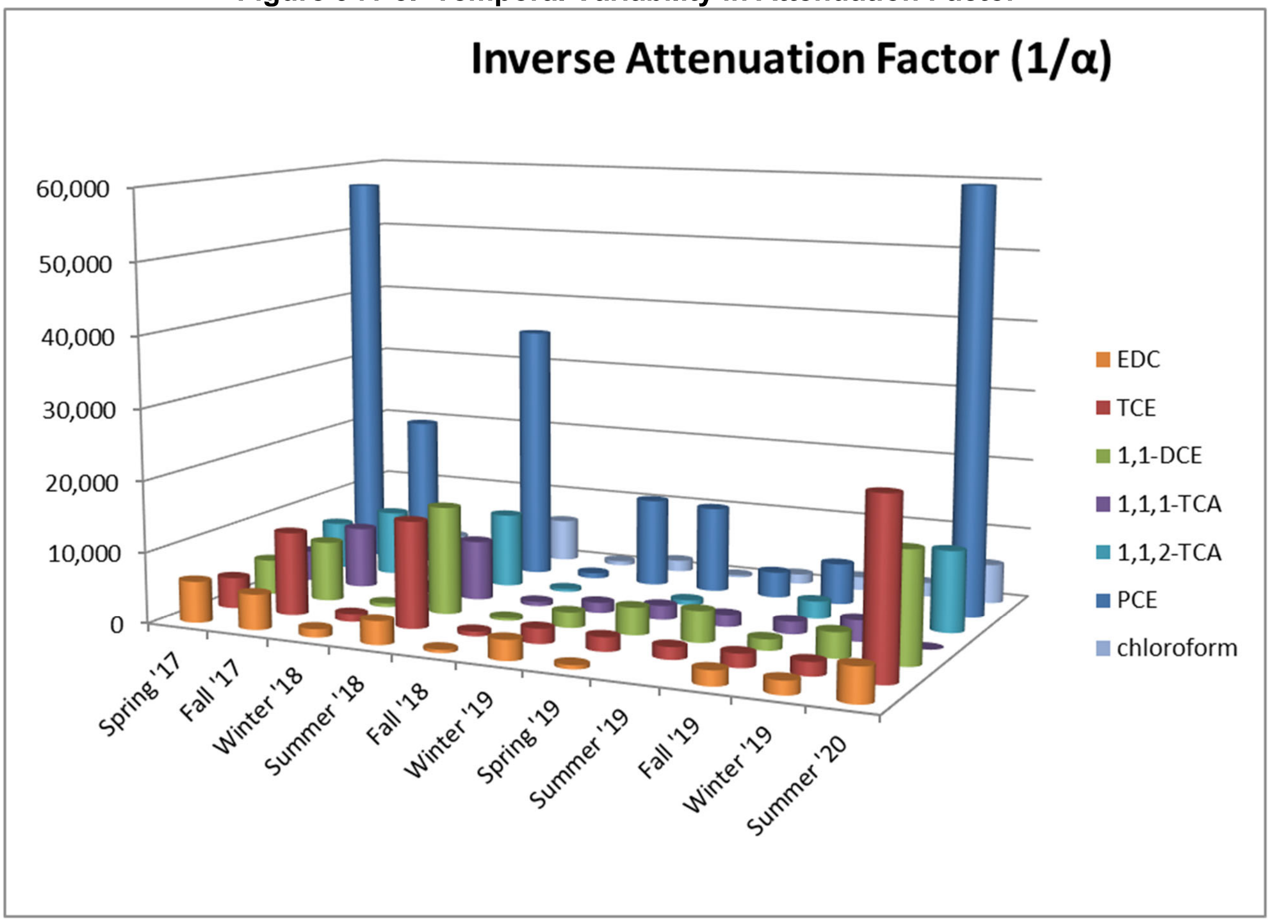
	E7	E8	E9	E10	E11
Evaluation Based on Maximum Detected Value					
PCE	8.2E-05	2.8E-04	1.7E-04	1.5E-04	7.1E-05
TCE	5.1E-04	5.9E-04	5.2E-04	5.2E-04	4.1E-05
EDC	1.8E-03	5.9E-04	4.8E-04	5.3E-04	2.1E-04
1,1,2-TCA	1.5E-03	7.9E-04	4.1E-04	6.8E-04	8.7E-05
1,1-DCE	2.6E-04	2.3E-04	6.5E-04	2.8E-04	6.4E-05
Chloroform	3.3E-03	7.3E-04	5.3E-04	5.0E-04	1.8E-04
1,1,1-TCA	5.0E-04	6.0E-04	5.7E-04	3.4E-04	--

NC - Not calculated due to no detections in soil gas during that round of testing.

The tabulated attenuation factors generally are consistent except that PCE tends to show somewhat greater attenuation during some rounds. This may be due to the spatial variability of PCE versus the other analytes (i.e., PCE was primarily detected at 941-SS-04, whereas TCE was primarily detected at 941-SS-02, 941-SS-04, and 041-SS-05). Any of the other analytes could be used, but the best conservative estimates of a building-specific attenuation factor for Building 941 are assumed to be the values for TCE for each sampling event.

Temporal Variability in Attenuation Factor – As shown in Table 941-15, there was slightly less than two orders of magnitude in temporal variability in the calculated attenuation factors observed in the data set, with E5 having the least attenuation and E11 generally having the greatest attenuation. Floor cracks were sealed in 2019 but did not result in a noticeable improvement in indoor air quality. The E11 sampling event occurred after the Retro-Coat™ Vapor Intrusion Coating System was completed in July 2020. This interim action does appear to show a measurable improvement in attenuation, as illustrated in the figure below that plots the inverse attenuation factor for various analytes for each sampling event. Taller columns denote greater attenuation (i.e., less VI), so the height of the last sampling event (E11) versus the earlier sampling events provides an indication of the effectiveness of the Retro-Coat™ Vapor Intrusion Coating System. Assuming VI was the only source of these analytes in indoor air, all of the columns for each event would be expected to have about the same height. Shorter columns either indicate greater levels of vapor intrusion or greater contribution from indoor workplace chemical use and/or outdoor sources for a given analyte.

Figure 941-3. Temporal Variability in Attenuation Factor



NON-DETECT EVALUATION

There were several potential exceedances noted where the compound was ND analytes in indoor air and/or soil gas due to the RLs of the analytical laboratory exceeding the screening level. The most significant were for HCBD, EDB, and 1,2,4-TCB. There have been similar issues with those same compounds at other buildings. For all three compounds, estimated indoor air concentrations are provided in the tables below. Furthermore, due to laboratory limitations to achieve low enough RLs that consistently meet screening levels for EDB and HCBD, further investigation for these analytes will be conducted once the facility-wide priority buildings have been sampled and evaluated. In events E8 –

E10, the majority of the sub-slab soil gas reporting limits for HCBD and 1,2,4-TCB were below EGLE SSCs. For EDB and HCBD, all indoor air ND reporting limits were below screening levels in E8 – E10.

As shown in Tables 941-16, 941-17 and 941-18, the ND evaluation demonstrates that the estimated indoor air concentrations attributable to VI for HCBD, EDB and 1,2,4-TCB generally are below their respective EGLE SSC for all four sampling events shown in the tables below based on the maximum ND reporting limits. Results from E7 – E10 are shown on the table. Note that during E11, the sub-slab soil gas samples were not analyzed for HCBD, EDB, or 1,2,4-TCB, because these analytes are not analytes of interest and were not retained for the reduced IM analyte list.

Table 941-16. Evaluation of Estimated Indoor Air Concentrations for HCBD

	E7	E8	E9	E10
Evaluation Based on Maximum Detection Limit				
Maximum Detection Limit of HCBD in Sub-Slab Soil Gas (μg/m^3)	<86,000	<1,600	<12,000	<3,500
Building-specific attenuation factor	5.1E-04	5.9E-04	5.2E-04	5.2E-04
Predicted Indoor Air Impacts (μg/m^3)[a]	<44	<0.94	<6.2	<1.8
Exceedance of Screening Level of 5.4 μg/m^3?	Possibly	No	Possibly	No

[a] Based on the selected building-specific attenuation factor for each sampling event.

Table 941-17. Evaluation of Estimated Indoor Air Concentrations for EDB

	E7	E8	E9	E10
Evaluation Based on Maximum Detection Limit				
Maximum Detection Limit of EDB in Sub-Slab Soil Gas (μg/m^3)	<15,000	<290	<2,100	<630
Building-specific attenuation factor	5.1E-04	5.9E-04	5.2E-04	5.2E-04
Predicted Indoor Air Impacts (μg/m^3)[a]	<7.6	<0.17	<1.1	<0.33
Exceedance of Screening Level of 0.2 μg/m^3?	Possibly	No	Possibly	Possibly

[a] Based on the selected building-specific attenuation factor for each sampling event.

Table 941-18. Evaluation of Estimated Indoor Air Concentrations for 1,2,4-TCB

	E7	E8	E9	E10
Evaluation Based on Maximum Detection Limit				
Maximum Detection Limit of EDB in Sub-Slab Soil Gas (μg/m^3)	<60,000	<1,100	<8,100	<2,400
Building-specific attenuation factor	5.1E-04	5.9E-04	5.2E-04	5.2E-04
Predicted Indoor Air Impacts (μg/m^3)[a]	<31	<0.65	<4.2	<1.2
Exceedance of Screening Level of 2.1 μg/m^3?	Possibly	No	Possibly	No

[a] Based on the selected building-specific attenuation factor for each sampling event.

WEIGHT-OF-EVIDENCE SUMMARY

A summary of all VI data trends and findings is presented in Table 941-19.

Table 941-19. Summary of Findings of Seasonal Confirmation Sampling

Topic	Finding	Details
Spatial Variability of Soil Gas	Four orders of magnitude or less	TCE during E4 ranged from 6 to 63,000 µg/m^3, log max./min. = 4.0 PCE during E4 ranged from 88 to 210,000 µg/m^3, log max./min. = 3.4
Temporal Variability of Soil Gas	A factor of two for the locations with relatively high concentrations	PCE at location 941-SS-04 ranged from 120,000 to 250,000 µg/m^3, log max./min. = 0.32 Up to two orders of magnitude variability observed for some other analytes
Seasonal Trend Analysis	Seasonal sampling is appropriate	No observed upward or downward trend in concentration. Limited evidence for less attenuation during wintertime.
Spatial Variability of Indoor Air	Two orders of magnitude or less	PCE during E5 ranged from 2.9 to 220 µg/m^3, log max./min. = 1.9
Temporal Variability of Indoor Air	Two orders of magnitude	PCE at location 941-SS-04 ranged from 1.0 to 220 µg/m^3, log max./min. = 2.3
Comparison of Sub-Slab Soil Gas vs. Indoor Air	Data show the expected trends for spatial variability. Less temporal variability in indoor air than expected.	Spatial variability: sub-slab soil gas > indoor air Temporal variability: sub-slab soil gas >indoor air
Best Estimate of Attenuation Factor	Varies from event to event	Most defensible values are based on TCE, 1,1-DCE and PCE data. Values vary from a minimum of 1.8E-05 and a maximum of 1.5E-03
Temporal Variability in Attenuation Factor	Wintertime event had the lowest attenuation	All calculated attenuation factors fall within about two orders of magnitude
Overall Summary	**Significant decrease of VI impacts after Retro-Coat™ Vapor Intrusion Coating System application.**	**Overall attenuation factor reduction post-application to approximately 1E-05 for PCE and TCE.**

SUMMARY AND PATH FORWARD

Building 941 is confirmed as a VI Path Forward Group 4B building. Dow implemented an interim response action in July 2020 and one round of sampling has been performed since that time. The initial sampling results post-application (E11) of the Retro-Coat™ Vapor Intrusion Coating System indicate the effectiveness of the Retro-Coat barrier as a preventative measure against VI.

Quarterly interim monitoring will continue. When data and/or findings are available, updates will be provided to EGLE in the monthly Corrective Action meetings. Results from each monitoring event will be reported in the annual CAIP. Dow may propose changes to the frequency or other aspects of these interim actions based on an evaluation of the data, changes in building use or implementation of other interim response actions to address the potential VI pathway.

Building 1028 Interim Monitoring Results Summary

INTRODUCTION

Building 1028 is a Category 1 building in Zone 2 Phase 1. It is a medium-sized single-story office building with a laboratory. It is known as the Sulfonamide Control Room and is located within the central portion of the facility designated as Zone 2. Building 1028 is a Group 2 building that completed seasonal confirmation sampling in August 2019. A full evaluation and trend analysis was provided in the 2019 CAIP. All indoor air analytes were detected below screening levels during each of the seasonal confirmation sampling events. The sub-slab soil gas AOI is chloroform. There were no exceedances of $TSRIASL_{12}$ in sub-slab soil gas.

Based on the evaluation of the four seasonal confirmation sampling events, the VI pathway is insignificant for Building 1028 and the sub-slab soil gas results demonstrated stable or decreasing concentrations over time. There was no evidence of increasing concentrations over time for any of the chlorinated hydrocarbons. Sufficient information exists to make a human exposure under control EI determination. However, while currently there is no evidence of potential VI, for future use, long-term monitoring (LTM) was warranted and the building-specific Interim Monitoring Plan was implemented.

Indoor air is monitored at location 1028-IA-04 (see Figure 5.3.2-1). This location was selected for continued monitoring since it demonstrated the highest sub-slab soil gas results. Monitoring is performed for chloroform. An outdoor air sample was also collected. Interim monitoring occurs semi-annually and the initial event was conducted in August 2020. The indoor air results are shown below on Table 1028-1.

Table 5.3.2-1. Interim Monitoring Indoor Air Results for Building 1028

Indoor Air Analyte	Result Value (μg/m³)	Reporting Limit (μg/m³)	EGLE SSC (μg/m³)	NONRES $TSRIASL_{12}$ (μg/m³)	Dow IH OEL (8-hour Time Weighted Average) (μg/m³)	Outdoor Air Result (ug/m³)
Chloroform	0.68	--	5.2	52	9,760	ND

ND = Not detected

As shown on the table above, the indoor air result from Event 1 was below the indoor air $RIASL_{12}$. The outdoor air result was not detected. The analytical data is presented in Appendix A. Field sampling forms are provided in Appendix B. The next interim measure (IM) event is scheduled for Winter 2020/2021. Semi-annual interim monitoring will continue in the summer and winter of 2021.

5.3.2 Building 1233 Interim Monitoring Results Summary

INTRODUCTION

Building 1233 is a Category 1 building located in the central portion of the facility designated as Zone 2. It is known as the Garlon Plant Granular Building and is a single-story building that includes process area, a laboratory, a shop, and office space. Building 1233 is a Group 2 building that has completed seasonal confirmation sampling in November 2018. A full evaluation and trend analysis was provided in the 2019 CAIP. All indoor air analytes were detected below screening levels during each of the seasonal confirmation sampling events. The sub-slab soil gas AOIs are 1,1,2-TCA, EDC, 1,2-DCP, chloroform, HCBD, PCE, and TCE.

Based on the evaluation of the four seasonal confirmation sampling events, the VI pathway is insignificant for Building 1233 and the sub-slab soil gas results demonstrated stable concentrations over time. There was no evidence of increasing concentrations over time for any of the chlorinated hydrocarbons. Sufficient information exists to make a human exposure under control EI determination. However, while currently there is no evidence of potential VI, for future use, long-term monitoring (LTM) was warranted and the building-specific Interim Monitoring Plan was implemented.

Indoor air is monitored at locations 1233-IA-02 and 1233-IA-04 (see Figure 5.3.3-1). These locations were selected for continued monitoring since they demonstrated the highest sub-slab soil gas results. Monitoring is performed for 1,1,2-TCA, EDC, 1,2-DCP, chloroform, HCBD, PCE, and TCE. Interim monitoring occurs semi-annually and the initial event was conducted in August 2019 and the results were presented in the 2019 CAIP (January 2020). The results for the Summer 2019 initial interim monitoring event showed that all indoor air results were below the indoor air $RIASL_{12}$, with the exception TCE at 1233-IA-02 which had a result (4.4 μg/m³) slightly above the $RIASL_{12}$. Due to this exceedance of TCE, co-located samples were collected at 1233-02 in November 2019 and the results were discussed in the February 2020 corrective action status meeting. Sub-slab soil gas results were consistent with previous sampling events. As shown below in Table 1233-1, the Summer 2019 indoor air result for TCE was not replicated during the fall confirmation sampling and TCE was detected at a concentration below the $RIASL_{12}$.

In 2020, interim monitoring continued as scheduled. In addition to indoor air samples collected at locations 1233-IA-02 and 1233-IA-04, an outdoor air sample was also collected. The indoor air results for IM Event 2 (January 2020) and IM Event 3 (August 2020) are shown below on Table 1233-1.

Table 1233-1. Interim Monitoring Indoor Air Results for Building 1233

Indoor Air Analyte	Result Value (µg/m³)	Reporting Limit (µg/m³)	EGLE SSC (µg/m³)	NONRES TSRIASL12 (µg/m³)	Dow IH OEL (8hr Time Weighted Average) (µg/m³)	Outdoor Air Result (ug/m³)
Sample 1233-IA-02						
1,1,2-Trichloroethane (1)	ND	0.17	0.62	NA	54,600	NS
1,1,2-Trichloroethane (1A)	ND	0.19	0.62	NA	54,600	ND
1,1,2-Trichloroethane (2)	ND	0.19	0.62	NA	54,600	ND
1,1,2-Trichloroethane (3)	ND	0.19	0.62	NA	54,600	ND
1,2-Dichloroethane (1)	0.86	--	4.6	NA	4,050	NS
1,2-Dichloroethane (1A)	0.15	--	4.6	NA	4,050	ND
1,2-Dichloroethane (2)	0.24	--	4.6	NA	4,050	0.2
1,2-Dichloroethane (3)	0.15	--	4.6	NA	4,050	ND
1,2-Dichloropropane (1)	ND	0.73	12.2	NA	46,200	NS
1,2-Dichloropropane (1A)	ND	0.8	12.2	NA	46,200	ND
1,2-Dichloropropane (2)	ND	0.8	12.2	NA	46,200	ND
1,2-Dichloropropane (3)	ND	0.81	12.2	NA	46,200	ND
Chloroform (1)	2.4	--	5.2	52	9,760	NS
Chloroform (1A)	1.4	--	5.2	52	9,760	ND
Chloroform (2)	1.2	--	5.2	52	9,760	0.49
Chloroform (3)	1.5	--	5.2	52	9,760	0.64
Hexachlorobutadiene (1)	ND	8.4	5.4	NA	213.4	NS
Hexachlorobutadiene (1A)	ND	9.2	5.4	NA	213.4	ND
Hexachlorobutadiene (2)	ND	9.3	5.4	NA	213.4	ND
Hexachlorobutadiene (3)	ND	9.3	5.4	NA	213.4	ND
Tetrachloroethene (1)	6.4	--	82	82	67,800	NS
Tetrachloroethene (1A)	0.62	--	82	82	67,800	ND
Tetrachloroethene (2)	4.3	--	82	82	67,800	4.5
Tetrachloroethene (3)	1.5	--	82	82	67,800	0.97
Trichloroethene (1)	4.4	--	4	12	26,850	NS
Trichloroethene (1A)	0.81	--	4	12	26,850	ND
Trichloroethene (2)	0.97	--	4	12	26,850	0.5
Trichloroethene (3)	1.7	--	4	12	26,850	1.2
Sample 1233-IA-04						
1,1,2-Trichloroethane (1)	ND	0.18	0.62	NA	54,600	
1,1,2-Trichloroethane (2)	ND	0.19	0.62	NA	54,600	
1,1,2-Trichloroethane (3)	ND	0.2	0.62	NA	54,600	
1,2-Dichloroethane (1)	0.65	--	4.6	NA	4,050	
1,2-Dichloroethane (2)	0.24	--	4.6	NA	4,050	
1,2-Dichloroethane (3)	0.15	--	4.6	NA	4,050	
1,2-Dichloropropane (1)	ND	0.78	12.2	NA	46,200	
1,2-Dichloropropane (2)	ND	0.81	12.2	NA	46,200	
1,2-Dichloropropane (3)	ND	0.84	12.2	NA	46,200	
Chloroform (1)	2.4	--	5.2	52	9,760	
Chloroform (2)	1.3	--	5.2	52	9,760	
Chloroform (3)	1.4	--	5.2	52	9,760	
Hexachlorobutadiene (1)	ND	9	5.4	NA	213.4	
Hexachlorobutadiene (2)	ND	9.4	5.4	NA	213.4	
Hexachlorobutadiene (3)	ND	9.8	5.4	NA	213.4	
Tetrachloroethene (1)	5.2	--	82	82	67,800	
Tetrachloroethene (2)	4.4	--	82	82	67,800	
Tetrachloroethene (3)	1.3	--	82	82	67,800	
Trichloroethene (1)	1.7	--	4	12	26,850	

Trichloroethene (2)	0.95	--	4	12	26,850	
Trichloroethene (3)	1.2	--	4	12	26,850	

(1) IM Event 1 (Summer 2019)
(1A) IM Event 1 Confirmation Sampling (Nov 2019)
(2) Indicates IM Event 2 (Winter 2020)
(3) Indicates IM Event 3 (Summer 2020)
ND = Not detected
NS = Not sampled

As shown on the table above, all indoor air results for Events 2 and 3 were either non-detect (ND), with reporting limits (RLs) below the indoor air $RIASL_{12}$, or detected less than the indoor air $RIASL_{12}$, with the exception of the ND reporting limits for HCBD. The ND reporting limits for HCBD (9.3 – 9.8 ug/m3) were slightly above the $RIASL_{12}$. The outdoor air results were either ND or detected at low concentrations. The next IM event is scheduled for Winter 2020/2021. The analytical data is presented in Appendix A. Field sampling forms are provided in Appendix B. The next interim measure (IM) event is scheduled for Winter 2020/2021. Semi-annual interim monitoring will continue in the summer and winter of 2021.

5.3.3 Building 827 Interim Monitoring Results Summary

INTRODUCTION

Building 827 is a Category 1 building in Zone 2 Phase 1. It is known as the Growth Insecticides Building and is a large two-story building that includes office space, a laboratory, shop, and warehouse space. Building 827 is a Group 4A building that completed seasonal confirmation sampling in August 2019. A full evaluation and trend analysis was provided in the 2019 CAIP. With the exception of TCE and chloroform, all other indoor air analytes were detected below screening levels during each of the seasonal confirmation sampling events. The sub-slab soil gas AOIs are PCE and TCE.

Based on the evaluation of the eight seasonal confirmation sampling events, the VI pathway at Building 827 is an insignificant exposure pathway and indoor air detections appear to be the result of workplace chemical use and not attributable to VI. Maximum indoor air detections were less than 0.2% of the Dow OELs for analytes that exceeded the $RIASL_{12}$. Further investigation activities were conducted with a mobile GC in May and July 2019 and reported in the October 2019 Summary of Investigative Findings (see Appendix C). During these activities, the weight of evidence collected throughout this investigation confirms that the elevated TCE and chloroform concentrations in Building 827 are likely due to active workplace chemical use and not attributable to VI.

The sub-slab soil gas results demonstrated stable or decreasing concentrations over time. There was no evidence of increasing concentrations over time for any of the chlorinated hydrocarbons. Sufficient information exists to make a human exposure under control EI determination. However, while currently there is no evidence of potential VI, for future use, long-term monitoring (LTM) was warranted and the building-specific Interim Monitoring Plan was implemented.

Indoor air is monitored at location 827-IA-11 and 827-IA-13 (see Figure 5.3.4-1). These locations were selected for continued monitoring since they demonstrated the highest sub-slab soil gas results. An outdoor air sample was also collected during the sampling event. Monitoring is performed for PCE and TCE. Interim monitoring occurs semi-annually and the initial event was conducted in August 2020. The indoor air results are shown below on Table 827-1.

Table 827-1. Interim Monitoring Indoor Air Results for Building 827

Indoor Air Analyte	Result Value (μg/m³)	Reporting Limit (μg/m³)	EGLE SSC (μg/m³)	NONRES TSRIASL12 (μg/m³)	Dow IH OEL (8-hour Time Weighted Average) (μg/m³)	Outdoor Air Result (ug/m³)
827-IA-11						
Tetrachloroethene	0.29	--	82	82	67,800	ND
Trichloroethene	0.2	--	4	12	26,850	0.22
827-IA-13						
Tetrachloroethene	0.27	--	82	82	67,800	
Trichloroethene	0.23	--	4	12	26,850	

ND = Not detected

As shown on the table above, all indoor air results from Event 1 were below the indoor air $RIASL_{12}$. The results of the outdoor air sample were ND for PCE and the detected concentration of TCE was similar to the detected concentrations in indoor air, indicating that indoor air may be influenced by outdoor air. When this event was conducted, indoor air samples were also inadvertently collected at locations 827-IA-4, 827-IA-12 and 827-IA-14 and analyzed for PCE and TCE. The results for these sample locations were also below the indoor air $RIASL_{12}$. These three additional sample locations will not be included in future IM events. The analytical data is presented in Appendix A. Field sampling forms are provided in Appendix B. The next interim measure (IM) event is scheduled for Winter 2020/2021. Semi-annual interim monitoring will continue in the summer and winter of 2021.

5.3.4 Building 948 Interim Monitoring Results Summary

INTRODUCTION

Building 948 is a Category 2 building in Zone 2 Phase 1. This building has an office, laboratory, locker rooms, process area, and a control room. It is known as Phenoxy Herbicides Building and is located within the central portion of the facility designated as Zone 2. Building 948 is a Group 4A building that completed seasonal confirmation sampling in October 2018. A full evaluation and trend analysis was provided in the 2019 CAIP. Indoor air results were less than screening levels, with the exception of PCE, which is used in the process at Building 948. Sub-slab soil gas AOIs are benzene, chloroform, cis-1,2-DCE, cumene, ethylbenzene, PCE, and TCE.

The evaluation of the four seasonal confirmation sampling events and the further investigation activities conducted with a mobile GC in July 2019 and the weight of evidence collected throughout the investigation confirms that the elevated indoor air PCE concentrations observed in Building 948 during E1 were likely due to laboratory chemical use and were not attributable to VI. There was no evidence of increasing concentrations over time for any of the chlorinated hydrocarbons. Sufficient information exists to make a human exposure under control EI determination. However, while currently there is no evidence of potential VI, for future use, long-term monitoring (LTM) was warranted and the building-specific Interim Monitoring Plan was implemented.

Indoor air is monitored at locations 948-IA-07 and 948-IA-08 (see Figure 5.3.5-1). These locations were selected for continued monitoring since it demonstrated the highest sub-slab soil gas results. Monitoring was performed for benzene, chloroform, cis-1,2-DCE, cumene, ethylbenzene, PCE, and TCE. Interim monitoring occurs semi-annually and the initial event and monitoring began in August 2019. The results of the initial event were reported in the 2019 CAIP and all indoor air results from the Summer 2019 IM event had detected results below the $RIASL_{12}$ or were ND with RLs below the indoor air $RIASL_{12}$. The indoor air results from IM Events 2 (Winter 2019/2020) and 3 (Summer 2020) are shown below in Table 948-1. An outdoor air sample was also collected with both IM Events 2 and 3.

Table 948-1. Interim Monitoring Indoor Air Results for Building 948

Indoor Air Analyte	Result Value (μg/m3)	Reporting Limit (μg/m³)	EGLE SSC (μg/m³)	NONRES TSRIASL12 (μg/m³)	Dow IH OEL (8hr Time Weighted Average) (μg/m³)	Outdoor Air Result (ug/m³)
Sample 948-IA-07						
Benzene (1)	0.4	--	15.4	54	1,595	NS
Benzene (2)	0.49	--	15.4	54	1,595	0.35
Benzene (3)	1.5	--	15.4	54	1,595	0.52
Chloroform (1)	0.37	--	5.2	52	9,760	NS
Chloroform (2)	0.32	--	5.2	52	9,760	ND
Chloroform (3)	1.7	--	5.2	52	9,760	0.26
cis-1,2-Dichloroethene (1)	ND	0.13	24	72	794,000	NS
cis-1,2-Dichloroethene (2)	0.23	--	24	72	794,000	ND
cis-1,2-Dichloroethene (3)	0.82	--	24	72	794,000	ND
Cumene (1)	ND	0.79	11.4	NA	246,000	NS
Cumene (2)	ND	0.79	11.4	NA	246,000	ND
Cumene (3)	ND	0.84	11.4	NA	246,000	ND
Ethyl Benzene (1)	0.95	--	48	480	86,800	NS
Ethyl Benzene (2)	0.17	--	48	480	86,800	ND
Ethyl Benzene (3)	0.56	--	48	480	86,800	0.44
Tetrachloroethene (1)	0.63	--	82	82	67,800	NS
Tetrachloroethene (2)	5.7	--	82	82	67,800	ND
Tetrachloroethene (3)	68	--	82	82	67,800	6.2
Trichloroethene (1)	ND	0.17	4	12	26,850	NS
Trichloroethene (2)	ND	0.17	4	12	26,850	ND
Trichloroethene (3)	1.1	--	4	12	26,850	0.21
Sample 948-IA-08						
Benzene (1)	0.26	--	15.4	54	1,595	
Benzene (2)	0.38	--	15.4	54	1,595	
Benzene (3)	0.63	--	15.4	54	1,595	
Chloroform (1)	0.36	--	5.2	52	9,760	
Chloroform (2)	0.33	--	5.2	52	9,760	
Chloroform (3)	1.7	--	5.2	52	9,760	
cis-1,2-Dichloroethene (1)	ND	0.13	24	72	794,000	
cis-1,2-Dichloroethene (2)	0.22	--	24	72	794,000	
cis-1,2-Dichloroethene (3)	1.1		24	72	794,000	
Cumene (1)	ND	0.81	11.4	NA	246,000	
Cumene (2)	ND	0.8	11.4	NA	246,000	
Cumene (3)	ND	0.88	11.4	NA	246,000	
Ethyl Benzene (1)	1.1	--	48	480	86,800	
Ethyl Benzene (2)	0.17	--	48	480	86,800	
Ethyl Benzene (3)	0.51	--	48	480	86,800	
Tetrachloroethene (1)	1.2	0.22	82	82	67,800	
Tetrachloroethene (2)	6.9	--	82	82	67,800	
Tetrachloroethene (3)	76	--	82	82	67,800	
Trichloroethene (1)	ND	0.18	4	12	26,850	
Trichloroethene (2)	ND	0.18	4	12	26,850	
Trichloroethene (3)	1.2	--	4	12	26,850	

(1) IM Event 1 (Summer 2019)
(2) IM Event 2 (Winter 2020)
(3) IM Event 3 (Summer 2020)
ND = Not detected
NS = Not sampled

As shown on the table above, the indoor air results from Events 2 and 3 were below the indoor air $RIASL_{12}$ or ND with RLs below the indoor air $RIASL_{12}$. Outdoor air results were either ND or low concentration detections. The analytical data is presented in Appendix A. Field sampling forms are provided in Appendix B. The next interim measure (IM) event is scheduled for Winter 2020/2021. Semi-annual interim monitoring will continue in the summer and winter of 2021.

5.3.5 Building 768 Interim Monitoring Results Summary

INTRODUCTION

Building 768 is a Category 2 building in Zone 2 Phase 1. Building 768 is approximately 14,090 ft^2 and has a warehouse, laboratory, and process area with office space. It is known as the Pilot Plant Office/Lab and is located within the central portion of the facility designated as Zone 2. Building 768 is a Group 2 building that completed seasonal confirmation sampling in August 2019. A full evaluation and trend analysis was provided in the 2019 CAIP. All indoor air analytes were detected below screening levels during each of the seasonal confirmation sampling events. The sub-slab soil gas AOIs are chloroform, PCE and TCE.

Based on the evaluation of the four seasonal confirmation sampling events, the VI pathway is insignificant for Building 768 and the sub-slab soil gas results demonstrated stable concentrations over time. There was no evidence of increasing concentrations over time for any of the chlorinated hydrocarbons. Sufficient information exists to make a human exposure under control EI determination. However, while currently there is no evidence of potential VI, for future use, long-term monitoring (LTM) was warranted and the building-specific Interim Monitoring Plan was implemented.

Indoor air is monitored at location 768-IA-04 and 768-IA-05 (see Figure 5.3.6-1). This location was selected for continued monitoring since it demonstrated the highest sub-slab soil gas results. Monitoring is performed for chloroform, PCE, and TCE. An outdoor air sample is also collected at the time of each monitoring event. Interim monitoring occurs semi-annually and the initial event was conducted in August 2020. The indoor air results are shown below on Table 768-1.

Table 768-1. Interim Monitoring Indoor Air Results for Building 768

Indoor Air Analyte	Result Value (μg/m³)	Reporting Limit (μg/m³)	EGLE SSC (μg/m³)	NONRES TSRIASL$_{12}$ (μg/m³)	Dow IH OEL (8-hour Time Weighted Average) (μg/m³)	Outdoor Air Result (ug/m³)
Sample 768-IA-04						
Chloroform	0.52	--	5.2	52	9,760	ND
Tetrachloroethene	ND	0.24	82	82	67,800	0.38
Trichloroethene	ND	0.19	4	12	26,850	ND
Sample 768-IA-05						
Chloroform	3.3	--	5.2	52	9,760	
Tetrachloroethene	1.1	--	82	82	67,800	
Trichloroethene	ND	0.19	4	12	26,850	

ND = Not detected

As shown on the table above, the indoor air results from Event 1 was below the indoor air RIASL$_{12}$. The outdoor air results were either ND or low detected concentrations. The analytical data is presented in Appendix A. Field sampling forms are provided in Appendix B. The next interim measure (IM) event is scheduled for Winter 2020/2021. Semi-annual interim monitoring will continue in the summer and winter of 2021.

5.3.6 Building 849 Interim Monitoring Results Summary

INTRODUCTION

Building 849 is a Category 2 building in Zone 2 Phase 1. This building is a warehouse with a small office. It is known as the 849 Building Warehouse and is located within the western portion of the facility designated as Zone 2. Building 849 is a Group 2 building that completed seasonal confirmation sampling in August 2019. A full evaluation and trend analysis was provided in the 2019 CAIP. All indoor air analytes were detected below screening levels during each of the seasonal confirmation sampling events. The sub-slab soil gas AOI is ethylbenzene.

Based on the evaluation of the four seasonal confirmation sampling events, the VI pathway is insignificant for Building 849 and the sub-slab soil gas results demonstrated stable or decreasing concentrations over time. There was no evidence of increasing concentrations over time for any of the chlorinated hydrocarbons. Sufficient information exists to make a human exposure under control EI determination. However, while currently there is no evidence of potential VI, for future use, long-term monitoring (LTM) was warranted and the building-specific Interim Monitoring Plan was implemented.

Indoor air is monitored at location 849-IA-01 (see Figure 5.3.7-1). This location was selected for continued monitoring since it demonstrated the highest sub-slab soil gas results. Monitoring is performed for ethylbenzene. An outdoor air sample was also collected at the time of each monitoring event. Monitoring is performed for ethylbenzene. Interim monitoring occurs semi-annually and the initial event was conducted in August 2020. The indoor air results are shown below on Table 849-1.

Table 849-1. Interim Monitoring Indoor Air Results for Building 849

Indoor Air Analyte	Result Value (μg/m³)	Reporting Limit (μg/m³)	EGLE SSC (μg/m³)	NONRES $TSRIASL_{12}$ (μg/m³)	Dow IH OEL (8-hour Time Weighted Average) (μg/m³)	Outdoor Air Result (ug/m³)
Ethylbenzene	1.2	--	48	480	86,800	ND

ND = Not detected

As shown on the table above, the indoor air result from Event 1 was below the indoor air $RIASL_{12}$. The outdoor air result was not detected. The analytical data is presented in Appendix A. Field sampling forms are provided in Appendix B. The next interim measure (IM) event is scheduled for Winter 2020/2021. Semi-annual interim monitoring will continue in the summer and winter of 2021.

5.3.7 Building 969 Interim Monitoring Results Summary

INTRODUCTION

Building 969 is a Category 2 building in Zone 2 Phase 1. This building is located in the central portion of the facility designated as Zone 2. It is known as the Ag Chem Development Building and is multiple stories tall with the office space on the first floor. Building 969 is a Group 2 building that completed seasonal confirmation sapling in October 2018. A full evaluation and trend analysis was provided in the 2019 CAIP. All indoor air analytes were detected below screening levels at Building 969, with the exception of a single exceedance of naphthalene that did not have a correlated sub-slab soil gas sample exceedance. TCE and chloroform also had limited indoor air exceedances and no exceedances in sub-slab soil gas throughout any of the seasonal confirmation sampling events. The sub-slab soil gas AOIs are 1,1,2-TCA, 1,2,4-TMB, benzene, cumene, ethylbenzene, naphthalene, and total xylenes.

Based on the evaluation of the four seasonal confirmation sampling events, the VI pathway is insignificant for Building 969 and the sub-slab soil gas results demonstrated stable concentrations over time. There was no evidence of increasing concentrations over time for any of the chlorinated hydrocarbons. Sufficient information exists to make a human exposure under control EI determination. However, while currently there is no evidence of potential VI, for future use, long-term monitoring (LTM) was warranted and the building-specific Interim Monitoring Plan was implemented.

Indoor air is being monitored at location 969-IA-08 (see Figure 5.3.8-1). This location was selected for continued monitoring since it demonstrated the highest sub-slab soil gas results. Monitoring is performed for 1,1,2-TCA, 1,2,4-TMB, benzene, cumene, ethylbenzene, naphthalene and total xylenes. Interim monitoring occurs semi-annually and the initial event and monitoring began in August 2019. The results of the initial event were reported in the 2019 CAIP and all indoor air results from the Summer 2019 IM event had detected results below the $RIASL_{12}$ or were ND with RLs below the indoor air $RIASL_{12}$. The indoor air results from IM Events 2 (Winter 2019/2020) and 3 (Summer 2020) are shown below in Table 969-1. An outdoor air sample was also collected with both IM Events 2 and 3.

Table 969-1. Interim Monitoring Indoor Air Results for Building 969

Indoor Air Analyte	Result Value (µg/m³)	Reporting Limit (µg/ m³)	EGLE SSC (µg/ m³)	NONRES $TSRIASL_{12}$ (µg/ m³)	Dow IH OEL (8hr Time Weighted Average) (µg/ m³)	Outdoor Air Result (ug/m³)
1,1,2-Trichloroethane (1)	ND	0.19	0.62	NA	54,600	NS
1,1,2-Trichloroethane (2)	ND	0.2	0.62	NA	54,600	NS
1,1,2-Trichloroethane (3)	ND	0.18	0.62	NA	54,600	ND
1,2,4-Trimethylbenzene (1)	ND	0.85	184	560	125,000	NS
1,2,4-Trimethylbenzene (2)	ND	0.88	184	560	125,000	NS
1,2,4-Trimethylbenzene (3)	ND	0.84	184	560	125,000	ND
Benzene (1)	0.44	--	15.4	54	1,595	NS
Benzene (2)	0.58	--	15.4	54	1,595	NS
Benzene (3)	ND	0.27	15.4	54	1,595	ND
Cumene (1)	ND	0.85	11.4	NA	246,000	NS
Cumene (2)	ND	0.88	11.4	NA	246,000	NS
Cumene (3)	ND	0.84	11.4	NA	246,000	ND
Ethyl Benzene (1)	3.8	--	48	480	86,800	NS
Ethyl Benzene (2)	2.1	--	48	480	86,800	NS
Ethyl Benzene (3)	1.2	--	48	480	86,800	0.26
Naphthalene (1)	ND	0.45	3.6	NA	52,400	NS
Naphthalene (2)	ND	0.47	3.6	NA	52,400	NS
Naphthalene (3)	ND	0.44	3.6	NA	52,400	0.29
Total Xylenes (1)	14.4	--	680	2000	434,000	NS
Total Xylenes (2)	8.5	--	680	2000	434,000	NS
Total Xylenes (3)	4.4	--	680	2000	434,000	0.36

(1) IM Event 1 (Summer 2019)
(2) IM Event 2 (Winter 2020)
(3) IM Event 3 (Summer 2020)
ND = Not detected
NS = Not sampled

As shown on the table above, the indoor air results from Events 2 and 3 were below the indoor air $RIASL_{12}$ or ND with RLs below the indoor air $RIASL_{12}$. Outdoor air results were either ND or low concentration detections. The analytical data is presented in Appendix A. Field sampling forms are provided in Appendix B. The next interim measure (IM) event is scheduled for Winter 2020/2021. Semi-annual interim monitoring will continue in the summer and winter of 2021.

5.3.8 Building 1222 Interim Monitoring Results Summary

INTRODUCTION

Building 1222 is a Category 2 building in Zone 2 Phase 1. Building 1222 has a maintenance shop with office space and is approximately 16,340 ft². It is known as the Dursban Maintenance and is located within the central portion of the facility designated as Zone 2. Building 1222 is a Group 2 building that completed seasonal confirmation sampling in August 2019. A full evaluation and trend analysis was provided in the 2019 CAIP. All indoor air analytes were detected below screening levels during each of the seasonal confirmation sampling events. The sub-slab soil gas AOIs are EDB, CFC-11, CFC-12, chloroform, hexane and TCE.

Based on the evaluation of the four seasonal confirmation sampling events, the VI pathway is insignificant for Building 1222 and the sub-slab soil gas results demonstrated stable concentrations over time. There was no evidence of increasing concentrations over time for any of the chlorinated hydrocarbons.

Sufficient information exists to make a human exposure under control EI determination. However, while currently there is no evidence of potential VI, for future use, long-term monitoring (LTM) was warranted and the building-specific Interim Monitoring Plan was implemented.

Indoor air is monitored at locations 1222-IA-03 and 1222-IA-06 (see Figure 5.3.9-1). These locations were selected for continued monitoring since it demonstrated the highest sub-slab soil gas results. Monitoring is performed for EDB, CFC-11, CFC-12, chloroform, hexane and TCE. An outdoor air sample is also collected at the time of each monitoring event. Interim monitoring occurs semi-annually and the initial event was conducted in August 2020. The results are shown below on Table 1222-1.

Table 1222-1. Interim Monitoring Indoor Air Results for Building 1222

Indoor Air Analyte	Result Value (μg/m³)	Reporting Limit (μg/m³)	EGLE SSC (μg/m³)	NONRES $TSRIASL_{12}$ (μg/m³)	Dow IH OEL (8-hour Time Weighted Average) (μg/m³)	Outdoor Air Result (ug/m³)
Sample 1222-IA-03						
1,2-Dichloroethane	ND	0.15	4.6	NA	4,050	ND
CFC-11	1.8	--	1,340	--	5,620,000	1.8
CFC-12	2.6	--	1,020	--	4,950,000	2.8
Chloroform	0.81	--	5.2	52	9,760	0.31
Hexane	ND	3.2	2,200	6,600	176,000	ND
Trichloroethene	ND	0.19	4	12	26,850	ND
Sample 1222-IA-06						
1,2-Dichloroethane	ND	0.15	4.6	NA	4,050	
CFC-11	1.5	--	1,340	--	5,620,000	
CFC-12	2.6	--	1,020	--	4,950,000	
Chloroform	0.29	--	5.2	52	9,760	
Hexane	ND	3.3	2,200	6,600	176,000	
Trichloroethene	ND	0.2	4	12	26,850	

ND = Not detected

As shown on the table above, the indoor air results from Event 1 were all below the indoor air $RIASL_{12}$. All outdoor air results were not detected. The analytical data is presented in Appendix A. Field sampling forms are provided in Appendix B. The next interim measure (IM) event is scheduled for Winter 2020/2021. Semi-annual interim monitoring will continue in the summer and winter of 2021.

5.4 Zone 2 Phase 2 Evaluations

The Zone 2 Phase 2 buildings were evaluated in the 2018 CAIP (January 2019) and in the 2019 CAIP (January 2020). Zone 2 Phase 2 VI sampling and/or interim monitoring results are presented for the buildings listed below in the following subsections:

- Section 5.4.1 Building 1255;
- Section 5.4.2 Building 304;
- Section 5.4.3 Building 499;
- Section 5.4.4 Building 593;
- Section 5.4.5 Building 826/494; and
- Section 5.4.6 Building 923.

5.4.1 Building 1255 Interim Monitoring Results Summary

INTRODUCTION

Building 1255 is a Category 1 building in Zone 2 Phase 2. Building 1255 is located in the southeastern quadrant of the Midland Facility designated as Zone 2. It is known as the EH&S Offices building. Building 1255 is a Group 4A building that completed seasonal confirmation sampling in August 2019. A full evaluation and trend analysis was provided in the 2019 CAIP. With the exception of chloroform (the indoor air AOI), all indoor air results are less than screening levels. The sub-slab soil gas AOIs are CFC-12 and chloroform.

Further Investigation Activities

Further investigation activities were conducted in February 2020 to better understand the source and distribution of chloroform in the indoor air at Building 1255. These activities were documented in the *Summary of Further Investigation Activities for Buildings 49, 593, 1255, 1790, 680 and 941* (April 2020) (provided in Appendix C).

Breathing-zone baseline samples were collected at many of the previously sampled co-located indoor air and sub-slab soil gas locations, as well as at the air handler unit. During this time, renovation work was occurring throughout the building, primarily in the men's and women's locker rooms. Initial baseline readings were found to be very consistent around 0.30 ppbv, significantly below the screening level.

A depressurization test took place in Office #104, adjacent to sample location 1255-06 to evaluate chloroform concentrations. Office #104 was first pressurized for an hour and then depressurized for an hour. Samples were collected at the end of pressurization and depressurization in Office #104, and control samples were collected at 1255-06 before and after the pressurization experiments. Neither pressurization nor depressurization impacted the chloroform concentrations in Office #104. The before and after control samples at 1255-06 were consistent at 0.27 ppbv chloroform. This indicates that the indoor air concentrations of chloroform are not attributable to VI.

All samples collected in this investigation had chloroform concentrations significantly below the screening level. Two of the four seasonal confirmation sampling events had chloroform results in indoor air greater than the $RIASL_{12}$ and those results did not correlate with sub-slab soil gas results. Chloroform is one of the trihalomethanes produced by chlorination of water supplies. Chloroform and other VOCs in tap water can be emitted into indoor air (McKone, 1987). Washing machines and kitchen sinks may also be significant sources (Howard and Corsi, 1998) (Howard and Corsi, 1996). Furthermore, during previous Field GC sampling events conducted at other buildings on-site where chloroform was an analyte of interest, it has been concluded for some buildings that the main source of chloroform is running treated water from sinks, drinking fountains, and showers. Based on these results, it was concluded that the VI pathway at Building 1255 is an insignificant exposure pathway based on current use.

Interim Monitoring Activities

Based on the evaluation of the four seasonal confirmation sampling events and the results of the further investigation, the VI pathway continues to be insignificant for Building 1255. The sub-slab soil gas results have demonstrated relatively stable concentrations and no evidence of increasing over time. Sufficient information exists to make a human exposure under control EI determination. However, while currently there is no evidence of potential VI, for future use, LTM is warranted and the building-specific Interim Monitoring Plan is discussed below.

Indoor air is monitored at location 1255-IA-01 and 1255-IA-06 (see Figure 5.4.1-1). These locations were selected for continued monitoring since they demonstrated the highest sub-slab soil gas results. Monitoring is performed for CFC-12 and chloroform. An outdoor air sample was also collected at the time of each monitoring event. Interim monitoring occurs semi-annually and the initial event was conducted in August 2020. The results are shown below on Table 1255-1

Table 1255-1. Interim Monitoring Indoor Air Results for Building 1255

Indoor Air Analyte	Result Value (μg/m³)	Reporting Limit (μg/m³)	EGLE SSC (μg/m³)	NONRES $TSRIASL_{12}$ (μg/m³)	Dow IH OEL (8-hour Time Weighted Average) (μg/m³)	Outdoor Air Result (ug/m³)
Sample 1255-IA-01						
CFC-12	62	--	1,020	--	4,950,000	2.5
Chloroform	5.3	--	5.2	52	9,760	0.19
Sample 1255-IA-06						
CFC-12	56	--	1,020	--	4,950,000	
Chloroform	5.5	--	5.2	52	9,760	

As shown on the table above, the indoor air results from Event 1 for CFC-12 were below the indoor air $RIASL_{12}$. For chloroform, the results at both sample locations slightly exceeded the $RIASL_{12}$. These indoor air detections are very similar to the detections seen throughout seasonal confirmation sampling. Based on these repetitive results and the conclusions of the further investigation activities, confirmation sampling is not recommended. During the further investigation activities, real-time breathing height samples were significantly below screening levels and the pressurization and depressurization test demonstrated that detected indoor air concentrations were not attributable to VI. Additionally, it is known that chloroform in tap water can be emitted into indoor air (McKone, 1987). The outdoor air results had detects, but do not appear to be influencing indoor air. The analytical data is presented in Appendix A. Field sampling forms are provided in Appendix B. The next IM event is scheduled for Winter 2020/2021. Semi-annual interim monitoring will continue in the summer and winter of 2021.

5.4.2 Building 304 Interim Monitoring Results Summary

INTRODUCTION

Building 304 is a Category 2 building in Zone 2 Phase 2. This building is located in the southwestern quadrant of the Midland facility in Zone 2 and is known as the Dow Automotive and Brake Fluids Building. Building 304 is a Group 4A building and seasonal confirmation sampling was completed in February

2019. A full evaluation and trend analysis was provided in the 2019 CAIP. A single indoor air exceedance of TCE occurred during E1 but was not repeated in the remainder of seasonal confirmation samples or in the July 2019 further investigation activities. All other indoor air results were less than screening levels. Sub-slab soil gas AOIs are 1,1,2-trichloroethane, 1,2-dichloroethane, 1,2-dichloropropane, carbon tetrachloride, chloroform, cis-1,2-DCE, dibromochloromethane, ethylbenzene, PCE, and TCE.

The evaluation of the four seasonal confirmation sampling events and the further investigation activities conducted with a mobile GC in July 2019 and the weight of evidence collected throughout the investigation confirms that the elevated indoor air TCE concentrations observed in Building 304 during E1 were likely due to active workplace chemical use and were not attributable to VI. There was no evidence of increasing concentrations over time for any of the chlorinated hydrocarbons. Sufficient information exists to make a human exposure under control EI determination. However, while currently there is no evidence of potential VI, for future use, long-term monitoring (LTM) was warranted and the building-specific Interim Monitoring Plan was implemented.

Indoor air is monitored at locations 304-IA-01 and 304-IA-02 (see Figure 5.4.2-1). These locations were selected for continued monitoring since it demonstrated the highest sub-slab soil gas results. Monitoring was performed for 1,1,2-trichloroethane, 1,2-dichloroethane, 1,2-dichloropropane, carbon tetrachloride, chloroform, cis-1,2-DCE, dibromochloromethane, ethylbenzene, PCE, and TCE. Interim monitoring occurs semi-annually and the initial event and monitoring began in August 2019. The results of the initial event were reported in the 2019 CAIP and all indoor air results from the Summer 2019 IM event had detected results below the $RIASL_{12}$ or were ND with RLs below the indoor air $RIASL_{12}$. The indoor air results from IM Events 2 (Winter 2019/2020) and 3 (Summer 2020) are shown below in Table 304-1. An outdoor air sample was also collected with both IM Events 2 and 3.

Table 304-1. Interim Monitoring Indoor Air Results for Building 304

Indoor Air Analyte	Result Value (µg/m3)	Reporting Limit (µg/m3)	EGLE SSC (µg/m3)	NONRES $TSRIASL_{12}$ (µg/m3)	Dow IH OEL (8hr Time Weighted Average) (µg/m3)	Outdoor Air Result (ug/m^3)
Sample 304-IA-01						
1,1,2-Trichloroethane (1)	ND	0.17	0.62	NA	54,600	NS
1,1,2-Trichloroethane (2)	ND	0.2	0.62	NA	54,600	ND
1,1,2-Trichloroethane (3)	ND	0.16	0.62	NA	54,600	ND
1,2-Dichloroethane (1)	ND	0.12	4.6	NA	4,050	NS
1,2-Dichloroethane (2)	0.2	--	4.6	NA	4,050	ND
1,2-Dichloroethane (3)	ND	0.12	4.6	NA	4,050	ND
1,2-Dichloropropane (1)	ND	0.71	12.2	NA	46,200	NS
1,2-Dichloropropane (2)	ND	0.86	12.2	NA	46,200	ND
1,2-Dichloropropane (3)	ND	0.7	12.2	NA	46,200	ND
Carbon Tetrachloride (1)	0.58	--	22	NA	1,2580	NS
Carbon Tetrachloride (2)	0.56	--	22	NA	1,2580	0.46
Carbon Tetrachloride (3)	0.52	--	22	NA	1,2580	0.48
Chloroform (1)	0.26	--	5.2	52	9,760	NS
Chloroform (2)	ND	0.18	5.2	52	9,760	ND
Chloroform (3)	0.25	--	5.2	52	9,760	ND
cis-1,2-Dichloroethene (1)	ND	0.12	24	72	794,000	NS
cis-1,2-Dichloroethene (2)	ND	0.15	24	72	794,000	ND
cis-1,2-Dichloroethene (3)	0.14	--	24	72	794,000	ND
Dibromochloromethane (1)	ND	1.3	5	NA	5,170	NS
Dibromochloromethane (2)	ND	1.6	5	NA	5,170	ND
Dibromochloromethane (3)	ND	1.3	5	NA	5,170	ND
Ethylbenzene (1)	0.42	--	48	480	86,800	NS
Ethylbenzene (2)	ND	0.16	48	480	86,800	ND
Ethylbenzene (3)	0.16	--	48	480	86,800	ND
Tetrachloroethene (1)	2.6	--	82	82	67,800	NS

Tetrachloroethene (2)	6.9	--	82	82	67,800	ND
Tetrachloroethene (3)	1.8	--	82	82	67,800	ND
Trichloroethene (1)	0.18	--	4	12	26,850	NS
Trichloroethene (2)	0.36	--	4	12	26,850	ND
Trichloroethene (3)	ND	0.16	4	12	26,850	ND
Sample 304-IA-02						
1,1,2-Trichloroethane (1)	ND	0.2	0.62	NA	54,600	
1,1,2-Trichloroethane (2)	ND	0.2	0.62	NA	54,600	
1,1,2-Trichloroethane (3)	ND	0.19	0.62	NA	54,600	
1,2-Dichloroethane (1)	ND	0.15	4.6	NA	4,050	
1,2-Dichloroethane (2)	0.2	--	4.6	NA	4,050	
1,2-Dichloroethane (3)	ND	0.14	4.6	NA	4,050	
1,2-Dichloropropane (1)	ND	0.84	12.2	NA	46,200	
1,2-Dichloropropane (2)	ND	0.83	12.2	NA	46,200	
1,2-Dichloropropane (3)	ND	0.8	12.2	NA	46,200	
Carbon Tetrachloride (1)	0.57	--	22	NA	12,580	
Carbon Tetrachloride (2)	0.57	--	22	NA	12,580	
Carbon Tetrachloride (3)	0.53	--	22	NA	1,2580	
Chloroform (1)	0.26	--	5.2	52	9,760	
Chloroform (2)	0.18	--	5.2	52	9,760	
Chloroform (3)	0.36	--	5.2	52	9,760	
cis-1,2-Dichloroethene (1)	ND	0.14	24	72	794,000	
cis-1,2-Dichloroethene (2)	ND	0.14	24	72	794,000	
cis-1,2-Dichloroethene (3)	ND	0.14	24	72	794,000	
Dibromochloromethane (1)	ND	1.6	5	NA	5,170	
Dibromochloromethane (2)	ND	1.5	5	NA	5,170	
Dibromochloromethane (3)	ND	1.5	5	NA	5,170	
Ethylbenzene (1)	0.42	--	48	480	86,800	
Ethylbenzene (2)	ND	0.16	48	480	86,800	
Ethylbenzene (3)	0.31	--	48	480	86,800	
Tetrachloroethene (1)	2.5	--	82	82	67,800	
Tetrachloroethene (2)	7.8	--	82	82	67,800	
Tetrachloroethene (3)	1.9	--	82	82	67,800	
Trichloroethene (1)	ND	0.2	4	12	26,850	
Trichloroethene (2)	0.4	--	4	12	26,850	
Trichloroethene (3)	ND	0.18	4	12	26,850	

(1) IM Event 1 (Summer 2019)
(2) IM Event 2 (Winter 2019/2020)
(3) IM Event 3 (Summer 2020)
ND = Not detected
NS = Not sampled

As shown on the table above, the indoor air results from Events 2 and 3 were below the indoor air $RIASL_{12}$ or ND with RLs below the indoor air $RIASL_{12}$. Outdoor air results were all ND with the exception of carbon tetrachloride, which was detected in both events at concentrations similar to those detected in indoor air. The analytical data is presented in Appendix A. Field sampling forms are provided in Appendix B. The next interim measure (IM) event is scheduled for Winter 2020/2021. Semi-annual interim monitoring will continue in the summer and winter of 2021.

5.4.3 Building 499 Interim Monitoring Results Summary

INTRODUCTION

Building 499 is a Category 2 building in Zone 2 Phase 2. This building is located in the southeastern quadrant of the Midland facility in Zone 2 and is known as the Demineralized Water Plant. Building 499 is a Group 4A building that completed seasonal confirmation sampling in February 2019. A full evaluation and trend analysis was provided in the 2019 CAIP. Sub-slab soil gas AOIs are 1,1,2-trichloroethane, 1,2-dichloroethane, 1,2-dichloropropane, carbon tetrachloride, chloroform, cis-1,2-DCE, dibromochloromethane, ethylbenzene, PCE, and TCE. Chloroform, PCE, and TCE were detected in indoor air at concentrations greater than screening levels, likely due to active workplace chemical use. All other indoor air results were less than screening levels.

The evaluation of the four seasonal confirmation sampling events and the further investigation activities conducted with a mobile GC in July 2019 and the weight of evidence collected throughout the investigation confirms that the elevated indoor air chloroform, PCE and TCE concentrations observed in Building 499 during seasonal confirmation sampling were likely due to active workplace chemical use and were not attributable to VI. Overall, the weight of evidence collected throughout that investigation including the presence of degreaser cans, confirmed that the elevated chlorinated concentrations in indoor air at Building 499 are likely due to active workplace chemical use and not attributable to VI. There was no evidence of increasing concentrations over time for any of the chlorinated hydrocarbons. Sufficient information exists to make a human exposure under control EI determination. However, while currently there is no evidence of potential VI, for future use, long-term monitoring (LTM) was warranted and the building-specific Interim Monitoring Plan was implemented.

Indoor air is being monitored at locations 499-IA-02 and 499-IA-05 (see Figure 5.4.3-1). These locations were selected for continued monitoring since they demonstrated the highest sub-slab soil gas results. These locations were selected for continued monitoring since it demonstrated the highest sub-slab soil gas results. Monitoring is performed for chloroform, cis-1,2-dichloroethene, PCE, and TCE. Interim monitoring occurs semi-annually and the initial event and monitoring began in August 2019. The results of the initial event were reported in the 2019 CAIP and all indoor air results from Event 1 had detected results below the $RIASL_{12}$ or were ND with RLs below the indoor air $RIASL_{12}$. In Event 1, a sample was inadvertently collected for location 499-IA-09 and this error was corrected in the next events.

The indoor air results from IM Events 2 (Winter 2019/2020) and 3 (Summer 2020) are shown below in Table 499-1. An outdoor air sample was also collected with both IM Events 2 and 3.

Table 499-1. Interim Monitoring Indoor Air Results for Building 499

Indoor Air Analyte	Result Value (μg/m3)	Reporting Limit (μg/m3)	EGLE SSC (μg/m3)	NONRES $TSRIASL_{12}$ (μg/m3)	Dow IH OEL (8hr Time Weighted Average) (μg/m3)	Outdoor Air Results (ug/m^3)
Sample 499-IA-02						
Chloroform (1)	1.6	--	5.2	52	9,760	NS
Chloroform (2)	2.2	--	5.2	52	9,760	0.78
Chloroform (3)	3.6	--	5.2	52	9,760	0.46
cis-1,2-Dichloroethene (1)	1.2	--	24	72	794,000	NS
cis-1,2-Dichloroethene (2)	0.14	--	24	72	794,000	ND
cis-1,2-Dichloroethene (3)	ND	0.14	24	72	794,000	ND
Tetrachloroethene (1)	55	--	82	82	67,800	NS
Tetrachloroethene (2)	13	--	82	82	67,800	3
Tetrachloroethene (3)	2.8	--	82	82	67,800	2
Trichloroethene (1)	0.7	--	4	12	26,850	NS
Trichloroethene (2)	0.52	--	4	12	26,850	0.085
Trichloroethene (3)	0.59	--	4	12	26,850	0.28
Sample 499-IA-05						
Chloroform (1)	1.1	--	5.2	52	9,760	
Chloroform (2)	1.4	--	5.2	52	9,760	
Chloroform (3)	3.4	--	5.2	52	9,760	
cis-1,2-Dichloroethene (1)	1	--	24	72	794,000	
cis-1,2-Dichloroethene (2)	ND	0.13	24	72	794,000	
cis-1,2-Dichloroethene (3)	ND	0.14	24	72	794,000	
Tetrachloroethene (1)	46	--	82	82	67,800	
Tetrachloroethene (2)	6.6	--	82	82	67,800	
Tetrachloroethene (3)	3	--	82	82	67,800	
Trichloroethene (1)	0.54	--	4	12	26,850	
Trichloroethene (2)	0.21	--	4	12	26,850	
Trichloroethene (3)	0.57	--	4	12	26,850	

(1) IM Event 1 (Summer 2019)
(2) IM Event 2 (Winter 2019/2020)
(3) IM Event 3 (Summer 2020)
ND = Not detected
NS = Not sampled

As shown on the table above, the indoor air results from Events 2 and 3 were below the indoor air $RIASL_{12}$ or ND with RLs below the indoor air $RIASL_{12}$. Outdoor air results were either ND or detected at low concentrations. The analytical data is presented in Appendix A. Field sampling forms are provided in Appendix B. The next interim measure (IM) event is scheduled for Winter 2020/2021. Semi-annual interim monitoring will continue in the summer and winter of 2021.

5.4.4 Building 593 Interim Monitoring Results Summary

INTRODUCTION

Building 593 is a Category 2 building in Zone 2 Phase 2. It is known as the Fabrication Shop and located in the southeastern quadrant of the Midland facility. The building was constructed sometime between 1938 and 1952. The 95,544 ft^2 structure is a slab-on-grade L-shaped construction that is approximately three stories high. The L-shaped portion of the building is predominantly a large fabrication shop containing a variety of different work areas that is used by various contractors. A single-story annex containing office space, locker rooms, storage, a conference room, and a large kitchen/break room is located to the southwest of the inside corner of the L-shaped fabrication shop area. Building 593 is a Group 4A building that completed seasonal confirmation sampling in April 2019. The sub-slab soil gas AOIs are 1,1,2-TCA, 1,2-DCP, chloroform, HCBD, PCE, and TCE.

1,2-Dichloroethane, chloroform, PCE, and TCE had exceedances of the indoor air $RIASL_{12}$ and/or $TSRIASL_{12}$ during the initial event (E1). PCE was the only indoor air analyte with an exceedance during E2. All of the indoor air results were below screening levels during E3 and E4. During E5, 1,2,4-TMB, naphthalene had exceedances at a single sample location and PCE had exceedances at two sample locations. An additional investigation was undertaken at Building 593 in October 2019 and was reported in the January 2020 Summary of Investigative Findings which made use of a field GC capable of detecting TCE at relatively low concentrations. While the analytical method was optimized for TCE, the approach also provided data for PCE and chloroform. Workplace sources of PCE, and TCE were discovered during this investigation (e.g., degreasers containing 80+% of either PCE or TCE). Chloroform concentrations observed appear to be trending based on the location of treated municipal water in the building, a known source of chloroform and other trihalomethanes. Although TCE continues to be detected in indoor air throughout this investigation, results are comparatively low.

Further Investigation Activities

Further investigation activities were conducted to follow-up further investigation activities in February 2020. The goal for the follow-up building-specific investigation for Building 593 was to gain further understanding of the distribution of PCE around a potential preferential pathway identified during the Field GC investigations in October 2019, though it does not necessarily appear to be a conduit for PCE. All results, including this location from the October 2019 sampling event, were less than the screening levels for PCE, TCE, and chloroform. These activities were documented in the Summary of Further Investigation Activities for Buildings 49, 593, 1255, 1790, 680 and 941 (April 2020).

During the October 2019 investigation, a potential preferential pathway was identified underneath a set of lockers near sample location 593-14. The presence of the lockers had precluded inspection or testing of the floor slab in that area. However, on February 14, 2020, it was discovered the lockers had been removed. The field crew was unable to replicate the ppbRAE PID results observed in October 2019 that had indicated the presence of the potential preferential pathway. However, a slightly elevated ppbRAE PID reading (280 ppbv) was measured nearby at a joint seam in the floor immediately east of the double doors leading into the large warehouse/shop area. The February 14, 2020 results showed comparable to slightly higher PCE concentrations in the indoor air at nearby location 593-14 (6.38 ppbv) when compared to the PCE result collected immediately above the newly identified joint seam at 593-14CC (6.20 ppbv).

The field crew followed up with additional sampling on February 18, 2020. A sample collected in the breathing zone had a PCE concentration of 1.25 ppbv, while the sample collected at the joint seam on the floor next to the double doors had a PCE concentration of 4.60 ppbv. Later that day, pressurization and depressurization tests were performed at this joint seam. While the depressurized sample did have a higher concentration of PCE (0.59 ppbv), it was significantly below screening levels.

This sampling event was conducted to gain further understanding of a potential preferential pathway identified near location 593-14 during the October 2019 Field GC sampling event. Overall, PCE concentrations near that sample location were low and all of the samples collected throughout both Field GC investigations, as well as during pressurization and depressurization tests, resulted in PCE concentrations below the $RIASL_{12}$. While the sample results were low, the joint seam investigated will be sealed. Based on these results, the VI pathway at Building 593 is an insignificant exposure pathway based on current use.

Interim Monitoring Activities

Based on the evaluation of the seasonal confirmation sampling events and the results of the further investigation, the VI pathway continues to be insignificant for Building 593. Weight of evidence based on seasonal confirmation sampling, as documented in email notifications provided to EGLE throughout 2018 and 2019, Building seasonal confirmation sample results demonstrate a lack of correlated sub-slab soil gas and indoor air exceedances ($RIASL^{12}$ and/or $TSRIASL^{12}$) and other lines of evidence indicate VI is insignificant and IA exceedances are likely due to work place chemical use. The sub-slab soil gas results have demonstrated relatively stable or decreasing concentrations over time. Sufficient information exists to make a human exposure under control EI determination. However, while currently there is no evidence of significant VI, for future use, LTM is warranted and the building-specific Interim Monitoring Plan is discussed below.

Indoor air is being monitored at locations 593-IA-20, -22, -29, and -30 (see 5.4.4-1). These locations were selected for continued monitoring since they demonstrated the highest sub-slab soil gas results. Monitoring will be performed for 1,1,2-TCA, 1,2-DCP, chloroform, HCBD, PCE, and TCE. An outdoor air sample is also collected at the time of each monitoring event. Monitoring began in December 2019 (IM Event 1) and a second event occurred in summer 2020 (IM Event 2). Interim monitoring occurs semi-annually. The indoor air results of IM Events 1 and 2 are shown below on Table 593-1.

Table 593-1. Interim Monitoring Indoor Air Results for IM Event 1 for Building 593

Indoor Air Analyte	Result Value (µg/m³)	Reporting Limit (µg/m³)	EGLE SSC (µg/m³)	NONRES TSRIASL12 (µg/m³)	Dow IH OEL (8-hour Time Weighted Average) (µg/m³)	Outdoor Air Results (ug/m³)
Sample 593-IA-20						
1,1,2-Trichloroethane (1)	ND	0.18	0.62	NA	54,600	NS
1,1,2-Trichloroethane (2)	ND	0.19	0.62	NA	54,600	ND
1,2-Dichloropropane (1)	ND	0.78	12.2	NA	46,200	NS
1,2-Dichloropropane (2)	ND	0.79	12.2	NA	46,200	ND
Chloroform (1)	ND	0.82	5.2	52	9,760	NS
Chloroform (2)	ND	0.84	5.2	52	9,760	ND
Hexachlorobutadiene (1)	ND	9	5.4	NA	213.4	NS
Hexachlorobutadiene (2)	ND	9.2	5.4	NA	213.4	ND
Tetrachloroethene (1)	4.5	--	82	82	67,800	NS
Tetrachloroethene (2)	0.49	--	82	82	67,800	0.46
Trichloroethene (1)	ND	0.18	4	12	26,850	NS
Trichloroethene (2)	ND	0.18	4	12	26,850	ND
Sample 593-IA-22						
1,1,2-Trichloroethane (1)	ND	0.2	0.62	NA	54,600	
1,1,2-Trichloroethane (2)	ND	0.18	0.62	NA	54,600	
1,2-Dichloropropane (1)	ND	0.84	12.2	NA	46,200	
1,2-Dichloropropane (2)	ND	0.78	12.2	NA	46,200	
Chloroform (1)	ND	0.89	5.2	52	9,760	
Chloroform (2)	ND	0.83	5.2	52	9,760	
Hexachlorobutadiene (1)	ND	9.8	5.4	NA	213.4	
Hexachlorobutadiene (2)	ND	9.1	5.4	NA	213.4	
Tetrachloroethene (1)	1.8	--	82	82	67,800	
Tetrachloroethene (2)	0.62	--	82	82	67,800	
Trichloroethene (1)	ND	0.2	4	12	26,850	
Trichloroethene (2)	ND	0.18	4	12	26,850	
Sample 593-IA-29						
1,1,2-Trichloroethane (1)	ND	0.2	0.62	NA	54,600	
1,1,2-Trichloroethane (2)	ND	0.19	0.62	NA	54,600	
1,2-Dichloropropane (1)	ND	0.84	12.2	NA	46,200	
1,2-Dichloropropane (2)	ND	0.81	12.2	NA	46,200	
Chloroform (1)	ND	0.89	5.2	52	9,760	
Chloroform (2)	ND	0.85	5.2	52	9,760	
Hexachlorobutadiene (1)	ND	9.8	5.4	NA	213.4	
Hexachlorobutadiene (2)	ND	9.3	5.4	NA	213.4	
Tetrachloroethene (1)	0.57	--	82	82	67,800	
Tetrachloroethene (2)	0.65	--	82	82	67,800	
Trichloroethene (1)	ND	0.2	4	12	26,850	
Trichloroethene (2)	ND	0.19	4	12	26,850	
Sample 593-IA-30						
1,1,2-Trichloroethane (1)	ND	0.2	0.62	NA	54,600	
1,1,2-Trichloroethane (2)	ND	0.19	0.62	NA	54,600	
1,2-Dichloropropane (1)	ND	0.83	12.2	NA	46,200	
1,2-Dichloropropane (2)	ND	0.82	12.2	NA	46,200	
Chloroform (1)	ND	0.87	5.2	52	9,760	
Chloroform (2)	ND	0.87	5.2	52	9,760	
Hexachlorobutadiene (1)	ND	9.5	5.4	NA	213.4	
Hexachlorobutadiene (2)	ND	9.5	5.4	NA	213.4	
Tetrachloroethene (1)	10	--	82	82	67,800	
Tetrachloroethene (2)	0.59	--	82	82	67,800	
Trichloroethene (1)	0.29	--	4	12	26,850	
Trichloroethene (2)	ND	0.19	4	12	26,850	

(1) IM Event 1 (Winter, December 2019)

(2) IM Event 2 (Summer 2020)
ND = Not detected
NS = Not sampled

As shown on the table above, the indoor air results from first two IM events were either detected at concentrations less than the indoor air $RIASL_{12}$ or ND with RLs less than the indoor air $RIASL_{12}$, with the exception of HCBD. All ND RLs for HCBD were greater than the indoor air $RIASL_{12}$ (5.4 ug/m^3). The outdoor air results were either ND or detected at low concentrations. The analytical data is presented in Appendix A. Field sampling forms are provided in Appendix B. The next interim measure (IM) event is scheduled for Winter 2020/2021. Semi-annual interim monitoring will continue in the Summer and Winter of 2021.

5.4.5 Building 826/494 Interim Monitoring Results Summary

INTRODUCTION

Building 826/494 is a Category 2 building in Zone 2 Phase 2. It is located in the southeastern quadrant of the Midland facility and is known as the Maintenance Shops. Building 826/494 is a Group 2 building and seasonal confirmation sampling was completed in February 2019. A full evaluation and trend analysis was provided in the 2019 CAIP. All indoor air results were less than screening levels. Sub-slab soil gas AOIs are CFC-12, PCE and TCE.

Based on the evaluation of the four seasonal confirmation sampling events, the VI pathway is insignificant for Building 826/494 and the sub-slab soil gas results demonstrated stable or decreasing concentrations over time. There was no evidence of increasing concentrations over time for any of the chlorinated hydrocarbons. Sufficient information exists to make a human exposure under control EI determination. However, while currently there is no evidence of potential VI, for future use, long-term monitoring (LTM) was warranted and the building-specific Interim Monitoring Plan was implemented.

Indoor air is monitored at locations 826/494-IA-01 and 826/494-IA-02 (see Figure 5.4.5-1). These locations were selected for continued monitoring since they demonstrated the highest sub-slab soil gas results. Monitoring is performed for CFC-12, PCE, and TCE. Interim monitoring occurs semi-annually and the initial event and monitoring began in August 2019. The results of Event 1 were reported in the 2019 CAIP and all indoor air results were detected below the $RIASL_{12}$ or were ND with RLs below the indoor air $RIASL_{12}$. The indoor air results from IM Events 2 (Winter 2019/2020) and 3 (Summer 2020) are shown below in Table 826/494-1. An outdoor air sample was also collected with both IM Events 2 and 3.

Table 826/494-1. Interim Monitoring Indoor Air Results for Building 826/494

Indoor Air Analyte	Result Value (µg/m³)	Reporting Limit (µg/m³)	EGLE SSC (µg/m³)	NONRES TSRIASL12 (µg/m³)	Dow IH OEL (8hr Time Weighted Average) (µg/m³)	Outdoor Air Result (ug/m³)
Sample 826/494-IA-01						
CFC-12 (1)	4.4	--	1,020	NA	4,950,000	NS
CFC-12 (2)	3.9	--	1,020	NA	4,950,000	2.4
CFC-12 (3)	4.8	--	1,020	NA	4,950,000	2
Tetrachloroethene (1)	1.2	--	82	82	67,800	NS
Tetrachloroethene (2)	2.3	--	82	82	67,800	0.28
Tetrachloroethene (3)	0.97	--	82	82	67,800	ND
Trichloroethene (1)	ND	0.18	4	12	26,850	NS
Trichloroethene (2)	0.28	--	4	12	26,850	0.17
Trichloroethene (3)	ND	0.18	4	12	26,850	0.23
Sample 826/494-IA-02						
CFC-12 (1)	4.3	--	1,020	NA	4,950,000	
CFC-12 (2)	3.9	--	1,020	NA	4,950,000	
CFC-12 (3)	4.8	--	1,020	NA	4,950,000	
Tetrachloroethene (1)	1.1	--	82	82	67,800	
Tetrachloroethene (2)	2.4	--	82	82	67,800	
Tetrachloroethene (3)	0.94	--	82	82	67,800	
Trichloroethene (1)	ND	0.18	4	12	26,850	
Trichloroethene (2)	0.21	--	4	12	26,850	
Trichloroethene (3)	ND	0.18	4	12	26,850	

(1) IM Event 1 (Summer 2019)
(2) IM Event 2 (Winter 2019/2020)
(3) IM Event 3 (Summer 2020)
ND = Not detected
NS = Not sampled

As shown on the table above, the indoor air results from Events 2 and 3 were below the indoor air $RIASL_{12}$ or ND with RLs below the indoor air $RIASL_{12}$. Outdoor air results were either ND or detected at low concentrations. CFC-12 was detected in outdoor air at approximately half of the concentrations detected in indoor air, which may indicate that outdoor air is influencing indoor air. The analytical data is presented in Appendix A. Field sampling forms are provided in Appendix B. The next interim measure (IM) event is scheduled for Winter 2020/2021. Semi-annual interim monitoring will continue in the summer and winter of 2021.

5.4.6 Building 923 Interim Monitoring Results Summary

INTRODUCTION

Building 923 is a Category 2 building in Zone 2 Phase 2. It is located within the southeastern quadrant of the Midland facility and is a maintenance contractor building occupied by an on-site contractor. Building 923 is a Group 4A building that completed seasonal confirmation sampling in February 2019. A full evaluation and trend analysis was provided in the 2019 CAIP. Sub-slab soil gas AOIs are 1,2,4-TMB, 1,2-DCP, 1,3,5-TMB, benzene, cumene, ethylbenzene, naphthalene, and total xylenes. A single indoor air exceedance of benzene in E2 was likely due to workplace chemical use or maintenance activities.

Based on the evaluation of the four seasonal confirmation sampling events, the VI pathway continues to be insignificant for Building 923 and the sub-slab soil gas results have demonstrated relatively stable concentrations and no evidence of increasing over time. Sufficient information exists to make a human exposure under control EI determination. However, while currently there is no evidence of potential VI, for future use, LTM is warranted and the building-specific Interim Monitoring Plan is discussed below.

Indoor air is monitored at locations 923-IA-04 and 923-IA-09 (see Figure 5.4.6-1). These locations were selected for continued monitoring since it demonstrated the highest sub-slab soil gas results. Monitoring will be performed for 1,2,4-TMB, 1,2-DCP, 1,3,5-TMB, benzene, cumene, ethylbenzene, naphthalene, and total xylenes. An outdoor air sample is also collected at the time of each monitoring event. Interim monitoring occurs semi-annually and the initial event and monitoring began in August 2019. The results of Event 1 were reported in the 2019 CAIP and all indoor air results from were detected below the $RIASL_{12}$ or ND with RLs below the indoor air $RIASL_{12}$. The indoor air results from IM Event 2 (Summer 2020) are shown below in Table 923-1. A Winter 2019/2020 event could not be performed as construction activities were occurring in the building over the winter season.

Table 923-1. Interim Monitoring Indoor Air Results for Building 923

Indoor Air Analyte	Result Value (μg/m³)	Reporting Limit (μg/m³)	EGLE SSC (μg/m³)	NONRES $TSRIASL_{12}$ (μg/m³)	Dow IH OEL (8hr Time Weighted Average) (μg/m³)	Outdoor Air Result (ug/m³)
Sample 923-IA-04						
1,2,4-Trimethylbenzene (1)	ND	0.86	184	560	125,000	NS
1,2,4-Trimethylbenzene (2)	0.92	--	184	560	125,000	ND
1,2-Dichloropropane (1)	ND	0.81	12.2	NA	46,200	NS
1,2-Dichloropropane (2)	ND	0.79	12.2	NA	46,200	ND
1,3,5-Trimethylbenzene (1)	ND	0.86	184	560	125,000	NS
1,3,5-Trimethylbenzene (2)	ND	0.84	184	560	125,000	ND
Benzene (1)	0.46	--	15.4	54	1,595	NS
Benzene (2)	1	--	15.4	54	1,595	0.34
Cumene (1)	ND	0.86	11.4	NA	246,000	NS
Cumene (2)	ND	0.84	11.4	NA	246,000	ND
Ethylbenzene (1)	2.1	--	48	480	86,800	NS
Ethylbenzene (2)	2.1	--	48	480	86,800	0.24
Naphthalene (1)	ND	0.46	3.6	NA	52,400	NS
Naphthalene (2)	ND	0.45	3.6	NA	52,400	ND
Total Xylenes (1)	11.1	--	680	2000	434,000	NS
Total Xylenes (2)	10.5	--	680	2000	434,000	0.98
Sample 923-IA-09						
1,2,4-Trimethylbenzene (1)	ND	0.86	184	560	125,000	
1,2,4-Trimethylbenzene (2)	0.96	--	184	560	125,000	
1,2-Dichloropropane (1)	ND	0.81	12.2	NA	46,200	
1,2-Dichloropropane (2)	ND	0.78	12.2	NA	46,200	
1,3,5-Trimethylbenzene (1)	ND	0.86	184	560	125,000	
1,3,5-Trimethylbenzene (2)	ND	0.83	184	560	125,000	
Benzene (1)	0.44	--	15.4	54	1,595	
Benzene (2)	0.97	--	15.4	54	1,595	
Cumene (1)	ND	0.86	11.4	NA	246,000	
Cumene (2)	ND	0.83	11.4	NA	246,000	
Ethylbenzene (1)	1.5	--	48	480	86,800	
Ethylbenzene (2)	2.5	--	48	480	86,800	
Naphthalene (1)	ND	0.46	3.6	NA	52,400	
Naphthalene (2)	ND	0.44	3.6	NA	52,400	
Total Xylenes (1)	6.9	--	680	2000	434,000	
Total Xylenes (2)	12.7	--	680	2000	434,000	

(4) IM Event 1 (Summer 2019)
(5) IM Event 2 (Summer 2020)
ND = Not detected
NS = Not sampled

As shown on the table above, the indoor air results from Events 2 and 3 were below the indoor air $RIASL_{12}$ or ND with RLs below the indoor air $RIASL_{12}$. Outdoor air results were either ND or detected at low concentrations. The analytical data is presented in Appendix A. Field sampling forms are provided in Appendix B. The next interim measure (IM) event is scheduled for Winter 2020/2021. Semi-annual interim monitoring will continue in the summer and winter of 2021.

5.5 Zone 3 Phase 1 Buildings

The Zone 3 Phase 1 buildings were initially evaluated in the 2019 CAIP (January 2020). The Group 2 and 4 buildings that required seasonal confirmation sampling are evaluated within this section. The Zone 3 Phase 1 priority building surveys are included in Appendix D. Zone 3 Phase 1 sampling and/or interim monitoring results are presented for the buildings listed below in the following subsections:

- Section 5.5.1 Building 887;
- Section 5.5.2 Building 1038;
- Section 5.5.3 Building 100;
- Section 5.5.4 Building 564;
- Section 5.5.5 Building 881;
- Section 5.5.6 Building 1037; and
- Section 5.5.7 Building 1042.

5.5.1 VI Seasonal Confirmation Sampling Results Evaluation for Building 887

INTRODUCTION

Building 887 is a Category 4A building in Zone 3 Phase 1, located in the southwestern quadrant of the Midland facility (Figure 5.5.1-1). The building is a one-story structure of slab-on-grade construction with no basement or elevators and has a footprint of approximately 1,449 ft^2. This building contains lab space and a large switch room with a bathroom. The building is used as a lab where operators from Building 954 perform material testing. The 2018 CAIP concluded that the VI pathway at Building 887 was an insignificant exposure pathway based on current use. However, based on the sub-slab soil gas results and given the potential for future VI, Building 887 was placed in VI Path Forward Building Group 4A, as lines of evidence indicated that VI is insignificant and the single indoor air exceedance of chloroform was likely due to indoor sources, including the laboratory and potentially sewer gas from the bathroom drain during heavy rain events. Any building placed in Group 4A is scheduled for seasonal confirmation sampling.

The results of the initial sampling event (E1) were evaluated in the 2018 CAIP. The 2019 CAIP evaluated three seasonal sampling events (through E3). The remaining seasonal event (E4) has been completed (see Table 887-1) and the results of all four sampling events are included and evaluated herein. Chloroform and HCBD were detected in sub-slab soil gas above the EGLE SSCs. In indoor air, chloroform was detected above the EGLE SSC and $TSRIASL_{12}$ during E1, which triggered expedited reporting and further investigation activities, both summarized further below.

Table 887-1. Summary of Seasonal Confirmation Sampling Events for Building 887

Building 887	
Initial Sampling Event	**Completed**
E1	September 2018 (Fall)
Seasonal Sampling Event	**Completed**
E2	April 2019 (Spring)
E3	August 2019 (Summer)
E4	December 2019 (Winter)

Based on the evaluation of the four seasonal confirmation sampling events and the results of the further investigation activities conducted in 2019 (discussed further below), the VI pathway continues to be insignificant. Sufficient information exists to make a human exposure under control EI determination.

SUB-SLAB SOIL GAS RESULTS EVALUATION

Sub-slab soil gas samples were collected from three locations from within the building. Indoor air samples were collected at three locations corresponding to the soil gas sample locations, along with an outdoor air sample from the main air intake. The sampling locations are shown on Figure 5.5.1-2. Summary statistics and screening comparison results are presented for sub-slab soil gas on Table 5.5.1-1 and indoor and outdoor air on Table 5.5.1-2. The analytical data is presented in Appendix A. Field sampling forms are provided in Appendix B. Table 887-2 presents the results for the sub-slab soil gas analytes that exceed the EGLE SSCs.

Table 887-2. Summary of Sub-Slab Soil Gas Exceedances for Building 887

Analyte (Sampling Event)	Detection Frequency	Measured Range of Detects (μg/m^3)	% Detections > EGLE SSC	EGLE SSC (μg/m^3)
Chloroform (1)	100%	3,200 - 4,700	100%	170
Chloroform (2)	100%	100 - 1,700	67%	170
Chloroform (3)	100%	270 - 2,100	100%	170
Chloroform (4)	100%	130 – 1,500	67%	170
Hexachlorobutadiene (1)	33%	470	33%	180
Hexachlorobutadiene (2)	0%	ND	0%	180
Hexachlorobutadiene (3)	33%	580	33%	180
Hexachlorobutadiene (4)	33%	290	33%	180

Table 887-3 summarizes the indoor air results relative to the sub-slab soil gas exceedances, since VI only potentially occurs if the analyte is present in both sub-slab soil gas and indoor air. Therefore, the table below provides the analyte detected above applicable screening levels in sub-slab soil gas as well as the corresponding indoor air sample result. The outdoor air sample result is also provided to determine if the analytes were present in indoor air due to migration from outdoor air.

Table 887-3. Vapor Intrusion Evaluation for Building 887

Analyte (Sampling Event)	Indoor Air Detection Frequency	Indoor Air Measured Range ($\mu g/m^3$)	EGLE SSC ($\mu g/m^3$)	Outdoor Air Result ($\mu g/m^3$)
Chloroform (1)	100%	1.6 - 8.6	5.2	ND
Chloroform (2)	100%	0.23 - 0.43	5.2	ND
Chloroform (3)	100%	0.37 - 0.42	5.2	0.36
Chloroform (4)	0%	ND	5.2	ND
Hexachlorobutadiene (1)	0%	ND	5.4	ND
Hexachlorobutadiene (2)	0%	ND	5.4	ND
Hexachlorobutadiene (3)	0%	ND	5.4	ND
Hexachlorobutadiene (4)	0%	ND	5.4	ND

All indoor air results for Building 887, with the exception of chloroform during E1, are below the EGLE SSC. There was an exceedance of chloroform in indoor air at a single sample location during E1. The maximum detected indoor air concentration was 8.6 $\mu g/m^3$ at location 887-IA-02 (EGLE SSC = 5.2 $\mu g/m^3$; $TSRIASL_{12}$ = 52 $\mu g/m^3$). During E2 and E3 all indoor air results for chloroform were below the EGLE SSC. During E4, the chloroform results were ND for all three indoor air samples. In sub-slab soil gas, chloroform exceeded the EGLE SSC in all but two samples. The maximum detected concentration was 4,700 $\mu g/m^3$ (EGLE SSC = 170 $\mu g/m^3$) from E1. Figure 5.5.1-3 presents the sub-slab soil gas and indoor air results for each sampling event at each sample location for chloroform.

HCBD was ND in indoor air samples during each of the four seasonal sampling events. In sub-slab soil gas, HCBD exceeded the EGLE SSC when it was detected in 3 total samples at sample location 887-SS-03. The maximum detected concentration was 580 $\mu g/m^3$ during E3 (EGLE SSC = 180 $\mu g/m^3$). All other sample results were ND.

VAPOR INTRUSION CONCEPTUAL SITE MODEL

VI is an exposure pathway that results from the migration of volatilized chemicals from the subsurface to indoor air in overlying occupied buildings. A source, migration route and a human receptor must be present for the VI pathway to be complete. The focus of this building specific investigation is to evaluate the potential VI exposure pathway for employees and contractors at Building 887. The CSM is illustrated in Figure 5.5.1-4.

Building 887 was constructed in the 1970s and is located in the southwestern quadrant of the Midland facility. The building is a one-story structure of slab-on-grade construction with no basement or elevators and has a footprint of approximately 1,449 ft^2. This building contains lab space and a large switch room with a bathroom. The building is used as a lab where operators from Building 954 perform material testing.

The building's heat is produced via a small gas-powered furnace, and an AC unit is located on the roof. The building also contains some small space heaters and a lab hood. The intake for this building is located on the roof. No bay doors/overhead doors exist on this structure. The concrete flooring in the lab portion of the building is painted. The ground cover outside of the building is predominantly concrete or asphalt, with some patches of gravel located to the south, west, and east.

At peak use, approximately 3-5 workers from Building 954 use this building in short shifts of 1-3 hours. Occupants use a contracted laundry service to clean uniforms and work clothes. The typical parameters for non-residential exposures are assumed to apply but likely overestimate exposure for the personnel stationed at this building (i.e., 40 hours/week, 50 weeks/year exposure).

A building survey was completed before the initial sampling event. Drains and other openings were screened with a PID and no soil gas entry points were identified. The chemical inventory performed during the building survey identified various potential indoor emission sources, including soap, air freshener, and various laboratory reagents (e.g., acetone, hydrochloric acid). The building has running water, which is a potential source of chloroform, but no specific consumer items containing chloroform were identified.

An EBS was provided in February 2019 based on the Fall 2018 sampling event and EGLE's request for expedited reporting if an indoor air result exceeds the $TSRIASL_{12}$. Email notifications were provided in January, July, and October 2019. Seasonal confirmation sampling has continued for both sub-slab soil gas and indoor air. Dow conducted further investigation activities at Building 887 in May, July, and October 2019 and results were presented to EGLE during the monthly Corrective Action Status meetings. A Summary of Investigative Findings documenting the further investigation activities was submitted to EGLE in October 2019 and is summarized below.

Based on the results from the initial sampling event (E1), further investigation activities were conducted for Building 887 and documented in the Summary of Investigative Findings (October 2019). The goals for the building-specific investigation for Building 887 were to gain an understanding of potential sources and distribution of chloroform concentrations. Appendix C presents the October 2019 Summary of Further Investigation Findings report.

While TCE was also measured by the Field GC, chloroform is the main AOI in Building 887. In May and July 2019, baseline samples were collected at the previous indoor air and sub-slab soil gas locations. All baseline sample results in May were < 0.2 ppbv chloroform and in July, there were no detectable levels of chloroform; however, in May, a sample collected an inch above the drain (887-BRD) that contained 12 ppbv chloroform and 14 ppbv TCE. During the July event, a depressurization test was conducted on the drain. There were no detected concentrations of chloroform or TCE at the bathroom drain, even after conducting a depressurization test. During the October 2019 further investigation activities, the field GC team revisited Building 887 since there were recent rains and retested the drain but results continued to be below detection limits.

During the initial May investigation, weather conditions were very wet with significant rains. Radar estimates[2] show that over two inches of rain fell in the area over the eight days prior to the May activities. For the July investigation, radar estimates showed < 0.25 inches of rain fell in the week prior to the July investigation (i.e., dry conditions). These weather conditions are a possible explanation for the significant difference in findings at this drain. Weather conditions and sampling results suggest that vapors from the bathroom drain occurred as a result of the heavy rain event and that elevated chloroform and TCE concentrations measured from the drain were likely not attributable to VI, and more likely originated from sewer gas. Furthermore, while the presence of TCE was detected in the bathroom drain sample, it has not been detected in indoor air at Building 887. The VI seasonal confirmation sampling results indicate that the TCE concentrations detected in the drain are not attributable to VI, as all sub-slab soil gas results are well below the sub-slab soil gas EGLE SSC.

EVALUATION OF SEASONAL CONFIRMATION SAMPLING EVENTS

Four seasonal sampling events have been completed at Building 887. The sampling events encompass more than one year of time and include sampling during each season of the year. The results from the four seasonal confirmation sampling events were evaluated with respect to spatial variability, temporal variability, and seasonal trend analysis. Building specific attenuation factors (α) were calculated and compared between events to evaluate temporal variability and determine the best estimate of a building-specific attenuation factor. This evaluation serves to confirm that the existing study design is appropriate and provides insight for the determination of the path forward for this building.

This evaluation focused on any analytes detected in the sub-slab soil gas samples that met the criterion for inclusion in one or more of the following categories:

[2] https://water.weather.gov/precip/

1) Analytes detected in sub-slab soil-gas at concentrations that exceed screening levels;

2) Analytes detected in sub-slab soil-gas at concentrations of 1,000 µg/m^3 or greater in one or more samples. Data for analytes detected above 1,000 µg/m^3 should provide the clearest signal and be the simplest to interpret when assessing data trends. The same data trends observed for these analytes are expected to apply to other similar analytes present at lower concentrations; and

3) PCE and TCE. These two analytes are of particular interest for many VI evaluations at industrial sites.

For this building, the only analytes detected in the sub-slab soil gas at concentrations above the EGLE SSCs were chloroform and hexachlorobutadiene. Two additional analytes had a detected concentration $\geq$1,000 µg/m^3, acetone and CFC-12; however, due to minimal detections throughout sampling, acetone was excluded from additional evaluation, as was PCE and TCE. Sample results for chloroform, HBCD, and CFC-12 are provided in the following data tables.

Table 887-4 Summary of Results for Chloroform

Sample Type	Screening Level (µg/m^3)	Sample ID	Measured Concentration (µg/m^3)			
			Sept. 2018	Apr. 2019	Aug. 2019	Dec. 2019
			E1	E2	E3	E4
Outdoor Air	-	887-OA-01	<0.17	<0.15	0.36	<0.16
Indoor Air	5.2 (EGLE SSC) 52 ($TSRIASL_{12}$)	887-IA-01	4.1	0.43	0.37	<0.17
		887-IA-02	8.6	0.38	0.39	<0.19
		887-IA-03	1.6	0.23	0.42	<0.2
Sub-Slab Soil Gas	170 (EGLE SSC) 1,700 ($TSRIASL_{12}$)	887-SS-01	**4,700**	**1,700**	**2,100**	1,500
		887-SS-02	**3,200**	100	1,600	1,000
		887-SS-03	**4,500**	1,100	270	130

-	not applicable
	EGLE SSC Exceedance
BOLD	$TSRIASL_{12}$ Exceedance

Table 887-5 Summary of Results for Hexachlorobutadiene (HCBD)

Sample Type	Screening Level (µg/m³)	Sample ID	Measured Concentration (µg/m³)			
			Sept. 2018	Apr. 2019	Aug. 2019	Dec. 2019
			E1	E2	E3	E4
Outdoor Air	-	887-OA-01	<9.1	<8.3	<3.7	<3.4
Indoor Air	5.4 (EGLE SSC)	887-IA-01	<9	<8.7	<3.9	<3.8
		887-IA-02	<8.7	<8.4	<3.8	<4.2
		887-IA-03	<8.5	<9	<3.9	<4.3
Sub-Slab Soil Gas	180 (EGLE SSC)	887-SS-01	<140	<87	<240	<170
		887-SS-02	<100	<34	<88	<68
		887-SS-03	470	<220	580	290

Table 887-6 Summary of Results for Chloroflurocarbon (CFC-12)

Sample Type	Screening Level (µg/m³)	Sample ID	Measured Concentration (µg/m³)			
			Sept. 2018	Apr. 2019	Aug. 2019	Dec. 2019
			E1	E2	E3	E4
Outdoor Air	-	887-OA-01	2.1	2.1	2.1	2.6
Indoor Air	1,020 (EGLE SSC)	887-IA-01	8.2	4.5	2	2.6
		887-IA-02	5.8	3.9	2	2.7
		887-IA-03	4.2	3.5	2	2.5
Sub-Slab Soil Gas	34,000 (EGLE SSC)	887-SS-01	1,800	2,000	7,100	4,200
		887-SS-02	1,700	170	2,800	2,000
		887-SS-03	8,000	5,300	3,500	2,000

-	not applicable
(shaded)	EGLE SSC Exceedance
BOLD	$TSRIASL_{12}$ Exceedance

EVALUATION OF VI DATA TRENDS

Data trends for Building 887 are discussed below for both sub-slab soil gas and indoor air. When data exhibit a narrow range of variability, it is typical practice to express the range as a percentage (e.g., relative percent difference [RPD]). When data exhibit a large range of variability, however, it is more useful to express the range in orders of magnitude (i.e., factors of 10). This can be expressed mathematically as the log of the ratio of maximum/minimum values. If the values differ by a factor of 10, the log of the ratio is 1, if the values differ by a factor of 100, the log of the ratio is 2, and so on.

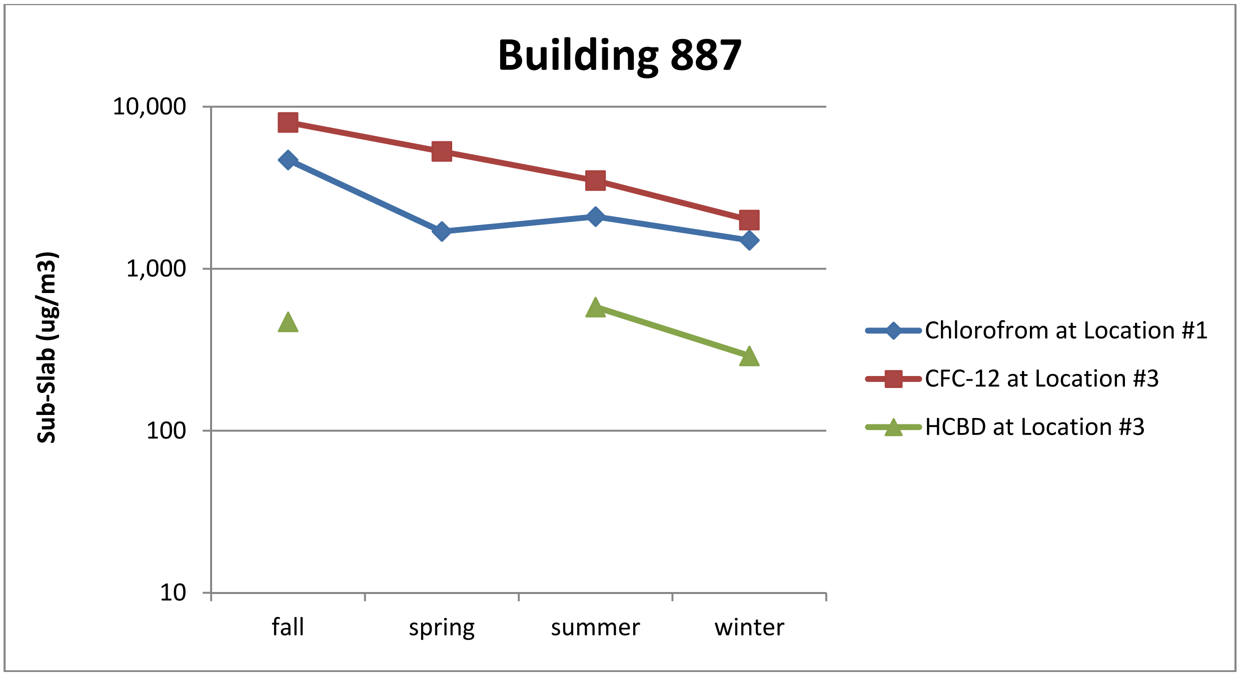
The variability across all locations over all sampling events is the total variability. This encompasses different types of variability, including spatial variability (i.e., how do the results vary from location to location), temporal variability (i.e., how do the results at a given location vary over time), and measurement variability. Measurement variability can be determined by evaluating results of duplicate or collocated samples and includes both sampling variability and analytical variability.

Sub-Slab Soil Gas Data Trends

Spatial Variability of Sub-Slab Soil Gas – The soil gas exhibit less than two orders of magnitude of spatial variability. For example, sub-slab soil gas detections of chloroform vary from 3,200 to 4,700 $\mu g/m^3$ (log of max./min. = 0.17) across all three locations for E1. Other events for chloroform show a little more variability (1.2 for E2, 0.89 for E3, and 1.1 for E4). Detections of CFC-12 vary from 1,700 to 8,000 $\mu g/m^3$ (log of max./min. = 0.67) across all three locations for E1. HCBD was only detected in a handful of sub-slab soil gas samples so temporal variability could not be calculated.

Temporal Variability of Sub-Slab Soil Gas – The sub-slab soil gas concentrations exhibit less than two orders of magnitude of temporal variability. For chloroform, sub-slab soil gas concentrations of vary from 4,700 to 1,500 $\mu g/m^3$ at location 887-SS-01 (log max/min = 0.49) and for location 887-SS-03 concentrations vary from 130 to 4,500 $\mu g/m^3$ (log max/min = 1.5). CFC-12 at location 887-SS-03 varies from 8,000 to 2,000 $\mu g/m^3$ (log max/min = 0.6). For HCBD, sub-slab soil gas detected concentrations vary from 290 to 580 $\mu g/m^3$ at location 887-SS-03 (log max/min = 0.3). Overall, temporal variability is similar to spatial variability, which is contrary to expectations.

Seasonal Confirmation Sampling Trend Analysis – No formal statistical tests were performed, but the data exhibits relatively consistent results between the seasons. This is demonstrated by the graph below, which shows the three analytes selected above at locations where they were detected at relatively high concentrations. Note that the y-axis is a log scale.



The data set was examined to see what the potential consequences would have been had only a single sampling event been performed. For chloroform and CFC-12, the highest sub-slab soil gas concentrations were collected during the fall (E1) and the lowest concentrations occurred during the winter (E4). For HCBD, the highest sub-slab concentration was also collected during the summer (E3) and the lowest concentration occurred during the winter (E4). Overall, the minimum and maximum values appear to be consistent between sampling events.

Since both chloroform and CFC-12 had the highest results occur during E1, there was no negative bias introduced by results from other seasonal sampling events. For HCBD at location 887-SS-03, the value increased from 470 ug/m^3 during E1 to 580 ug/m^3 during E3. If only the first sampling event had been performed, a negative bias of 23% would have been introduced (i.e., the HCBD value for E3 was 23% higher than the HCBD value for E1). Therefore, implementing four seasonal confirmation sampling events provided only limited insight regarding maximum concentration levels, but the larger data set served to increase the confidence in the findings.

Indoor Air Data Trends

Spatial Variability of Indoor Air – The indoor air exhibit less than one order of magnitude of spatial variability. CFC-12 had 100% detection frequency in indoor air across all sampling events. For CFC-12 during E1, indoor air concentrations vary from 4.2 to 8.2 μg/m^3 (log max./min. = 0.29). The other events saw much less variability. For chloroform, the highest spatial variability occurred during E1 where indoor air concentrations vary from 1.6 to 8.6 μg/m^3 (log max./min. = 0.73). The other events saw much less variability. HCBD was ND in indoor air during all events. The data suggests the air within the building is well-mixed.

Temporal Variability of Indoor Air – The indoor air has, at most, one order of magnitude of temporal variability. For example, indoor air concentrations of chloroform at location 887-IA-01 varied from 0.37 to 4.1 μg/m^3 (log of max./min. = 1.0). Temporal variability for all other locations for chloroform were similar. For CFC-12 at location 887-IA-03, concentrations varied from 2 to 4.2 μg/m^3 (log max./min. = 0.32). Variability at all other locations were a little higher but similar to 887-IA-03. Overall, temporal variability across the four seasons sampled is relatively small.

Additional Analyses

Comparison of Sub-Slab Soil Gas and Indoor Air Data Sets – As expected, the sub-slab soil gas data exhibit greater spatial variability than the indoor air data set. The sub-slab soil gas also exhibits greater temporal variability than the indoor air data set, which is contrary to expectations.

Seasonal Effects – The sub-slab soil gas data exhibit some variability from event to event. Maximum sub-slab soil gas and indoor air results for CFC-12 and chloroform occurred in E1 (fall). Maximum sub-slab soil gas values for HCBD occurred in E3 (summer). The data does not support the hypothesis that wintertime should have the highest indoor air impacts.

Comparison of Attenuation Factors by Event – Attenuation factors were calculated for CFC-12 based on maximum values. The indoor air maximum concentration was corrected for contribution of outdoor air to indoor air (e.g., outdoor air detected concentration was subtracted from indoor air concentration). The calculated event-specific attenuation factors are shown in Tables 887-3.

Table 887-7. Comparison of Building-Specific Attenuation Factors for CFC-12 by Event

	E1 (Fall)	E2 (Winter)	E3 (Spring)	E4 (Summer)
Maximum Values				
CFC-12 in Sub-Slab Soil Gas (μg/m^3)	8,000	5,300	7,100	4,200
CFC-12 in Outdoor Air (μg/m^3)	2.1	2.1	2.1	2.6
CFC-12 in Indoor Air (μg/m^3)	8.2	4.5	2	2.7
CFC-12 in Indoor Air (μg/m^3) Corrected for Outdoor Air Contribution	6.1	2.4	0	0.1
Attenuation Factor	**7.6E-04**	4.5E-04	--	2.4E-05

These serve as the best estimates of attenuation at this building. The results can vary from day to day due to differences in rates of vapor intrusion and rates of building ventilation. Overall, the most conservative estimate of a building-specific attenuation factor for Building 887 is 7.6E-04 based on CFC-12 during E1.

Temporal Variability in Attenuation Factor – As shown in Table 887-7, there was about one order of magnitude of temporal variability in the calculated attenuation factors observed for CFC-12 between the four sampling events. To be as conservative as possible, the maximum values were used in calculating the attenuation factor for each event. The sampling location with the maximum value per event varied. In general, the low spatial variability in indoor air results means that roughly comparable attenuation factors would be obtained whichever indoor air value was used in the calculations.

NON-DETECT EVALUATION

Table 887-7 below lists the analytes in sub-slab soil gas that have ND RLs greater than the screening levels. The table also includes the indoor air results for each of the analytes. If a sub-slab soil gas analyte has ND RL exceedances, but all results and ND RLs in indoor air are below the screening levels, no further evaluation is warranted. If an analyte was identified as an AOI in sub-slab soil gas (detected results > screening level), it is excluded from the ND evaluation. Also, if an ND analyte has an 0% detection frequency for all sampling events and all ND RLs met the screening level during at least one event, no further ND evaluation is warranted.

Table 887-8. Non-Detect Evaluation for Building 887

Soil Gas Analytes with ND RL > SL	Indoor Air Result Summary
1,1,2-Trichloroethane	0% Detection Frequency, All ND RLs < EGLE SSC
1,2-Dibromoethane (EDB)	0% Detection Frequency, ND RLs during E3 & E4 < EGLE SSC
Hexachlorobutadiene (HCBD)	0% Detection Frequency, ND RLs during E3 & E4 < EGLE SSC

WEIGHT-OF-EVIDENCE SUMMARY

Building 887 was confirmed as a VI Path Forward Group 4A building due to its potential for VI based on sub-slab soil gas exceedances of the EGLE SSC and/or $TSRIASL_{12}$ for CFC-12 and chloroform. However, after further investigation and evaluation, the following evidence supports the conclusion that VI is insignificant at Building 887:

- No exceedances of screening levels in indoor air with the exception of chloroform during E1, which was determined to be related to sewer gas and not attributed to VI.
- The sub-slab soil gas data generally shows decreasing concentrations over time.
- The data do not support the hypothesis that wintertime should have the highest indoor air impacts. The highest sub-slab soil gas concentrations generally were measured in the fall. Similarly, the highest indoor air concentrations were measured in the fall.
- The indoor air data show relatively little spatial variability, despite the greater spatial variability in the sub-slab soil gas values. This evaluation confirms that the sub-slab soil gas and indoor air concentrations were relatively constant from season to season.

Based on the CSM for Building 887, VI is an insignificant exposure pathway for current building utilization.

PATH FORWARD

Based on the evaluation of the four seasonal confirmation sampling events and the results of the further investigation, the VI pathway continues to be insignificant for Building 887. Weight of evidence based on seasonal confirmation sampling, as documented in email notifications provided to EGLE throughout 2019, supports Building 887 as a Group 4A building, which is defined as: Building seasonal confirmation sample results demonstrate a lack of correlated sub-slab soil gas and indoor air exceedances (EGLE SSC and/or $TSRIASL_{12}$) and other lines of evidence indicate VI is insignificant and IA exceedances are likely due to work place chemical use. The sub-slab soil gas results have demonstrated relatively stable concentrations with a decreasing trend over time. Furthermore, chloroform is ubiquitous in indoor air and often found in soil gas samples. Chloroform is one of the trihalomethanes produced by chlorination of water supplies. It has long been known that chloroform and other VOCs in tap water can be emitted into indoor air (McKone, 1987). Washing machines and kitchen sinks also may be significant sources (Howard and Corsi, 1998)(Howard and Corsi, 1996).

Sufficient information exists to make a human exposure under control EI determination. However, while currently there is no evidence of potential VI, for future use, LTM is warranted and the building-specific Interim Monitoring Plan is discussed below.

Building-specific Interim Monitoring Plan

Dow presented an interim monitoring plan for Building 887 during the April 2020 Corrective Action status meeting. Dow will implement the interim monitoring plan at Building 887 until a revised program or more permanent corrective action plan is developed for the site.

Indoor air will be monitored at location 887-IA-03. This location was selected for continued monitoring since it demonstrated the highest sub-slab soil gas results. Monitoring will be performed for chloroform and HCBD. An outdoor air sample will also be collected at the time of each monitoring event. Interim monitoring will be performed semi-annually for a minimum of two years and monitoring results will undergo trend analysis. Monitoring will begin winter 2020/2021. If results continue to be consistent and below screening levels, monitoring will be conducted on an annual basis. If indoor air results are observed to be increasing, further evaluation will be performed, which may include collection of a sub-slab soil gas sample(s) and an increase in monitoring frequency. Results from each monitoring event will be reported in the annual CAIP. In the event an indoor air result(s) exceeds screening levels, EGLE will be provided a brief email notification. A collocated indoor air and sub-slab soil gas sample will be collected from that location within 45 days. If both sub-slab soil gas and indoor air results indicate that VI continues to be insignificant, monitoring will continue at an appropriate frequency. If both sub-slab soil gas and indoor air results indicate that VI is significant and confirm Group 4 conditions, the building will be moved to Group 4 for follow-up actions.

Dow may propose changes to the frequency or other aspects of this interim monitoring plan in the future based on an evaluation of the data, changes in building use or implementation of other corrective actions to address the potential VI pathway.

5.5.2 VI Seasonal Confirmation Sampling Results Evaluation for Building 1038

INTRODUCTION

Building 1038 is a Category 2 building in Zone 3 Phase 1, located in the southwestern quadrant of the Midland facility (Figure 5.5.2-1). The building is a one-story structure of slab-on-grade construction with no basement or elevator and has a footprint of approximately 3,235 ft^2. This building is primarily used for storage and is “unoccupied” according to the building contacts; however, the building appears to have some level of consistent occupancy and has office areas, a library, bathrooms, a large break area, and an old lab space being used as storage. The building is used as additional work/break areas for the occupants in Building 1037, which is located next door to the east. The 2018 CAIP concluded that the VI pathway at Building 1038 was an insignificant exposure pathway based on current use. However, based on the sub-slab soil gas results and given the potential for future VI, Building 1038 was placed in VI Path Forward Building Group 2. Group 2 is a designation for buildings that have sub-slab soil gas AOI(s), but all indoor air results are less than screening levels. Any building placed in Group 2 is scheduled for seasonal confirmation sampling.

The results of the initial sampling event (E1) were evaluated in the 2018 CAIP. The 2019 CAIP evaluated three seasonal sampling events (through E3). The remaining seasonal event (E4) has been completed (see Table 1038-1) and the results of all four sampling events are included and evaluated herein. 1,3-Dichlorobenzene (1,3-DCB) and 1,4-diclorobenzene (1,4-DCB) were detected above the EGLE SSC in sub-slab soil gas. All indoor air results were less than EGLE SSCs.

Table 1038-1. Summary of Seasonal Confirmation Sampling Events for Building 1038

Building 1038	
Initial Sampling Event	**Completed**
E1	September 2018 (Fall)
Seasonal Sampling Event	**Completed**
E2	April 2019 (Spring)
E3	August 2019 (Summer)
E4	December 2019 (Winter)

Based on the evaluation of the four seasonal confirmation sampling events, the VI pathway continues to be insignificant. Sufficient information exists to make a human exposure under control EI determination.

SUB-SLAB SOIL GAS RESULTS EVALUATION

Sub-slab soil gas samples were collected from three locations from within the building. Indoor air samples were collected at three locations corresponding to the soil gas sample locations, along with an outdoor air sample from the main air intake. The sampling locations are shown on Figure 5.5.2-2. Summary statistics and screening comparison results are presented for sub-slab soil gas on Table 5.5.2-1 and indoor and outdoor air on Table 5.5.2-2. The analytical data is presented in Appendix A. Field sampling forms are provided in Appendix B. Table 1038-2 presents the sub-slab soil gas results that exceed the EGLE SSCs.

Table 1038-2. Summary of Sub-Slab Soil Gas Exceedances for Building 1038

Analyte (Sampling Event)	Detection Frequency	Measured Range of Detects (μg/m³)	% Detections > EGLE SSC	EGLE SSC (μg/m³)
1,3-Dichlorobenzene (1)	100%	95 – 420	67%	310
1,3-Dichlorobenzene (2)	100%	11 – 190	0%	310
1,3-Dichlorobenzene (3)	100%	16 – 98	0%	310
1,3-Dichlorobenzene (4)	67%	10 – 17	0%	310
1,4-Dichlorobenzene (1)	100%	600 - 6,200	67%	1,000
1,4-Dichlorobenzene (2)	67%	40 - 1,000	0%	1,000
1,4-Dichlorobenzene (3)	67%	86 - 1,300	33%	1,000
1,4-Dichlorobenzene (4)	67%	87 - 130	0%	1,000

Table 1038-3 summarizes the indoor air results relative to the sub-slab soil gas exceedances, since VI only potentially occurs if the analyte is present in both sub-slab soil gas and indoor air. Therefore, the table below provides the analyte detected above applicable screening levels in sub-slab soil gas as well as the corresponding indoor air sample result. The outdoor air sample result is also provided to determine if the analytes were present in indoor air due to migration from outdoor air.

Table 1038-3. Vapor Intrusion Evaluation for Building 1038

Analyte (Sampling Event)	Indoor Air Detection Frequency	Indoor Air Measured Range (μg/m³)	Indoor Air EGLE SSC (μg/m³)	Outdoor Air Result (μg/m³)
1,3-Dichlorobenzene (1)	0%	ND	9.2	ND
1,3-Dichlorobenzene (2)	0%	ND	9.2	ND
1,3-Dichlorobenzene (3)	0%	ND	9.2	ND
1,3-Dichlorobenzene (4)	0%	ND	9.2	ND
1,4-Dichlorobenzene (1)	0%	ND	30	ND
1,4-Dichlorobenzene (2)	67%	0.25 - 0.26	30	0.26
1,4-Dichlorobenzene (3)	33%	0.38	30	ND
1,4-Dichlorobenzene (4)	100%	0.22 – 0.25	30	ND

1,3-DCB was detected in sub-slab soil gas at a concentration greater than the EGLE SSC during E1 and all 1,3-DCB in indoor air results for each event were ND. 1,4-DCB was detected above the EGLE SSC in E1 and E3 and all detected results in indoor air were less than screening levels. All other indoor air results at Building 1038 are less than screening levels.

VAPOR INTRUSION CONCEPTUAL SITE MODEL

VI is an exposure pathway that results from the migration of volatilized chemicals from the subsurface to indoor air in overlying occupied buildings. A source, migration route and a human receptor must be present for the VI pathway to be complete. The focus of this building specific investigation is to evaluate the potential VI exposure pathway for employees and contractors at Building 1038. The CSM is illustrated in Figure 5.5.2-3.

Building 1038 was built in the 1970s and is located in the southwestern quadrant of the Midland facility. This building is primarily used for storage and is "unoccupied" according to the building contacts; however, the building appears to have some level of consistent occupancy and has office areas, a library, bathrooms, a large break area, and an old lab space being used as storage. It appears the building is used as additional work/break areas for the occupants in Building 1037, which is located next door to the east. The building is a one-story structure of slab-on-grade construction with no basement or elevator and has a footprint of approximately 3,235 ft^2.

The building is heated via steam radiation, and a central AC unit is associated with an air handler located in the southern mechanical room. The outdoor intake is located on the southern side of the building just outside of the southern mechanical room. This building has no overhead/bay doors and the surrounding outdoor ground cover is either asphalt or gravel. Approximately 10-15 occupants work an 8-hour day shift during the week and rarely work weekend hours. Occupants from Building 1037 also use this space. The typical parameters for non-residential exposures are assumed to apply but likely overestimate exposure for the personnel stationed at this building (i.e., 40 hours/week, 50 weeks/year exposure).

A building survey was completed before the initial sampling event. Drains and other openings were screened with a PID and no soil gas entry points were identified. The chemical inventory performed during the building survey identified various potential indoor emission sources, including soap, air freshener, and various laboratory reagents (e.g., acetone, hydrochloric acid). The building has running water, which is a potential source of chloroform, but no specific consumer items containing chloroform were identified.

No PID detections were observed in the ambient air throughout the building, and no PID readings were detected from any drain features noted at the time of the survey.

EVALUATION OF SEASONAL CONFIRMATION SAMPLING EVENTS

Four seasonal sampling events have been completed at Building 1038. The sampling events encompass more than one year of time and include sampling during each season of the year. The results from the four seasonal confirmation sampling events were evaluated with respect to spatial variability, temporal variability, and seasonal trend analysis.

Building specific attenuation factors (α) were calculated and compared between events to evaluate temporal variability and determine the best estimate of a building-specific attenuation factor. This evaluation serves to confirm that the existing study design is appropriate, and also provides insight for the determination of the path forward for this building.

This evaluation focused on any analytes detected in the sub-slab soil gas samples that met the criterion for inclusion in one or more of the following categories:

1) Analytes detected in sub-slab soil-gas at concentrations that exceeded EGLE SSCs;

2) Analytes detected in sub-slab soil-gas at concentrations of 1,000 µg/m^3 or greater in one or more samples. Data for analytes detected above 1,000 µg/m^3 should provide the clearest signal and be the simplest to interpret when assessing data trends. The same data trends observed for these analytes are expected to apply to other similar analytes present at lower concentrations; and

3) PCE and TCE. These two analytes are of particular interest for many VI evaluations at industrial sites.

For this building, the only analytes detected in the sub-slab soil gas at concentrations above the EGLE SSCs were 1,3-DCB and 1,4-DCB. Two additional analytes had detected concentrations $\geq$1,000 µg/m^3, acetone and total xylenes; however, due to minimal detections throughout sampling, acetone was excluded from additional evaluation, as was PCE and TCE. TCE was ND in sub-slab soil gas throughout the four sampling events. PCE was detected but at concentrations below the EGLE SSC and < 1,000 µg/m³. Sample results for 1,3-DCB, 1,4-DCB and total xylenes are provided in the following data tables.

Table 1038-4 Summary of Results for 1,3-DIchlorobenzene

Sample Type	Screening Level (µg/m³)	Sample ID	Measured Concentration (µg/m³)			
			Sept. 2018	Apr. 2019	Aug. 2019	Dec. 2019
			E1	E2	E3	E4
Outdoor Air	-	1038-OA-01	<0.92	<1	<1	<1
Indoor Air	9.2 (EGLE SSC) 28 ($TSRIASL_{12}$)	1038-IA-01	<0.95	<1	<1	<1
		1038-IA-02	<0.98	<1.8	<1.1	<1
		1038-IA-03	<0.94	<1	<1.1	<1.1
Sub-Slab Soil Gas	310 (EGLE SSC) 920 ($TSRIASL_{12}$)	1038-SS-01	330	190	35	17
		1038-SS-02	95	11	16	<4.9
		1038-SS-03	420	16	98	10

-	not applicable
	EGLE SSC Exceedance
BOLD	$TSRIASL_{12}$ Exceedance

Table 1038-5 Summary of Results for 1,4-Dichlorobenzene

Sample Type	Screening Level (μg/m³)	Sample ID	Measured Concentration (μg/m³)			
			Sept. 2018	Apr. 2019	Aug. 2019	Dec. 2019
			E1	E2	E3	E4
Outdoor Air	-	1038-OA-01	<0.18	0.26	<0.2	<0.21
Indoor Air	30 (EGLE SSC) 300 (TSRIASL12)	1038-IA-01	<0.19	0.25	<0.21	0.23
		1038-IA-02	<0.2	<0.36	<0.22	0.22
		1038-IA-03	<0.19	0.26	0.38	0.25
Sub-Slab Soil Gas	1,000 (EGLE SSC) 10,000 (TSRIASL12)	1038-SS-01	1,900	1,000	86	87
		1038-SS-02	600	<4.6	<4.6	<4.9
		1038-SS-03	6,200	40	1,300	130

Table 1038-6 Summary of Results for Total Xylenes

Sample Type	Screening Level (μg/m³)	Sample ID	Measured Concentration (μg/m³)			
			Sept. 2018	Apr. 2019	Aug. 2019	Dec. 2019
			E1	E2	E3	E4
Outdoor Air	-	1038-OA-01	0.345	<0.225	3.68	<0.225
Indoor Air	680 (EGLE SSC) 2,000 (TSRIASL12)	1038-IA-01	0.9	0.86	0.85	0.87
		1038-IA-02	0.94	1.02	0.73	1.09
		1038-IA-03	1.85	2.11	12.7	3.5
Sub-Slab Soil Gas	22,000 (EGLE SSC) 67,000 (TSRIASL12)	1038-SS-01	3,550	1,230	153	184
		1038-SS-02	<3.5	<3.4	<3.4	<3.6
		1038-SS-03	1,640	16.7	5,000	104

-	not applicable
(shaded)	EGLE SSC Exceedance
BOLD	TSRIASL12 Exceedance

EVALUATION OF VI DATA TRENDS

Data trends for Building 1038 are discussed below for both sub-slab soil gas and indoor air. When data exhibit a narrow range of variability, it is typical practice to express the range as a percentage (e.g., relative percent difference [RPD]). When data exhibit a large range of variability, however, it is more useful to express the range in orders of magnitude (i.e., factors of 10). This can be expressed mathematically as the log of the ratio of maximum/minimum values. If the values differ by a factor of 10, the log of the ratio is 1, if the values differ by a factor of 100, the log of the ratio is 2, and so on.

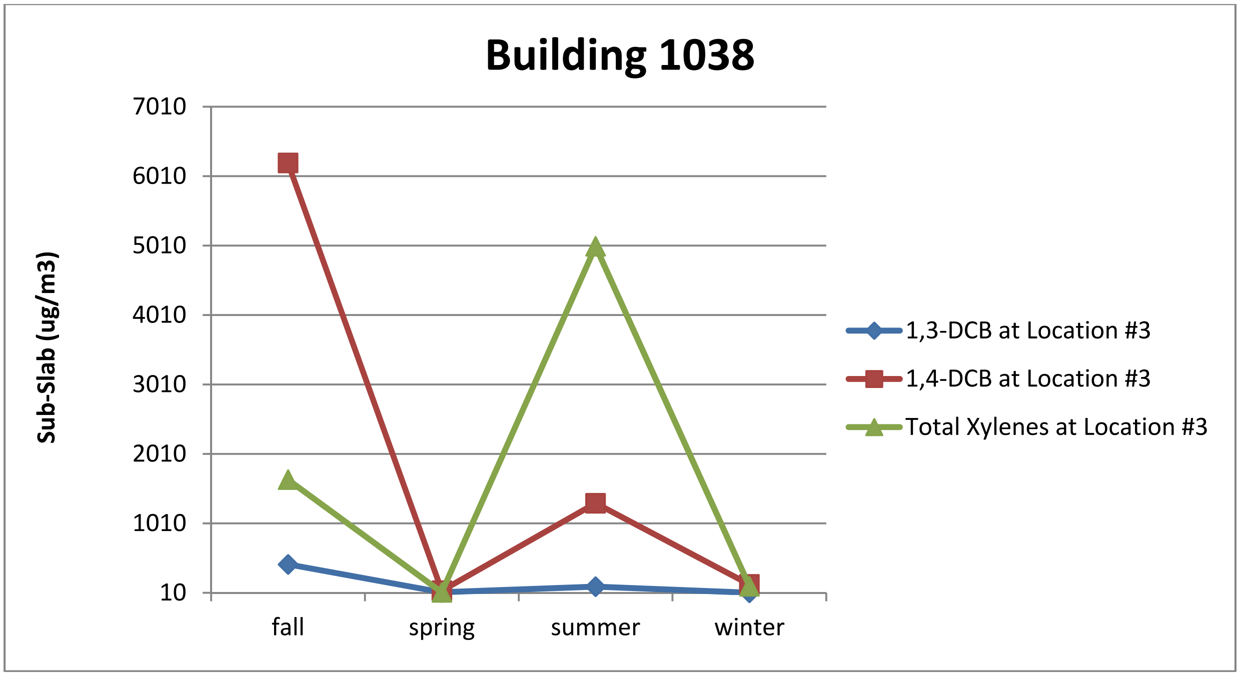
The variability across all locations over all sampling events is the total variability. This encompasses different types of variability, including spatial variability (i.e., how do the results vary from location to location), temporal variability (i.e., how do the results at a given location vary over time), and measurement variability. Measurement variability can be determined by evaluating results of duplicate or collocated samples and includes both sampling variability and analytical variability.

Sub-Slab Soil Gas Data Trends

Spatial Variability of Sub-Slab Soil Gas – The soil gas exhibit less than two orders of magnitude of spatial variability. For example, sub-slab soil gas detections of 1,3-DCB vary from 95 to 420 $\mu g/m^3$ across all three locations for E1 (log of max./min. = 1.4). Other events for 1,3-DCB show similar variability (1.2 for E2, 0.79 for E3, and 0.23 for E4). Detections of 1,4-DCB vary from 600 to 6,200 $\mu g/m^3$ across all three locations for E1 (log of max./min. = 1.0) and ranged from 0.17 to 1.39 over the other 3 sampling events. Total xylenes were only detected in two of the three sub-slab soil gas; however, spatial variability was similar and ranged from 0.24 to 1.86 for the four sampling events.

Temporal Variability of Soil Gas – The soil gas concentrations exhibit a little more than two orders of magnitude of temporal variability. For 1,3-DCB, sub-slab soil gas concentrations of vary from 10 to 420 $\mu g/m^3$ at location 1038-SS-03 (log max/min = 1.6). 1,4-DCB at location 1038-SS-03 varies from 40 to 6,200 $\mu g/m^3$ (log max/min = 2.2). For total xylenes, sub-slab soil gas detected concentrations vary from 16.7 to 5,000 $\mu g/m^3$ at location 1038-SS-03 (log max/min = 2.5). Temporal variability is greater to spatial variability, which is contrary to expectations.

Seasonal Confirmation Sampling Trend Analysis – No formal statistical tests were performed, but no strong seasonal trend was observed. It does appear that there may be a downward trend over time. This is demonstrated by the graph below, which shows the two analytes selected above at locations where they were detected at relatively high concentrations. Note that the y-axis is a log scale.



The data set was examined to see what the potential consequences would have been had only a single sampling event been performed. 1,3-DCB and 1,4-DCB had the highest sub-slab soil gas concentrations during the fall (E1). HCBD had highest sub-slab soil gas concentrations during the summer. 1,3-DCB had the lowest concentration during the winter (E4); however, 1,4-DCB and total xylenes have the lowest concentrations during spring (E2). Overall, the minimum and maximum values appear to be consistent between sampling events.

Since both analytes that exceed the EGLE SSC had the highest results occur during E1, there was no negative bias introduced by results from other seasonal sampling events. Therefore, implementing four seasonal confirmation sampling events provided only limited insight regarding maximum concentration levels, but the larger data set served to increase the confidence in the findings.

Indoor Air Data Trends

Spatial Variability of Indoor Air – The indoor air has, at most, one order of magnitude of spatial variability. All of the indoor air results for 1,3-DCB were ND and half of the indoor air samples for 1,4-DCB were ND. Total Xylenes had 100% detection frequency in indoor air across all sampling events. For 1,4-DCB during E4 (only event with 100% detection frequency), indoor air concentrations vary from 0.22 to 0.25 $\mu g/m^3$ (log max./min. = 0.06). For total xylenes, the highest spatial variability occurred during E3 where indoor air concentrations vary from 0.73 to 12.7 $\mu g/m^3$ (log max./min. = 1.2). The other events saw much less variability. The data suggests the air within the building is well-mixed.

Temporal Variability of Indoor Air – The indoor air exhibit less than one order of magnitude of temporal variability. For example, indoor air concentrations of 1,2-DCB at location 1038-IA-03 varied from 0.25 to 0.38 $\mu g/m^3$ (log of max./min. = 0.18). For total xylenes, the highest temporal variability occurred at location 1038-IA-03 and concentrations varied from 1.85 to 12.7 $\mu g/m^3$ (log max./min. = 0.84). Variability at all other locations were less than 1038-IA-03. Overall, temporal variability across the four seasons sampled is relatively small.

Additional Analyses

Comparison of Sub-Slab Soil Gas and Indoor Air Data Sets – As expected, the sub-slab soil gas data exhibit greater spatial variability than the indoor air data set. The sub-slab soil gas also exhibits greater temporal variability than the indoor air data set, which is contrary to expectations.

Seasonal Effects – The sub-slab soil gas data exhibit some variability from event to event. Maximum sub-slab soil gas results for 1,3-DCB and 1,4-DCB occurred in E1 (fall) and maximum indoor air values for both analytes occurred in E3 (summer). The data does not support the hypothesis that wintertime should have the highest indoor air impacts.

Comparison of Attenuation Factors by Event – Most analytes in Building 1038 did not have 100% detection frequencies in sub-slab soil gas and/or indoor air so it was difficult to identify an ideal candidate for use in deriving a building-specific attenuation factor. Attenuation factors were calculated for total xylenes based on maximum values, as it was the only analyte available for this evaluation with a 100% detection frequency in both media even though it did have significant contribution from outdoor air during one event. The indoor air maximum concentration was corrected for contribution of outdoor air to indoor air (e.g., outdoor air detected concentration was subtracted from indoor air concentration). The calculated event-specific attenuation factors are shown in Tables 1038-7. For Xylenes, as with many petroleum hydrocarbons, the calculated attenuation factor will be biased high to the extent indoor emission sources are present.

Table 1038-7. Comparison of Building-Specific Attenuation Factors for Xylenes by Event

	E1 (Fall)	E2 (Spring)	E3 (Summer)	E4 (Winter)
Maximum Values				
Xylenes in Sub-Slab Soil Gas (μg/m^3)	3,550	1,230	5,000	184
Xylenes in Outdoor Air (μg/m^3)	0.345	ND	3.68	ND
Xylenes in Indoor Air (μg/m^3)	1.85	2.11	12.7	3.5
Xylenes in Indoor Air (μg/m^3) Corrected for Outdoor Air Contribution	1.51	2.11	9.02	3.5
Attenuation Factor	4.2E-04	1.7E-03	1.8E-03	**1.9E-02**

These serve as the best estimates of attenuation at this building. The results can vary from day to day due to differences in rates of vapor intrusion and rates of building ventilation. Overall, the most conservative estimate of a building-specific attenuation factor for Building 1038 is 1.9E-02 based on total xylenes during E4.

Temporal Variability in Attenuation Factor – As shown in Table 1038-7, there was two orders of magnitude of temporal variability in the calculated attenuation factors observed for total xylenes between the four sampling events. To be as conservative as possible, the maximum values were used in calculating the attenuation factor for each event. The sampling location with the maximum value per event varied. In general, the low spatial variability in indoor air results means that roughly comparable attenuation factors would be obtained whichever indoor air value was used in the calculations.

NON-DETECT EVALUATION

Table 1038-8 below lists the analytes in sub-slab soil gas that have ND RLs greater than the screening levels. The table also includes the indoor air results for each of the analytes. If a sub-slab soil gas analyte has ND RL exceedances, but all results and ND RLs in indoor air are below the screening levels, no further evaluation is warranted. If an analyte was identified as an AOI in sub-slab soil gas (detected results > screening level), it is excluded from the ND evaluation. Also, if an ND analyte has an 0% detection frequency for all sampling events and all ND RLs met the screening level during at least one event, no further ND evaluation is warranted.

Table 1038-8. Non-Detect Evaluation for Building 1038

Soil Gas Analytes with ND RL > SL	Indoor Air Result Summary
1,1,2-Trichloroethane	0% Detection Frequency, All ND RLs < EGLE SSC
1,2-Dibromoethane (EDB)	0% Detection Frequency, E3 & E4 ND RLs < EGLE SSC
Hexachlorobutadiene (HCBD)	0% Detection Frequency, E3 & E4 ND RLs < EGLE SSC

WEIGHT-OF-EVIDENCE SUMMARY

Building 1038 was confirmed as a VI Path Forward Group 2 building due to its potential for VI based on sub-slab soil gas exceedances of the EGLE SSC for 1,3-DCB and 1,4-DCB. However, after further investigation and evaluation, the following evidence supports the conclusion that VI is insignificant at Building 1038:

- No exceedances of EGLE SSCs in indoor air during any of the sampling events.
- The sub-slab soil gas data exhibit some variability from event to event; however, results tend to show a decrease over time.
- The data do not support the hypothesis that wintertime should have the highest indoor air impacts. The highest sub-slab soil gas concentrations generally were measured in the fall and summer. The highest indoor air concentrations were measured in the summer.
- The indoor air data show relatively little spatial variability, despite the greater spatial variability in the sub-slab soil gas values. This evaluation confirms that the sub-slab soil gas and indoor air concentrations were relatively constant from season to season.

Based on the CSM for Building 1038, VI is an insignificant exposure pathway for current building utilization.

PATH FORWARD

Based on the evaluation of the four seasonal confirmation sampling events and the results of the further investigation, the VI pathway continues to be insignificant for Building 1038 and the sub-slab soil gas results have demonstrated relatively stable concentrations and no evidence of increasing over time. Sufficient information exists to make a human exposure under control EI determination. However, while currently there is no evidence of potential VI, for future use, LTM is warranted and the building-specific Interim Monitoring Plan is discussed below.

Building-specific Interim Monitoring Plan

Dow presented an interim monitoring plan for Building 887 during the April 2020 Corrective Action status meeting. Dow will implement the interim monitoring plan at Building 887 until a revised program or more permanent corrective action plan is developed for the site.

Indoor air will be monitored at location 1038-IA-03. This location was selected for continued monitoring since it demonstrated the highest sub-slab soil gas results. Monitoring will be performed for 1,3-DCB and 1,4-DCB. An outdoor air sample will also be collected at the time of each monitoring event. Interim monitoring will be performed semi-annually for a minimum of two years and monitoring results will undergo trend analysis. Monitoring will begin winter 2020/2021. If results continue to be consistent and below screening levels, monitoring will be conducted on an annual basis. If indoor air results are observed to be increasing, further evaluation will be performed, which may include collection of a sub-slab soil gas sample(s) and an increase in monitoring frequency. Results from each monitoring event will be reported in the annual CAIP. In the event an indoor air result(s) exceeds screening levels, EGLE will be provided a brief email notification. A collocated indoor air and sub-slab soil gas sample will be collected from that location within 45 days. If both sub-slab soil gas and indoor air results indicate that VI continues to be insignificant, monitoring will continue at an appropriate frequency. If both sub-slab soil gas and indoor air results indicate that VI is significant and confirm Group 4 conditions, the building will be moved to Group 4 for follow-up actions.

Dow may propose changes to the frequency or other aspects of this interim monitoring plan in the future based on an evaluation of the data, changes in building use or implementation of other corrective actions to address the potential VI pathway.

5.5.3 VI Seasonal Confirmation Sampling Results Evaluation for Building 100

INTRODUCTION

Building 100 is a Category 2 building in Zone 3 Phase 1, in the northwestern quadrant of the Midland facility and has a footprint of approximately 64,155 ft^2 (Figure 5.5.3-1). This building contains office space in its southeastern corner/annex portion, a warehouse, and large process area. An estimated 38,796 ft^2 of the footprint is process area that ranges from being fully enclosed to open-air. The 2019 CAIP concluded that the VI pathway at Building 100 was an insignificant exposure pathway based on current use. However, based on the sub-slab soil gas results and given the potential for future VI, Building 100 was placed in VI Path Forward Building Group 2. Group 2 is a designation for buildings that have sub-slab soil gas AOI(s), but all indoor air results are less than screening levels. Any building placed in Group 2 is scheduled for seasonal confirmation sampling.

The 2019 CAIP evaluated three seasonal sampling events (through E3). The remaining seasonal event (E4) has been completed (see Table 100-1) and the results of all four sampling events are included and evaluated herein. 1,1,2-Trichloroethane (1,1,2-TCA), 1,2-dichloropropane (1,2-DCP), chloroform, cis-1,2-dichloroethene (cis-1,2-DCE), HCBD, PCE, trans-1,2-dichloroethene (trans-1,2-DCE), and TCE were detected above the EGLE SSC in sub-slab soil gas. All indoor air results were less than the EGLE SSC.

Table 100-1. Summary of Seasonal Confirmation Sampling Events for Building 100

Building 100	
Initial Sampling Event	**Completed**
E1	September 2018 (Fall)
Seasonal Sampling Event	**Completed**
E2	April 2019 (Spring)
E3	August 2019 (Summer)
E4	December 2019 (Winter)

Based on the evaluation of the four seasonal confirmation sampling events, the VI pathway continues to be insignificant. Sufficient information exists to make a human exposure under control EI determination.

SUB-SLAB SOIL GAS RESULTS EVALUATION

Sub-slab soil gas samples were collected from 11 locations from within the building. Indoor air samples were collected at 11 locations corresponding to the soil gas sample locations, along with an outdoor air sample from the main air intake. The sampling locations are shown on Figure 5.5.3-2. Summary statistics and screening comparison results are presented for sub-slab soil gas on Table 5.5.3-1 and indoor and outdoor air on Table 5.5.3-2. The analytical data is presented in Appendix A. Field sampling forms are provided in Appendix B. Table 100-2 presents the sub-slab soil gas results that exceed the EGLE SSC.

Table 100-2. Summary of Sub-Slab Soil Gas Exceedances for Building 100

Analyte (Sampling Event)	Detection Frequency	Measured Range of Detects (μg/m³)	% Detections > EGLE SSC	EGLE SSC (μg/m³)
1,1,2-Trichloroethane (1)	0%	ND	0%	20
1,1,2-Trichloroethane (2)	0%	ND	0%	20
1,1,2-Trichloroethane (3)	0%	ND	0%	20
1,1,2-Trichloroethane (4)	9%	21	9%	20
1,2-Dichloropropane (1)	100%	6.4 - 1,800	36%	410
1,2-Dichloropropane (2)	91%	14 - 860	27%	410
1,2-Dichloropropane (3)	91%	16 - 1,200	18%	410
1,2-Dichloropropane (4)	73%	14 – 1,200	18%	410
Chloroform (1)	100%	14 - 2,200	55%	170
Chloroform (2)	91%	32 - 1,900	64%	170
Chloroform (3)	91%	18 - 2,600	36%	170
Chloroform (4)	73%	16 – 2,000	45%	170
cis-1,2-Dichloroethene (1)	100%	5.3 - 8,500	45%	820
cis-1,2-Dichloroethene (2)	91%	86 - 1,600	36%	820
cis-1,2-Dichloroethene (3)	91%	48 - 3,400	36%	820
cis-1,2-Dichloroethene (4)	91%	3.6 – 2,900	27%	820
Hexachlorobutadiene (1)	45%	160 - 830	36%	180
Hexachlorobutadiene (2)	36%	240 - 610	36%	180
Hexachlorobutadiene (3)	73%	210 - 1,700	73%	180
Hexachlorobutadiene (4)	36%	54 - 180	0%	180
PCE (1)	100%	300 - 240,000	73%	2,700
PCE (2)	100%	59 - 120,000	82%	2,700
PCE (3)	100%	30 - 170,000	55%	2,700
PCE (4)	100%	82 – 220,000	55%	2,700
trans-1,2-Dichloroethene (1)	100%	4.2 - 31,000	18%	8,200
trans-1,2-Dichloroethene (2)	91%	37 - 13,000	9%	8,200
trans-1,2-Dichloroethene (3)	91%	12 - 19,000	18%	8,200
trans-1,2-Dichloroethene (4)	82%	3.4 – 14,000	18%	8,200
TCE (1)	100%	40 - 23,000	82%	130
TCE (2)	100%	7.6 - 9,700	91%	130
TCE (3)	91%	240 - 17,000	91%	130
TCE (4)	100%	15 – 19,000	73%	130

Table 100-3 summarizes the indoor air results relative to the sub-slab soil gas exceedances, since VI only potentially occurs if the analyte is present in both sub-slab soil gas and indoor air. Therefore, the table below provides the analytes detected above applicable screening levels in sub-slab soil gas as well as the corresponding indoor air sample result. The outdoor air sample result is also provided to determine if the analytes were present in indoor air due to migration from outdoor air.

Table 100-3. Vapor Intrusion Evaluation for Building 100

Analyte (Sampling Event)	Indoor Air Detection Frequency	Indoor Air Measured Range (μg/m³)	Indoor Air EGLE SSC (μg/m³)	Outdoor Air Result (μg/m³)
1,1,2-Trichloroethane (1)	0%	ND	0.62	ND
1,1,2-Trichloroethane (2)	0%	ND	0.62	ND
1,1,2-Trichloroethane (3)	0%	ND	0.62	ND
1,1,2-Trichloroethane (4)	0%	ND	0.62	ND
1,2-Dichloropropane (1)	0%	ND	12.2	ND
1,2-Dichloropropane (2)	0%	ND	12.2	ND
1,2-Dichloropropane (3)	0%	ND	12.2	ND
1,2-Dichloropropane (4)	0%	ND	12.2	ND
Chloroform (1)	100%	0.43 - 1.8	5.2	ND
Chloroform (2)	73%	0.22 - 1.5	5.2	ND
Chloroform (3)	73%	0.17 - 3.1	5.2	ND

Analyte (Sampling Event)	Indoor Air Detection Frequency	Indoor Air Measured Range (μg/m³)	Indoor Air EGLE SSC (μg/m³)	Outdoor Air Result (μg/m³)
Chloroform (4)	64%	0.19 – 1.2	5.2	ND
cis-1,2-Dichloroethene (1)	36%	0.15 - 0.21	24	ND
cis-1,2-Dichloroethene (2)	9%	0.25	24	ND
cis-1,2-Dichloroethene (3)	9%	0.16	24	ND
cis-1,2-Dichloroethene (4)	36%	0.2 – 0.35	24	ND
Hexachlorobutadiene (1)	0%	ND	5.4	ND
Hexachlorobutadiene (2)	0%	ND	5.4	ND
Hexachlorobutadiene (3)	0%	ND	5.4	ND
Hexachlorobutadiene (4)	0%	ND	5.4	ND
PCE (1)	100%	0.54 - 5.8	82	ND
PCE (2)	100%	0.59 - 8.1	82	ND
PCE (3)	100%	0.63 - 4.1	82	0.88
PCE (4)	100%	0.3 - 21	82	0.35
trans-1,2-Dichloroethene (1)	0%	ND	240	ND
trans-1,2-Dichloroethene (2)	0%	ND	240	ND
trans-1,2-Dichloroethene (3)	0%	ND	240	ND
trans-1,2-Dichloroethene (4)	0%	ND	240	ND
TCE (1)	36%	0.96 - 1.1	4	ND
TCE (2)	55%	0.22 - 1.5	4	ND
TCE (3)	64%	0.17 - 0.84	4	ND
TCE (4)	36%	1.7 -3.1	4	ND

Although 1,1,2-TCA, 1,2-DCP, HCBD, and trans-1,2-DCE were detected in sub-slab soil gas at concentrations that exceeded the EGLE SSC, these analytes were not detected in indoor air. Chloroform, cis-1,2-DCE, PCE and TCE also were detected in sub-slab soil gas at concentrations that exceeded EGLE SSCs and were detected in indoor air, but at concentrations below the indoor air EGLE SSCs. Any contribution from outdoor air was not significant. Of the analytes of interest, only PCE was detected in outdoor air; it was detected at low levels in two sampling events.

VAPOR INTRUSION CONCEPTUAL SITE MODEL

VI is an exposure pathway that results from the migration of volatilized chemicals from the subsurface to indoor air in overlying occupied buildings. A source, migration route and a human receptor must be present for the VI pathway to be complete. The focus of this building specific investigation is to evaluate the potential VI exposure pathway for employees and contractors at Building 100. The CSM is illustrated in Figure 5.5.3-3.

Building 100 is a Category 2 building in Zone 3 Phase 1. Building 100 was constructed 13 years ago, is located in the northwestern quadrant of the Midland facility and has a footprint of approximately 64,155 ft^2. This building contains office space in its southeastern corner/annex portion, a warehouse, and large process area. An estimated 38,796 ft^2 of the footprint is process area that ranges from being fully enclosed to open-air. The warehouse, office area, and a portion of the process area are slab-on-grade construction with no basements or elevators. The office portion of the structure is one-story tall and the warehouse structure is roughly two to three stories tall.

The warehouse is heated via steam radiation and the office area is heated by hot air circulation. The office area is cooled by a central AC system. An outside intake for the office area is located on the north side of the office annex and an intake for the warehouse is located on the roof and points northward. The warehouse portion of the structure has 16 bay doors, four of which are open frequently for shipping purposes, but are typically left open for only a short period of time. However, during the summer months these bay doors are left open for longer periods. The surrounding ground cover outside the building consists of primarily concrete and asphalt. Propane-fueled forklifts are used in the warehouse area.

There are approximately 25-30 occupants working in Building 100 and some work a 12-hour day shift 7 days a week but office personnel work 8 hours per day Monday through Friday. Occupants either use a contracted weekly laundry service or use the washers and dryers located in Building 881. The typical parameters for non-residential exposures are assumed to apply but likely overestimate exposure for the personnel stationed at this building (i.e., 40 hours/week, 50 weeks/year exposure).

During the survey, no PID detections were observed in the ambient air throughout the office area or warehouse, but PID detections from drains found in the janitor's closet, women's bathroom, and men's bathroom ranged from 13.2 ppm to 520.1 ppm. The higher PID readings detected from drain features are believed to be false positive readings attributed to the presence of excess water vapor. High humidity can cause lamp fogging and decreased sensitivity. This can be significant when moisture levels are high in the general area to be measured.

EVALUATION OF SEASONAL CONFIRMATION SAMPLING EVENTS

Four seasonal sampling events have been completed at Building 100. The sampling events encompass more than one year of time and include sampling during each season of the year. The results from the four seasonal confirmation sampling events were evaluated with respect to spatial variability, temporal variability, and seasonal trend analysis.

Building specific attenuation factors (α) were calculated and compared between events to evaluate temporal variability and determine the best estimate of a building-specific attenuation factor. This evaluation serves to confirm that the existing study design is appropriate, and also provides insight for the determination of the path forward for this building.

This evaluation focused on any analytes detected in the sub-slab soil gas samples that met the criterion for inclusion in one or more of the following categories:

1) Analytes detected in sub-slab soil-gas at concentrations that exceeded EGLE SSCs;

2) Analytes detected in sub-slab soil-gas at concentrations of 1,000 $\mu g/m^3$ or greater in one or more samples. Data for analytes detected above 1,000 $\mu g/m^3$ should provide the clearest signal and be the simplest to interpret when assessing data trends. The same data trends observed for these analytes are expected to apply to other similar analytes present at lower concentrations; and

3) PCE and TCE. These two analytes are of particular interest for many VI evaluations at industrial sites.

For this building, the analytes detected in the sub-slab soil gas at concentrations above the EGLE SSC were 1,1,2-TCA, 1,2-DCP, chloroform, cis-1,2-DCE, HBCD, PCE, trans-1,2-DCE, and TCE. Two additional analytes had detected concentrations $\geq$1,000 $\mu g/m^3$, 1,1-dichloroethane, CFC-11; however, due to minimal detections throughout sampling, these two analytes were excluded from additional evaluation. Sample results for 1,1,2-TCA, 1,2-DCP, chloroform, cis-1,2-DCE, HBCD, PCE, trans-1,2-DCE, and TCE are provided in the following data tables.

Table 100-4. Summary of Results for 1,1,2-Trichloroethane (1,1,2-TCA)

Sample Type	Screening Level (μg/m^3)	Sample ID	Measured Concentration (μg/m^3)			
			Sept. 2018	Apr. 2019	Aug. 2019	Dec. 2019
			E1	E2	E3	E4
Outdoor Air	-	100-OA-01	<0.18	<0.17	<0.18	<0.17
Indoor Air	0.62 (EGLE SSC)	100-IA-01	<0.18	<0.22	<0.18	<0.19
		100-IA-02	<0.18	<0.17	<0.18	<0.2
		100-IA-03	<0.18	<0.18	<0.17	<0.19
		100-IA-04	<0.18	<0.18	<0.19	<0.21
		100-IA-05	<0.18	<0.17	<0.19	<0.2
		100-IA-06	<0.18	<0.18	<0.18	<0.2
		100-IA-07	<0.18	<0.18	<0.17	<0.19
		100-IA-08	<0.18	<0.18	<0.18	<0.2
		100-IA-09	<0.19	<0.19	<0.44	<0.19
		100-IA-10	<0.18	<0.18	<0.19	<0.2
		100-IA-11	<0.18	<0.19	<0.18	<0.22
Sub-Slab Soil Gas	20 (EGLE SSC)	100-SS-01	<140	<45	<80	<55
		100-SS-02	<200	<46	<160	<180
		100-SS-03	<430	<140	<210	<160
		100-SS-04	<84	<41	<85	<86
		100-SS-05	<3.8	<5.2	<4.3	<4.5
		100-SS-06	<3.9	<4.1	<4	<4.3
		100-SS-07	<4.1	<29	<12	<9.8
		100-SS-08	<20	<28	<4.1	21
		100-SS-09	<40	<56	<7.5	<4.4
		100-SS-10	<42	<89	<8.3	<4.1
		100-SS-11	<31	<45	<15	<4.6

-	not applicable
(shaded)	EGLE SSC Exceedance

Table 100-5. Summary of Results for 1,2-Dichloropropane (1,2-DCP)

Sample Type	Screening Level (µg/m^3)	Sample ID	Measured Concentration (µg/m^3)			
			Sept. 2018	Apr. 2019	Aug. 2019	Dec. 2019
			E1	E2	E3	E4
Outdoor Air	-	100-OA-01	<0.77	<0.72	<0.76	<0.73
Indoor Air	12.2 (EGLE SSC)	100-IA-01	<0.77	<0.95	<0.74	<0.79
		100-IA-02	<0.78	<0.72	<0.78	<0.83
		100-IA-03	<0.77	<0.77	<0.73	<0.81
		100-IA-04	<0.77	<0.75	<0.81	<0.9
		100-IA-05	<0.75	<0.73	<0.79	<0.86
		100-IA-06	<0.78	<0.76	<0.76	<0.83
		100-IA-07	<0.74	<0.76	<0.73	<0.81
		100-IA-08	<0.76	<0.76	<0.74	<0.83
		100-IA-09	<0.8	<0.79	<1.8	<0.79
		100-IA-10	<0.78	<0.74	<0.81	<0.86
		100-IA-11	<0.76	<0.79	<0.78	<0.94
Sub-Slab Soil Gas	410 (EGLE SSC)	100-SS-01	1,800	860	900	730
		100-SS-02	1,500	460	1,200	1,200
		100-SS-03	530	200	310	140
		100-SS-04	410	130	280	310
		100-SS-05	6.4	<4.4	<3.6	<3.8
		100-SS-06	12	14	16	<3.6
		100-SS-07	8.4	120	73	76
		100-SS-08	120	86	18	47
		100-SS-09	760	820	72	90
		100-SS-10	230	330	27	<3.5
		100-SS-11	62	74	21	14

-	not applicable
(shaded)	EGLE SSC Exceedance

Table 100-6. Summary of Results for Chloroform

Sample Type	Screening Level (µg/m³)	Sample ID	Measured Concentration (µg/m³)			
			Sept. 2018	Apr. 2019	Aug. 2019	Dec. 2019
			E1	E2	E3	E4
Outdoor Air	-	100-OA-01	<0.16	<0.15	<0.16	<0.15
Indoor Air	5.2 (EGLE SSC) 52 (TSRIASL12)	100-IA-01	0.63	0.22	0.17	1.2
		100-IA-02	0.57	<0.15	<0.16	0.47
		100-IA-03	0.58	<0.16	<0.15	0.29
		100-IA-04	0.67	<0.16	<0.17	0.3
		100-IA-05	0.49	0.24	0.82	<0.18
		100-IA-06	0.43	0.27	0.83	<0.17
		100-IA-07	0.64	0.35	0.95	0.19
		100-IA-08	0.45	0.25	0.84	<0.17
		100-IA-09	1.8	1.5	3.1	0.56
		100-IA-10	0.84	0.44	1.4	0.26
		100-IA-11	0.51	0.27	0.9	<0.2
Sub-Slab Soil Gas	170 (EGLE SSC) 1,700 (TSRIASL12)	100-SS-01	**3,200**	**1,900**	**2,600**	**2,000**
		100-SS-02	1,100	310	990	1,000
		100-SS-03	**2,300**	620	1,100	610
		100-SS-04	980	340	840	960
		100-SS-05	14	<4.7	<3.8	<4
		100-SS-06	24	32	30	<3.8
		100-SS-07	18	260	170	180
		100-SS-08	170	140	27	84
		100-SS-09	870	700	63	120
		100-SS-10	290	470	31	<3.7
		100-SS-11	56	70	18	16

-	not applicable
(shaded)	EGLE SSC Exceedance
BOLD	TSRIASL12 Exceedance

Table 100-7. Summary of Results for cis-1,2-Dichloroethene (cis-1,2-DCE)

Sample Type	Screening Level (µg/m^3)	Sample ID	Measured Concentration (µg/m^3)			
			Sept. 2018	Apr. 2019	Aug. 2019	Dec. 2019
			E1	E2	E3	E4
Outdoor Air	-	100-OA-01	<0.13	<0.12	<0.13	<0.12
Indoor Air	24 (EGLE SSC) 72 (TSRIASL$_{12}$)	100-IA-01	0.21	0.25	<0.13	0.35
		100-IA-02	0.2	<0.12	<0.13	0.26
		100-IA-03	0.18	<0.13	0.16	0.35
		100-IA-04	0.15	<0.13	<0.14	0.2
		100-IA-05	<0.13	<0.12	<0.14	<0.15
		100-IA-06	<0.13	<0.13	<0.13	<0.14
		100-IA-07	<0.13	<0.13	<0.12	<0.14
		100-IA-08	<0.13	<0.13	<0.13	<0.14
		100-IA-09	<0.14	<0.14	<0.32	<0.14
		100-IA-10	<0.13	<0.13	<0.14	<0.15
		100-IA-11	<0.13	<0.14	<0.13	<0.16
Sub-Slab Soil Gas	820 (EGLE SSC) 2,500 (TSRIASL$_{12}$)	100-SS-01	**2,500**	910	1,100	800
		100-SS-02	**4,000**	1,000	**3,100**	**2,900**
		100-SS-03	**8,500**	1,600	**3,400**	1,500
		100-SS-04	2,100	540	1,400	1,200
		100-SS-05	28	<3.8	<3.1	3.6
		100-SS-06	56	94	62	<3.1
		100-SS-07	5.3	86	48	44
		100-SS-08	300	240	49	140
		100-SS-09	1,000	1,200	100	160
		100-SS-10	450	760	59	6.2
		100-SS-11	260	470	100	99

-	not applicable
(shaded)	EGLE SSC Exceedance
BOLD	TSRIASL$_{12}$ Exceedance

Table 100-8. Summary of Results for Hexachlorobutadiene (HCBD)

Sample Type	Screening Level (µg/m³)	Sample ID	Measured Concentration (µg/m³)			
			Sept. 2018	Apr. 2019	Aug. 2019	Dec. 2019
			E1	E2	E3	E4
Outdoor Air	-	100-OA-01	<8.9	<8.3	<3.5	<3.4
Indoor Air	5.4 (EGLE SSC)	100-IA-01	<8.9	<11	<3.4	<3.7
		100-IA-02	<9	<8.4	<3.6	<3.8
		100-IA-03	<8.8	<8.9	<3.4	<3.8
		100-IA-04	<8.8	<8.7	<3.7	<4.2
		100-IA-05	<8.6	<8.4	<3.6	<4
		100-IA-06	<9	<8.7	<3.5	<3.8
		100-IA-07	<8.6	<8.7	<3.4	<3.7
		100-IA-08	<8.7	<8.7	<3.4	<3.8
		100-IA-09	<9.3	<9.1	<8.6	<3.6
		100-IA-10	<9	<8.6	<3.7	<4
		100-IA-11	<8.7	<9.1	<3.6	<4.4
Sub-Slab Soil Gas	180 (EGLE SSC)	100-SS-01	<1,100	<350	<620	<430
		100-SS-02	<1,600	<360	570	<1,400
		100-SS-03	<3,300	<1,100	1,700	<1,300
		100-SS-04	830	<320	660	<670
		100-SS-05	<30	<41	<34	<35
		100-SS-06	<31	<32	<31	<34
		100-SS-07	<32	240	210	180
		100-SS-08	160	260	210	68
		100-SS-09	410	610	440	56
		100-SS-10	330	<700	390	<32
		100-SS-11	300	560	430	54

-	not applicable
(shaded)	EGLE SSC Exceedance

Table 100-9. Summary of Results for Tetrachloroethene (PCE)

Sample Type	Screening Level (µg/m³)	Sample ID	Measured Concentration (µg/m³)			
			Sept. 2018	Apr. 2019	Aug. 2019	Dec. 2019
			E1	E2	E3	E4
Outdoor Air	-	100-OA-01	<0.23	<0.21	0.88	0.35
Indoor Air	82 (EGLE SSC) 82 (TSRIASL12)	100-IA-01	5.8	8.1	3.8	21
		100-IA-02	5.6	3.3	4.1	12
		100-IA-03	5.2	2.8	2.5	12
		100-IA-04	5.7	2.8	2.6	8.9
		100-IA-05	0.54	0.59	0.65	0.3
		100-IA-06	0.78	0.62	0.66	0.33
		100-IA-07	0.79	0.61	0.63	0.3
		100-IA-08	0.61	0.67	0.7	0.4
		100-IA-09	0.76	1.4	1.3	0.33
		100-IA-10	0.55	1.6	0.78	0.4
		100-IA-11	0.89	1.7	0.94	0.33
Sub-Slab Soil Gas	2,700 (EGLE SSC) 2,700 (TSRIASL12)	100-SS-01	**240,000**	**110,000**	**120,000**	**110,000**
		100-SS-02	**190,000**	**69,000**	**140,000**	**220,000**
		100-SS-03	**240,000**	**120,000**	**170,000**	**120,000**
		100-SS-04	**170,000**	**60,000**	**140,000**	**180,000**
		100-SS-05	370	59	30	93
		100-SS-06	1,200	1,700	1,800	82
		100-SS-07	300	**6,500**	**3,800**	**4,200**
		100-SS-08	**6,900**	**8,700**	1,600	**3,100**
		100-SS-09	**14,000**	**18,000**	2,300	1,600
		100-SS-10	**14,000**	**21,000**	2,600	130
		100-SS-11	**9,800**	**15,000**	**4,800**	1,800

-	not applicable
(shaded)	EGLE SSC Exceedance
BOLD	TSRIASL12 Exceedance

Table 100-10. Summary of Results for trans-1,2-Dichloroethene (trans-1,2-DCE)

Sample Type	Screening Level (µg/m³)	Sample ID	Measured Concentration (µg/m³)			
			Sept. 2018	Apr. 2019	Aug. 2019	Dec. 2019
			E1	E2	E3	E4
Outdoor Air	-	100-OA-01	<0.66	<0.61	<0.65	<0.63
Indoor Air	240 (EGLE SSC) 790 ($TSRIASL_{12}$)	100-IA-01	<0.66	<0.82	<0.64	<0.68
		100-IA-02	<0.67	<0.62	<0.67	<0.71
		100-IA-03	<0.66	<0.66	<0.63	<0.7
		100-IA-04	<0.66	<0.65	<0.69	<0.78
		100-IA-05	<0.64	<0.63	<0.68	<0.74
		100-IA-06	<0.67	<0.65	<0.65	<0.71
		100-IA-07	<0.64	<0.65	<0.63	<0.69
		100-IA-08	<0.65	<0.65	<0.64	<0.71
		100-IA-09	<0.69	<0.68	<1.6	<0.68
		100-IA-10	<0.67	<0.64	<0.69	<0.74
		100-IA-11	<0.65	<0.68	<0.67	<0.81
Sub-Slab Soil Gas	8,200 (EGLE SSC) 26,000 ($TSRIASL_{12}$)	100-SS-01	2,000	910	910	730
		100-SS-02	17,000	4,100	14,000	14,000
		100-SS-03	**31,000**	13,000	19,000	14,000
		100-SS-04	2,200	670	1,600	1,800
		100-SS-05	22	<3.8	<3.1	3.4
		100-SS-06	34	37	33	<3.1
		100-SS-07	4.2	83	47	55
		100-SS-08	110	80	12	55
		100-SS-09	270	260	20	55
		100-SS-10	160	190	14	<3
		100-SS-11	120	140	27	36

-	not applicable
(shaded)	EGLE SSC Exceedance
BOLD	$TSRIASL_{12}$ Exceedance

Table 100-11. Summary of Results for Trichloroethene (TCE)

Sample Type	Screening Level (µg/m³)	Sample ID	Measured Concentration (µg/m³)			
			Sept. 2018	Apr. 2019	Aug. 2019	Dec. 2019
			E1	E2	E3	E4
Outdoor Air	-	100-OA-01	<0.18	<0.17	<0.18	<0.17
Indoor Air	4 (EGLE SSC) 12 ($TSRIASL_{12}$)	100-IA-01	0.96	1.5	0.55	3.1
		100-IA-02	1.1	0.61	0.55	2.1
		100-IA-03	1	0.5	0.84	2.6
		100-IA-04	0.96	0.49	0.44	1.7
		100-IA-05	<0.17	<0.17	<0.18	<0.2
		100-IA-06	<0.18	<0.18	<0.18	<0.19
		100-IA-07	<0.17	<0.18	0.17	<0.19
		100-IA-08	<0.18	<0.18	<0.17	<0.19
		100-IA-09	<0.19	<0.18	<0.43	<0.18
		100-IA-10	<0.18	0.26	0.76	<0.2
		100-IA-11	<0.18	0.22	0.18	<0.22
Sub-Slab Soil Gas	130 (EGLE SSC) 400 ($TSRIASL_{12}$)	100-SS-01	**23,000**	**9,700**	**11,000**	**8,400**
		100-SS-02	**18,000**	**4,700**	**13,000**	**19,000**
		100-SS-03	**22,000**	**9,300**	**14,000**	**4,800**
		100-SS-04	**21,000**	**6,800**	**17,000**	**19,000**
		100-SS-05	86	7.6	<4.2	15
		100-SS-06	290	300	340	15
		100-SS-07	40	**710**	**440**	**490**
		100-SS-08	**1,400**	**1,300**	240	**690**
		100-SS-09	**2,400**	**2,700**	240	330
		100-SS-10	**2,900**	**3,700**	340	26
		100-SS-11	**2,200**	**2,800**	**770**	**500**

-	not applicable
(shaded)	EGLE SSC Exceedance
BOLD	$TSRIASL_{12}$ Exceedance

EVALUATION OF VI DATA TRENDS

Data trends for Building 100 are discussed below for both sub-slab soil gas and indoor air. When data exhibit a narrow range of variability, it is typical practice to express the range as a percentage (e.g., relative percent difference [RPD]). When data exhibit a large range of variability, however, it is more useful to express the range in orders of magnitude (i.e., factors of 10). This can be expressed mathematically as the log of the ratio of maximum/minimum values. If the values differ by a factor of 10, the log of the ratio is 1, if the values differ by a factor of 100, the log of the ratio is 2, and so on.

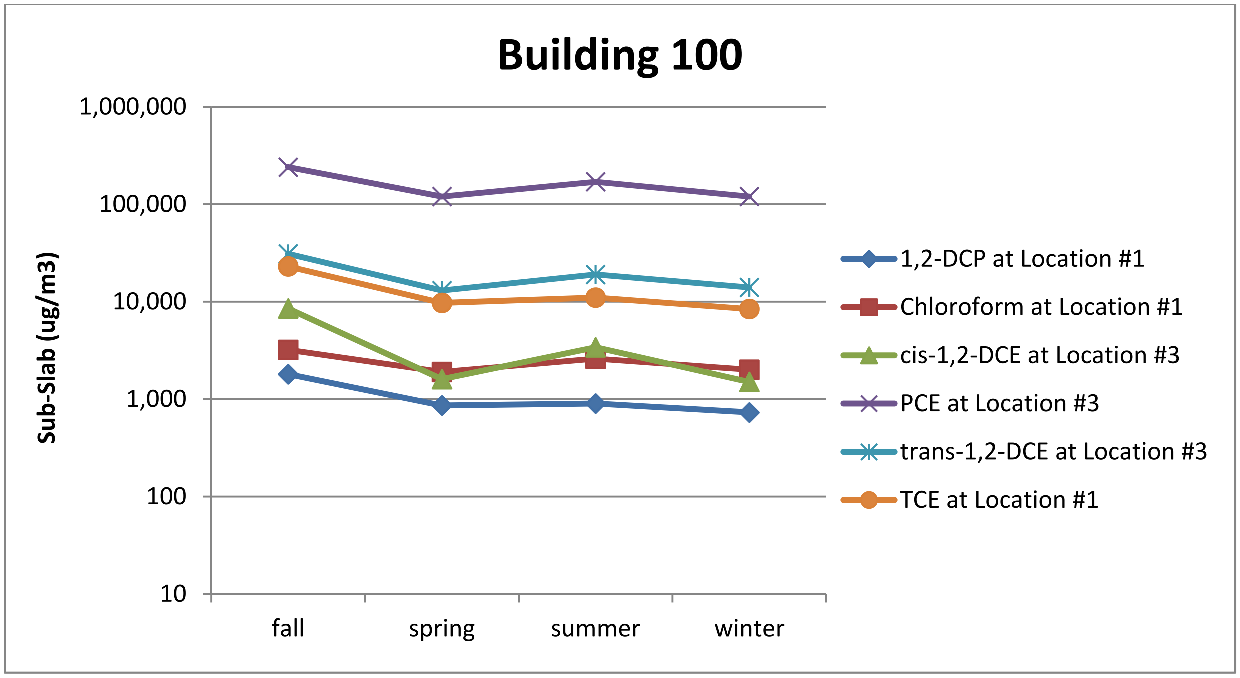
The variability across all locations over all sampling events is the total variability. This encompasses different types of variability, including spatial variability (i.e., how do the results vary from location to location), temporal variability (i.e., how do the results at a given location vary over time), and measurement variability. Measurement variability can be determined by evaluating results of duplicate or collocated samples and includes both sampling variability and analytical variability.

Sub-Slab Soil Gas Data Trends

Spatial Variability of Sub-Slab Soil Gas – The soil gas exhibit less than four orders of magnitude of spatial variability. For example, sub-slab soil gas detections of 1,2-DCP vary from 6.4 to 1,800 $\mu g/m^3$ (log of max./min. = 2.4) across all 11 locations for E1. Sub-slab soil gas detections of cis-1,2-DCE vary from 5.3 to 8,500 $\mu g/m^3$ (log of max./min. = 3.2) across all 11 locations for E1. Sub-slab soil gas detections of PCE vary from 30 to 170,000 $\mu g/m^3$ (log of max./min. = 3.8) across all 11 locations for E3. Sub-slab soil gas detections of TCE vary from 7.6 to 9,700 $\mu g/m^3$ (log of max./min. = 3.1) across all 11 locations for E2.

Temporal Variability of Soil Gas – The soil gas concentrations exhibit up to two orders of magnitude of temporal variability. For 1,2-DCP, sub-slab soil gas concentrations of vary from 8.4 to 120 $\mu g/m^3$ at location 100-SS-07 (log max/min = 1.2). Cis-1,2-DCE at location 100-SS10 varies from 6 to 760 $\mu g/m^3$ (log max/min = 2.1). For PCE, sub-slab soil gas detected concentrations vary from 130 to 2,100 $\mu g/m^3$ at location 100-SS-10 (log max/min = 2.2). Sub-slab soil gas concentrations of TCE vary from 26 to 3,700 $\mu g/m^3$ at location 100-SS-10 (log max/min = 2.2). Overall, temporal variability is less than spatial variability, which is in line with expectations.

Seasonal Confirmation Sampling Trend Analysis – No formal statistical tests were performed, but the data exhibits relatively consistent results between the seasons. This is demonstrated by the graph below, which shows six analytes selected above at locations where they were detected at relatively high concentrations. 1,2,2-TCA and HCBD had relatively few detected results in sub-slab soil gas and are not represented on the graph below. Note that the y-axis is a log scale.



The data set was examined to see what the potential consequences would have been had only a single sampling event been performed. For all six analytes included in this graph, the highest sub-slab soil gas concentrations were collected during the fall (E1) and the lowest concentrations occurred during the winter (E4) and for a couple analytes, in the spring (E2). Overall, the minimum and maximum values appear to be consistent between sampling events.

Since the analytes had the highest results occur during E1, there was no negative bias introduced by results from other seasonal sampling events. Therefore, implementing four seasonal confirmation sampling events provided only limited insight regarding maximum concentration levels, but the larger data set served to increase the confidence in the findings.

__Indoor Air Data Trends__

Spatial Variability of Indoor Air – The indoor air exhibit less than two orders of magnitude of spatial variability. Most analytes included in this evaluation had all ND results in indoor air or relatively few detects in indoor air, so this indoor air variability evaluation is limited to chloroform, PCE and TCE. For chloroform during E3, indoor air concentrations vary from 0.17 to 3.1 $\mu g/m^3$ (log max./min. = 1.3). For PCE, the highest spatial variability occurred during E4 where indoor air concentrations vary from 0.3 to 21 $\mu g/m^3$ (log max./min. = 1.8). For TCE, the highest spatial variability occurred during E3 where indoor air concentrations vary from 0.17 to 0.84 $\mu g/m^3$ (log max./min. = 0.7).

Temporal Variability of Indoor Air – The indoor air has less than one order of magnitude of temporal variability. For example, indoor air concentrations of chloroform at location 100-IA-01 varied from 0.17 to 1.2 $\mu g/m^3$ (log of max./min. = 0.85). For PCE at location 100-IA-01, concentrations varied from 3.8 to 21 $\mu g/m^3$ (log max./min. = 0.74). For TCE at location 100-IA-01, concentrations varied from 0.55 to 3.1 $\mu g/m^3$ (log max./min. = 0.75). Overall, temporal variability across the four seasons sampled is relatively small.

__Additional Analyses__

Comparison of Sub-Slab Soil Gas and Indoor Air Data Sets – As expected, the sub-slab soil gas data exhibit greater spatial variability than the indoor air data set. The sub-slab soil gas also exhibits greater temporal variability than the indoor air data set, which is contrary to expectations, but the variability for both is relatively low compared to what has been observed at some other buildings at the site.

Seasonal Effects – The sub-slab soil gas data exhibit some variability from event to event. As previously stated, for all six analytes included in this graph above, the highest sub-slab soil gas concentrations were collected during the fall (E1) and the lowest concentrations occurred during the winter (E4) and for a couple analytes, in the spring (E2). Maximum indoor air values for TCE and PCE occurred in E4 (winter) and for chloroform during summer (E3). The data does tend to support the hypothesis that wintertime should have the highest indoor air impacts; however the data set is relatively small, with few detected results in indoor air for the eight analytes that exceeded the EGLE SSC in sub-slab soil gas.

Comparison of Attenuation Factors by Event – Attenuation factors were calculated for PCE based on maximum values. PCE is the only analyte of interest with 100% detection frequency in indoor air. The indoor air maximum concentration was corrected for contribution of outdoor air to indoor air (e.g., outdoor air detected concentration was subtracted from indoor air concentration). The calculated event-specific attenuation factors are shown in Tables 100-12.

Table 100-12. Comparison of Building-Specific Attenuation Factors for PCE by Event

	E1 (Fall)	E2 (Winter)	E3 (Spring)	E4 (Summer)
Maximum Values				
PCE in Sub-Slab Soil Gas (μg/m³)	240,000	120,000	170,000	220,000
PCE in Outdoor Air (μg/m³)	<0.23	<0.21	0.88	0.35
PCE in Indoor Air (μg/m³)	5.8	8.1	4.1	21
PCE in Indoor Air (μg/m³) Corrected for Outdoor Air Contribution	5.8	8.1	3.2	20.7
Attenuation Factor	2.4E-05	6.8E-05	1.9E-05	**9.4E-05**

These serve as the best estimates of attenuation at this building. The results can vary from day to day due to differences in rates of vapor intrusion and rates of building ventilation. Overall, the most conservative estimate of a building-specific attenuation factor for Building 100 is 9.4E-05 based on PCE during E4.

Temporal Variability in Attenuation Factor – As shown in Table 100-12, there was less than one order of magnitude of temporal variability in the calculated attenuation factors observed for CFC-12 between the four sampling events. To be as conservative as possible, the maximum values were used in calculating the attenuation factor for each event. The sampling location with the maximum value per event varied. In general, the low spatial variability in indoor air results means that roughly comparable attenuation factors would be obtained whichever indoor air value was used in the calculations.

NON-DETECT EVALUATION

Table 100-13 below lists the analytes in sub-slab soil gas that have ND RLs greater than the screening levels. The table also includes the indoor air results for each of the analytes. If a sub-slab soil gas analyte has ND RL exceedances, but all results and ND RLs in indoor air are below the screening levels, no further evaluation is warranted. If an analyte was identified as an AOI in sub-slab soil gas (detected results > screening level), it is excluded from the ND evaluation. Also, if an ND analyte has an 0% detection frequency for all sampling events and all ND RLs met the screening level during at least one event, no further ND evaluation is warranted.

Table 100-13. Non-Detect Evaluation for Building 100

Soil Gas Analytes with ND RL > SL	Indoor Air Result Summary
1,1,2,2-Tetrachloroethane	0% Detection Frequency, All ND RLs < EGLE SSC
1,1,2-Trichloroethane	0% Detection Frequency, All ND RLs < EGLE SSC
1,2,4-Trichlorobenzene	0% Detection Frequency, 60% ND RLs < EGLE SSC
1,2-Dibromoethane (EDB)	0% Detection Frequency, E3 & E4 ND RLs < EGLE SSC
1,2-Dichloroethane	9% Detection Frequency, All ND RLs < EGLE SSC
1,3-Dichlorobenzene	0% Detection Frequency, All ND RLs < EGLE SSC
1,4-Dioxane	3% Detection Frequency, All ND RLs < EGLE SSC
alpha-Chlorotoluene	0% Detection Frequency, All ND RLs < EGLE SSC
Bromodichloromethane	0% Detection Frequency, All ND RLs < EGLE SSC
Bromomethane	0% Detection Frequency, All ND RLs < EGLE SSC
Dibromochloromethane	0% Detection Frequency, All ND RLs < EGLE SSC
Dibromomethane	0% Detection Frequency, All ND RLs < EGLE SSC
Hexachlorobutadiene (HCBD)	0% Detection Frequency, E3 & E4 ND RLs < EGLE SSC
Naphthalene	0% Detection Frequency, All ND RLs < EGLE SSC

WEIGHT-OF-EVIDENCE SUMMARY

Building 100 was confirmed as a VI Path Forward Group 2 building due to its potential for VI based on sub-slab soil gas exceedances of the EGLE SSCs for 1,1,2-TCA, 1,2-DCP, chloroform, cis-1,2-DCE, HBCD, PCE, trans-1,2-DCE, and TCE. However, the following evidence supports the conclusion that VI is insignificant at Building 100:

- No exceedances of EGLE SSCs in indoor air during any of the sampling events.

- The sub-slab soil gas data do not show any strong time dependence nor do the data show any strong seasonal effects.

- The data do somewhat support the hypothesis that wintertime should have the highest indoor air impacts. The highest sub-slab soil gas concentrations generally were measured in the fall. Of the limited indoor air detects, the highest indoor air concentrations were measured in the winter and summer.

- The indoor air data show relatively little spatial variability, despite the greater spatial variability in the sub-slab soil gas values. This evaluation confirms that the sub-slab soil gas and indoor air concentrations were relatively constant from season to season.

Based on the CSM for Building 100, VI is an insignificant exposure pathway for current building utilization.

PATH FORWARD

Based on the evaluation of the four seasonal confirmation sampling events and the results of the further investigation, the VI pathway continues to be insignificant for Building 100 and the sub-slab soil gas results have demonstrated relatively stable concentrations and no evidence of increasing over time. Sufficient information exists to make a human exposure under control EI determination. However, while currently there is no evidence of potential VI, for future use, LTM is warranted and the building-specific Interim Monitoring Plan is discussed below.

Building-specific Interim Monitoring Plan

Dow presented an interim monitoring plan for Building 100 during the April 2020 Corrective Action status meeting. Dow will implement the interim monitoring plan at Building 100 until a revised program or more permanent corrective action plan is developed for the site.

Indoor air will be monitored at locations 100-IA-01 and 100-IA-03. These locations were selected for continued monitoring since they demonstrated the highest sub-slab soil gas results. Monitoring will be performed for 1,1,2-TCA, 1,2-DCP, chloroform, cis-1,2-DCE, HBCD, PCE, trans-1,2-DCE, and TCE. An outdoor air sample will also be collected at the time of each monitoring event. Interim monitoring will be performed semi-annually for a minimum of two years and monitoring results will undergo trend analysis. Monitoring will begin winter 2020/2021. If results continue to be consistent and below screening levels, monitoring will be conducted on an annual basis. If indoor air results are observed to be increasing, further evaluation will be performed, which may include collection of a sub-slab soil gas sample(s) and an increase in monitoring frequency. Results from each monitoring event will be reported in the annual CAIP. In the event an indoor air result(s) exceeds screening levels, EGLE will be provided a brief email notification. A collocated indoor air and sub-slab soil gas sample will be collected from that location within 45 days. If both sub-slab soil gas and indoor air results indicate that VI continues to be insignificant, monitoring will continue at an appropriate frequency. If both sub-slab soil gas and indoor air results indicate that VI is significant and confirm Group 4 conditions, the building will be moved to Group 4 for follow-up actions.

Dow may propose changes to the frequency or other aspects of this interim monitoring plan in the future based on an evaluation of the data, changes in building use or implementation of other corrective actions to address the potential VI pathway.

5.5.4 Building 564 Interim Monitoring Plan

INTRODUCTION

Building 564 is a Category 2 building located within the northern portion of the facility designated as Zone 3 and is known as the Saran Building. The initial evaluation concluded that the TCE detected in the indoor air at Building 564 is due to indoor sources and not attributable to VI. The indoor air results suggest a common source, such as work within the shop and spare parts area in the northwest corner of the building involving degreasers or other products. Building 564 was placed in VI Path Forward Building Group 4A. Seasonal confirmation sampling was conducted and completed in August 2019.

In December 2017, sampling activities were completed for Building 564 as part of a Baseline Environmental Assessment (BEA) (AECOM, January 2018). An Expedited Building Summary was provided for Building 564 on August 24, 2018 based on sampling results from December 2017. Seasonal confirmation sampling has continued for both sub-slab soil gas and indoor air. Email notifications were provided in January and July 2019 based on the results of the Fall 2018 and Spring 2019 seasonal confirmation sampling events. A Summary of Investigative Findings documenting the further investigation activities that took place in May 2019 at Buildings 499, 564 and 827 was also provided to EGLE on July 19, 2019. The overall lack of correlation between the sub-slab soil gas and indoor air results continue to suggest VI is not the main source of indoor air detections.

PATH FORWARD

As documented in Section 5.5.7 of the 2019 CAIP, based on the evaluation of the four seasonal confirmation sampling events, the VI pathway continues to be insignificant for Building 564 and the sub-slab soil gas results have demonstrated relatively stable concentrations and no evidence of increasing over time. Elevated levels of TCE and PCE appear to be due to routine work place chemical use. Sufficient information exists to make a human exposure under control EI determination. However, while currently there is no evidence of potential VI, for future use, LTM is warranted and the building-specific Interim Monitoring Plan is discussed below.

Building-specific Interim Monitoring Plan

Dow presented an interim monitoring plan for Building 564 during the October 2019 Corrective Action status meeting. Dow will implement the interim monitoring plan at Building 564 until a revised program or more permanent corrective action plan is developed for the site.

Indoor air will be monitored at location 564-IA-30 (see Figure 5.5.4-1). This location was selected for continued monitoring since it demonstrated the highest sub-slab soil gas results. Monitoring will be performed for PCE and TCE. An outdoor air sample will also be collected at the time of each monitoring event. Interim monitoring will be performed semi-annually for a minimum of two years and monitoring results will undergo trend analysis. Due to monitoring delays, the initial IM event will begin in Winter 2020. If results continue to be consistent and below screening levels, monitoring will be conducted on an annual basis. If indoor air results are observed to be increasing, further evaluation will be performed, which may include collection of a sub-slab soil gas sample(s) and an increase in monitoring frequency. Results from each monitoring event will be reported in the annual CAIP. In the event an indoor air result(s) exceeds screening levels, EGLE will be provided a brief email notification. A collocated indoor air and sub-slab soil gas sample will be collected from that location within 45 days. If both sub-slab soil gas and indoor air results indicate that VI continues to be insignificant, monitoring will continue at an appropriate frequency. If both sub-slab soil gas and indoor air results indicate that VI is significant and confirm Group 4 conditions, the building will be moved to Group 4 for follow-up actions.

Dow may propose changes to the frequency or other aspects of this interim monitoring plan in the future based on an evaluation of the data, changes in building use or implementation of other corrective actions to address the potential VI pathway.

5.5.5 VI Seasonal Confirmation Sampling Results Evaluation for Building 881

INTRODUCTION

Building 881 is a Category 4A building in Zone 3 Phase 1, located in the southwestern quadrant of the Midland facility (Figure 5.5.5-1). The northern half of the building was built in the 1970s and the southern half of the building was built in the 1990s. This building contains large locker rooms with washer/dryers, two shops (one which has an office setup), a storage area, and a server room. The entire structure has a footprint of approximately 5,391 ft^2 and is a one-story slab-on-grade construction with no elevator or basement. The shop portions of the building have a ceiling height equivalent to two stories.

The 2018 CAIP concluded that based on the indoor air results and further investigation findings, the VI pathway at Building 881 is an insignificant exposure pathway based on current use. However, based on the sub-slab soil gas results and given the potential for future VI, Building 881 has been placed in VI Path Forward Building Group 4A, as lines of evidence indicate that VI is insignificant and the presence and use of degreasers in Building 881 indicate active workplace chemical use. Any building placed in Group 4A is scheduled for seasonal confirmation sampling.

The results of the initial sampling event (E1) were evaluated in the 2018 CAIP. The 2019 CAIP evaluated three seasonal sampling events (through E3). The remaining seasonal event (E4) has been completed (see Table 881-1) and the results of all four sampling events are included and evaluated herein. 1,1-Dichloroethane (1,1-DCA), chloroform and TCE were detected above the EGLE SSC and both 1,1-DCA and TCE also exceeded the $TSRIASL_{12}$ in sub-slab soil gas. TCE was also detected in indoor air at a concentration greater than the EGLE SSC during E1, triggering expedited reporting and further investigation activities, both summarized below. All other indoor air results were below screening levels and all indoor air results were below the $TSRIASL_{12}$.

Table 881-1. Summary of Seasonal Confirmation Sampling Events for Building 881

Building 881	
Initial Sampling Event	**Completed**
E1	September 2018 (Fall)
Seasonal Sampling Event	**Completed**
E2	April 2019 (Spring)
E3	August 2019 (Summer)
E4	December 2019 (Winter)

Based on the evaluation of the four seasonal confirmation sampling events and the results of the further investigation activities conducted in 2019 (discussed further below), the VI pathway continues to be insignificant. Sufficient information exists to make a human exposure under control EI determination.

SUB-SLAB SOIL GAS RESULTS EVALUATION

Sub-slab soil gas samples were collected from four locations from within the building. Indoor air samples were collected at four locations corresponding to the soil gas sample locations, along with an outdoor air sample from the main air intake. The sampling locations are shown on Figure 5.5.5-2. Summary statistics and screening comparison results are presented for sub-slab soil gas on Table 5.5.5-1 and indoor and outdoor air on Table 5.5.5-2. The analytical data is presented in Appendix A. Field sampling forms are provided in Appendix B. Table 881-2 presents the sub-slab soil gas results that exceed the EGLE SSCs.

Table 881-2. Summary of Sub-Slab Soil Gas Exceedances for Building 881

Analyte	Detection Frequency	Measured Range of Detects (μg/m^3)	% Detections > EGLE SSC	EGLE SSC (μg/m^3)
1,1-Dichloroethane (1)	100%	4.5 - 110,000	25%	2,500
1,1-Dichloroethane (2)	75%	24 - 1,500	0%	2,500
1,1-Dichloroethane (3)	100%	3.6 - 5,300	25%	2,500
1,1-Dichloroethane (4)	100%	3.8 – 1,200	0%	2,500
Chloroform (1)	100%	23 - 620	75%	170
Chloroform (2)	100%	8.2 - 340	25%	170
Chloroform (3)	100%	27 - 64	0%	170
Chloroform (4)	100%	8.1 - 28	0%	170
Trichloroethene (1)	100%	43 - 430	75%	130
Trichloroethene (2)	50%	130 - 210	25%	130
Trichloroethene (3)	50%	50 - 65	0%	130
Trichloroethene (4)	75%	6.1 - 21	0%	130

Table 881-3 summarizes the indoor air results relative to the sub-slab soil gas exceedances, since VI only potentially occurs if the analyte is present in both sub-slab soil gas and indoor air. Therefore, the table below provides the analyte detected above applicable screening levels in sub-slab soil gas as well as the corresponding indoor air sample result. The outdoor air sample result is also provided to determine if the analytes were present in indoor air due to migration from outdoor air.

Table 881-3. Vapor Intrusion Evaluation for Building 881

Analyte	Indoor Air Detection Frequency	Indoor Air Measured Range ($\mu g/m^3$)	Indoor Air EGLE SSC ($\mu g/m^3$)	Outdoor Air Result ($\mu g/m^3$)
1,1-Dichloroethane (1)	25%	0.2	74	ND
1,1-Dichloroethane (2)	0%	ND	74	ND
1,1-Dichloroethane (3)	25%	0.36	74	ND
1,1-Dichloroethane (4)	75%	0.15 – 0.44	74	ND
Chloroform (1)	100%	0.94- 2.1	5.2	ND
Chloroform (2)	75%	0.21 – 0.32	5.2	ND
Chloroform (3)	100%	0.67 - 3	5.2	ND
Chloroform (4)	100%	0.36 – 1.5	5.2	ND
Trichloroethene (1)	100%	0.7 - 10	4	ND
Trichloroethene (2)	100%	0.2 – 1.2	4	ND
Trichloroethene (3)	100%	0.63 – 1.6	4	ND
Trichloroethene (4)	100%	0.91 – 3.6	4	ND

All indoor air results for Building 881, with the exception of TCE in E1, are below the EGLE SSC. During the next three events, all indoor air results for TCE were below the EGLE SSC. The maximum detected indoor air concentration was 10 $\mu g/m^3$ (EGLE SSC = 4 $\mu g/m^3$; $TSRIASL_{12}$ = 12 $\mu g/m^3$). TCE was detected above the EGLE SSC in three sub-slab soil gas samples during E1 and one sub-slab soil gas sample in E2. Only one detected concentration in sub-slab soil gas during E1 was greater than the $TSRIASL_{12}$. All detected concentrations of TCE in sub-slab soil gas during E3 and E4 were less than the EGLE SSC. Figure 5.5.5-3 shows the TCE results for each sample location. While 1,1-DCA and chloroform were detected in sub-slab soil gas at concentrations greater than EGLE SSCs, concentrations in indoor air were less than criteria.

VAPOR INTRUSION CONCEPTUAL SITE MODEL

VI is an exposure pathway that results from the migration of volatilized chemicals from the subsurface to indoor air in overlying occupied buildings. A source, migration route and a human receptor must be present for the VI pathway to be complete. The focus of this building specific investigation is to evaluate the potential VI exposure pathway for employees and contractors at Building 881. The CSM is illustrated in Figure 5.5.5-4.

Building 881 is located in the northwestern quadrant of the Midland facility. The northern half of the building was built in the 1970s and the southern half of the building was built in the 1990s. This building contains large locker rooms with washer/dryers, two shops (one which has an office setup), a storage area, and a server room. The entire structure has a footprint of approximately 5,391 ft^2 and is a one-story slab-on-grade construction with no elevator or basement. The shop portions of the building have a ceiling height equivalent to two stories.

The building is cooled via one central AC unit with an associated intake located on the east side of the building near the southeastern corner. The shop portions of the building are heated via steam radiation, but the locker room areas are heated via hot air circulation. There are two bay doors on this structure, which are associated with the northwestern shop/garage area. The bay doors are only open when accessing equipment or dropping off materials. The outside ground cover surrounding the building consists of asphalt and gravel. Fuel-powered equipment is frequently stored in the northwest shop/garage area. Approximately 30 occupants may use Building 881. Occupants of the building do use the washer/dryers in the locker rooms, but an outside laundry service is also provided on a weekly basis.

The building survey completed before the initial sampling event can be found in Appendix D. Drains and other openings were screened with a PID and no PID detections were observed in the ambient air throughout the building, but a PID detection of 1.2 ppm was observed from the drain located in the northwestern garage/shop area. The chemical inventory performed during the building survey identified various potential indoor emission sources, including soap, air freshener, and various adhesive sprays, lubricants, and spray paints. The building has running water, which is a potential source of chloroform, but no specific consumer items containing chloroform were identified.

An EBS was provided in February 2019 based on the Fall 2018 sampling event and EGLE's request for expedited reporting if an indoor air result exceeds the $TSRIASL_{12}$. Email notifications were provided in January, July and October 2019. Seasonal confirmation sampling has continued for both sub-slab soil gas and indoor air. Dow conducted further investigation activities at Building 881 in May and July 2019 and results were presented to EGLE during the monthly Corrective Action Status meetings. A Summary of Investigative Findings documenting the further investigation activities was submitted to EGLE in October 2019 and is summarized below.

Based on the results from the initial sampling event (E1), further investigation activities were conducted for Building 881 and documented in the Summary of Investigative Findings (October 2019). The goals for the building-specific investigation for Building 881 were to gain an understanding of potential sources and distribution of TCE concentrations. Appendix C presents the October 2019 Summary of Further Investigation Findings report.

On May 8^{th}, baseline samples were collected at the previous indoor air and sub-slab soil gas locations and all breathing zone samples were below 0.1 ppbv (0.54 $\mu g/m^3$) TCE, with the exception of 0.18 ppbv TCE found at location 881-04 in the eastern shop area. Three opened Heavy Duty Flash Free Electrical Solvent aerosol canisters (i.e., degreaser) containing over 90% TCE were identified in the eastern shop. An additional sample was collected at the cabinet that contained two of the opened TCE aerosol degreaser cans (881-04CANS) with a result of 13.36 ppbv TCE.

On July 9^{th}, follow-up baseline samples were collected at the same sampling locations as the May investigation and again, all breathing zone samples collected during this second baseline sampling were below 0.1 ppbv TCE, with the exception of the 881-04 location at 0.21 ppbv TCE. Open TCE degreaser cans were found again in cabinets in the eastern shop. A sample was collected at the cabinet containing one of the open TCE degreaser cans near the original 881-04CANS location (0.84 ppbv).

During both investigations, potential preferential pathways were investigated again with a PID, and no significant VOC concentrations were detected. A very apparent concentration gradient originated from the cabinet storing open TCE aerosol degreaser cans in Building 881. It was determined the source of elevated TCE concentrations at Building 881 is due to active workplace chemical use and storage of TCE aerosol degreaser cans and not attributable to VI.

EVALUATION OF SEASONAL CONFIRMATION SAMPLING EVENTS

Four seasonal sampling events have been completed at Building 881. The sampling events encompass more than one year of time and include sampling during each season of the year. The results from the four seasonal confirmation sampling events were evaluated with respect to spatial variability, temporal variability, and seasonal trend analysis.

Building specific attenuation factors (α) were calculated and compared between events to evaluate temporal variability and determine the best estimate of a building-specific attenuation factor. This evaluation serves to confirm that the existing study design is appropriate, and also provides insight for the determination of the path forward for this building.

This evaluation focused on any analytes detected in the sub-slab soil gas samples that met the criterion for inclusion in one or more of the following categories:

1) Analytes detected in sub-slab soil-gas at concentrations that exceed screening levels;

2) Analytes detected in sub-slab soil-gas at concentrations of 1,000 µg/m^3 or greater in one or more samples. Data for analytes detected above 1,000 µg/m^3 should provide the clearest signal and be the simplest to interpret when assessing data trends. The same data trends observed for these analytes are expected to apply to other similar analytes present at lower concentrations; and

3) PCE and TCE. These two analytes are of particular interest for many VI evaluations at industrial sites.

For this building, the analytes detected in the sub-slab soil gas at concentrations above the EGLE SSCs were 1,1-DCA, chloroform, and TCE. Four additional analytes had detected concentrations $\geq$1,000 µg/m^3, including: 1,1,1-TCA, acetone, methylene chloride, and PCE. Methylene chloride was excluded due to intermittent detections. 1,1,1-TCA, acetone and PCE were each detected in 100% of the samples; however, acetone was generally detected at lower levels and was excluded. 1,1,1-TCA and PCE were included for this evaluation. Sample results for 1,1-DCA, 1,1,1-TCA, chloroform, PCE, and TCE are provided in the following data tables.

Table 881-4 Summary of Results for 1,1-Dichloroethane

Sample Type	Screening Level (µg/m^3)	Sample ID	Measured Concentration (µg/m^3)			
			Sept. 2018	Apr. 2019	Aug. 2019	Dec. 2019
			E1	E2	E3	E4
Outdoor Air	-	881-OA-01	<0.14	<0.13	<0.13	<0.3
Indoor Air	74 (EGLE SSC) 740 ($TSRIASL_{12}$)	881-IA-01	0.2	<0.13	0.36	0.44
		881-IA-02	<0.14	<0.13	<0.13	0.19
		881-IA-03	<0.14	<0.14	<0.13	0.15
		881-IA-04	<0.13	<0.13	<0.13	<0.14
Sub-Slab Soil Gas	2,500 (EGLE SSC) 25,000 ($TSRIASL_{12}$)	881-SS-01	52	63	10	8.5
		881-SS-02	4.5	<2.9	3.6	3.8
		881-SS-03	**110,000**	1,500	5,300	1,200
		881-SS-04	150	24	17	4

-	not applicable
	$RIASL_{12}$ Exceedance
BOLD	$TSRIASL_{12}$ Exceedance

Table 881-5 Summary of Results for Chloroform

Sample Type	Screening Level (µg/m³)	Sample ID	Measured Concentration (µg/m³)			
			Sept. 2018	Apr. 2019	Aug. 2019	Dec. 2019
			E1	E2	E3	E4
Outdoor Air	-	881-OA-01	<0.16	<0.15	<0.16	<0.37
Indoor Air	5.2 (EGLE SSC) 52 (TSRIASL12)	881-IA-01	0.94	0.32	3	1.5
		881-IA-02	2.1	0.22	0.67	0.37
		881-IA-03	1.1	0.21	0.74	0.38
		881-IA-04	1.1	<0.16	0.68	0.36
Sub-Slab Soil Gas	170 (EGLE SSC) 1,700 (TSRIASL12)	881-SS-01	350	340	54	23
		881-SS-02	23	8.2	27	28
		881-SS-03	310	22	30	8.1
		881-SS-04	**620**	89	64	10

-	not applicable
	RIASL12 Exceedance
BOLD	TSRIASL12 Exceedance

Table 881-6 Summary of Results for 1,1,1-Trichloroethane

Sample Type	Screening Level (µg/m³)	Sample ID	Measured Concentration (µg/m³)			
			Sept. 2018	Apr. 2019	Aug. 2019	Dec. 2019
			E1	E2	E3	E4
Outdoor Air	-	881-OA-01	<0.18	<0.17	<0.18	<0.41
Indoor Air	7,000 (EGLE SSC) 7,000 (TSRIASL12)	881-IA-01	0.34	<0.17	0.31	0.42
		881-IA-02	<0.18	<0.18	<0.18	<0.18
		881-IA-03	<0.18	<0.19	<0.18	<0.19
		881-IA-04	<0.18	<0.18	<0.18	<0.19
Sub-Slab Soil Gas	230,000 (EGLE SSC) 230,000 (TSRIASL12)	881-SS-01	89	120	16	15
		881-SS-02	12	7	27	48
		881-SS-03	24000	330	840	220
		881-SS-04	920	220	100	16

-	not applicable
	RIASL12 Exceedance
BOLD	TSRIASL12 Exceedance

Table 881-7 Summary of Results for Trichloroethene (TCE)

Sample Type	Screening Level (µg/m³)	Sample ID	Measured Concentration (µg/m³)			
			Sept. 2018	Apr. 2019	Aug. 2019	Dec. 2019
			E1	E2	E3	E4
Outdoor Air	-	881-OA-01	<0.18	<0.17	<0.18	<0.4
Indoor Air	4 (RIASL12) 12 (TSRIASL12)	881-IA-01	0.7	0.33	1.6	0.91
		881-IA-02	4.3	0.21	0.65	1.1
		881-IA-03	4.2	0.2	0.63	0.98
		881-IA-04	10	1.2	1.6	3.6
Sub-Slab Soil Gas	130 (RIASL12) 400 (TSRIASL12)	881-SS-01	380	210	50	21
		881-SS-02	43	<3.9	<4.6	<4.3
		881-SS-03	210	<6.7	<22	6.1
		881-SS-04	**430**	130	65	18

-	not applicable
	RIASL12 Exceedance
BOLD	TSRIASL12 Exceedance

Table 881-8 Summary of Results for Tetrachloroethene (PCE)

Sample Type	Screening Level (µg/m³)	Sample ID	Measured Concentration (µg/m³)			
			Sept. 2018	Apr. 2019	Aug. 2019	Dec. 2019
			E1	E2	E3	E4
Outdoor Air	-	881-OA-01	<0.23	<0.21	<0.22	<0.51
Indoor Air	4 (EGLE SSC) 12 (TSRIASL12)	881-IA-01	1.6	0.21	9.2	3.6
		881-IA-02	<0.23	<0.22	1.6	0.31
		881-IA-03	<0.23	<0.23	1.6	0.42
		881-IA-04	<0.22	<0.22	1.6	0.36
Sub-Slab Soil Gas	130 (EGLE SSC) 400 (TSRIASL12)	881-SS-01	1600	820	300	140
		881-SS-02	16	7.1	24	56
		881-SS-03	1200	22	110	38
		881-SS-04	1800	750	450	88

-	not applicable
	RIASL12 Exceedance
BOLD	TSRIASL12 Exceedance

EVALUATION OF VI DATA TRENDS

Data trends for Building 881 are discussed below for both sub-slab soil gas and indoor air. When data exhibit a narrow range of variability, it is typical practice to express the range as a percentage (e.g., relative percent difference [RPD]). When data exhibit a large range of variability, however, it is more useful to express the range in orders of magnitude (i.e., factors of 10). This can be expressed mathematically as the log of the ratio of maximum/minimum values. If the values differ by a factor of 10, the log of the ratio is 1, if the values differ by a factor of 100, the log of the ratio is 2, and so on.

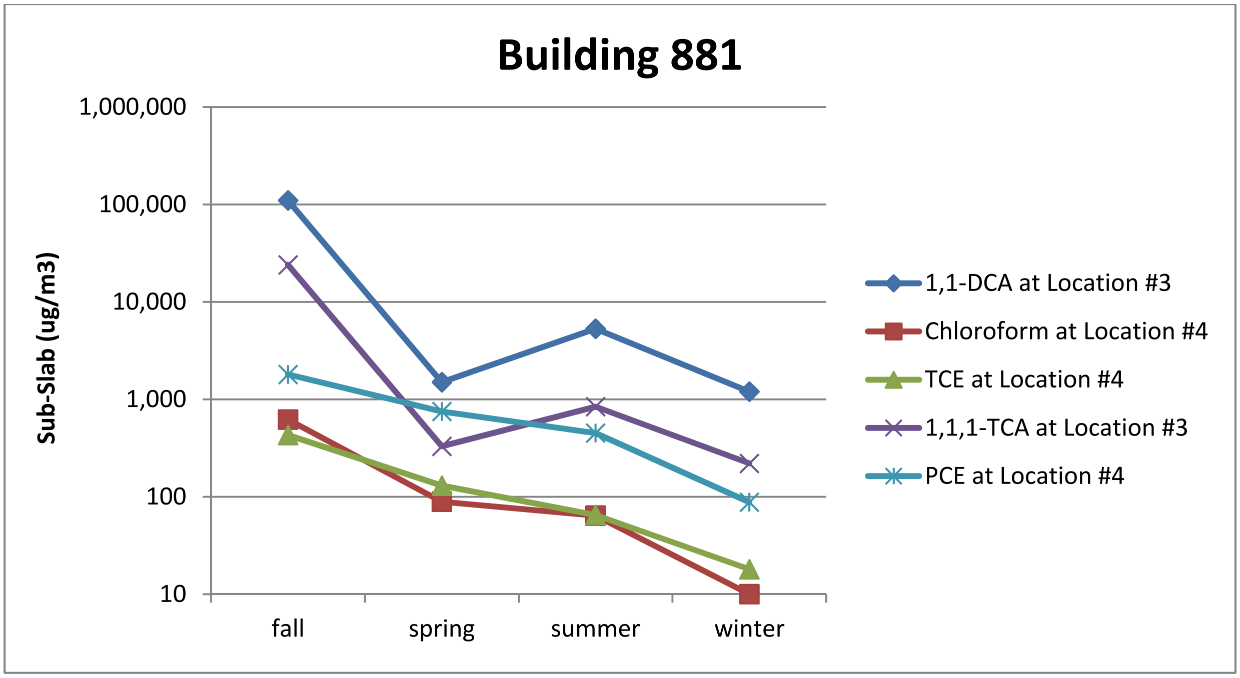
The variability across all locations over all sampling events is the total variability. This encompasses different types of variability, including spatial variability (i.e., how do the results vary from location to location), temporal variability (i.e., how do the results at a given location vary over time), and measurement variability. Measurement variability can be determined by evaluating results of duplicate or collocated samples and includes both sampling variability and analytical variability.

Sub-Slab Soil Gas Data Trends

Spatial Variability of Sub-Slab Soil Gas – The soil gas exhibits up to four orders of magnitude of spatial variability. For example, sub-slab soil gas detections of 1,1-DCE vary from 4.5 to 110,000 $\mu g/m^3$ (log of max./min. = 4.4) across all four locations for E1. Sub-slab soil gas detections of chloroform vary from 23 to 620 $\mu g/m^3$ (log of max./min. = 1.4) across all four locations for E1. TCE had the least amount of special variability, as it's highest variability was during E1 when concentrations ranged from 43 to 430 $\mu g/m^3$ (log of max./min. = 1.0).

Temporal Variability of Soil Gas – The soil gas concentrations exhibit up to two orders of magnitude of temporal variability. For 1,1-DCE, sub-slab soil gas concentrations of vary from 1,200 to 110,000 $\mu g/m^3$ at location 881-SS-03 (log max/min = 2.0). Chloroform at location 881-SS-04 varies from 10 to 620 $\mu g/m^3$ (log max/min = 1.8). For TCE, sub-slab soil gas detected concentrations vary from 18 to 430 $\mu g/m^3$ at location 881-SS-04 (log max/min = 1.4). Temporal variability for 1,1,1-TCA and PCE is similar to the other analytes evaluated. Overall, temporal variability is less than spatial variability, which is in line with expectations.

Seasonal Confirmation Sampling Trend Analysis – No formal statistical tests were performed, but the data exhibits relatively consistent results between the seasons. This is demonstrated by the graph below, which shows the five analytes selected above at locations where they were detected at relatively high concentrations. Note that the y-axis is a log scale.



The data set was examined to see what the potential consequences would have been had only a single sampling event been performed. For all five analytes evaluated, the highest sub-slab soil gas concentrations were collected during the fall (E1) and the lowest concentrations occurred during the winter (E4). Overall, the minimum and maximum values appear to be consistent between sampling events.

Since the analytes had the highest results occur during E1, there was no negative bias introduced by results from other seasonal sampling events. Therefore, implementing four seasonal confirmation sampling events provided only limited insight regarding maximum concentration levels, but the larger data set served to increase the confidence in the findings.

Indoor Air Data Trends

Spatial Variability of Indoor Air – The indoor air exhibit up to one order of magnitude of spatial variability. For chloroform during E3, indoor air concentrations vary from 0.67 to 3 $\mu g/m^3$ (log max./min. = 0.65). The other events saw much less variability. For TCE, the highest spatial variability occurred during E1 where indoor air concentrations vary from 0.7 to 10 $\mu g/m^3$ (log max./min. = 1.2). The other events saw much less variability. 1,1-DCE, 1,1,1-TCA and PCE have very low detection frequencies in indoor air so they cannot be evaluated. The data suggests the air within the building is well-mixed.

Temporal Variability of Indoor Air – The indoor air exhibits less than two orders of magnitude of temporal variability. For example, indoor air concentrations of 1,1-DCE at location 881-IA-01 varied from 0.2 to 0.44 $\mu g/m^3$ (log of max./min. = 0.34). For chloroform at location 881-IA-01, concentrations varied from 0.32 to 3 $\mu g/m^3$ (log max./min. = 0.97). For TCE at location 881-IA-04, concentrations varied from 1.2 to 10 $\mu g/m^3$ (log max./min. = 0.92). Variability for TCE was 1.3 for both sample locations 881-IA-02 and -03. Overall, temporal variability across the four seasons sampled is relatively small.

Additional Analyses

Comparison of Sub-Slab Soil Gas and Indoor Air Data Sets – As expected, the sub-slab soil gas data exhibit greater spatial variability than the indoor air data set. However, sub-slab soil gas only had somewhat more temporal variability than indoor air, which suggests that any indoor air emissions of the AOIs do not vary greatly over time if they are in regular use in the building.

Seasonal Effects – The sub-slab soil gas data exhibit some variability from event to event. Maximum sub-slab soil gas results for each of the five analytes evaluated occurred in E1 (fall). The highest indoor air concentrations varied between the seasons for different analytes. The data does not support the hypothesis that wintertime should have the highest indoor air impacts.

Comparison of Attenuation Factors by Event – Attenuation factors were calculated for 1,1-DCE based on maximum values. The indoor air maximum concentration was corrected for contribution of outdoor air to indoor air (e.g., outdoor air detected concentration was subtracted from indoor air concentration). The calculated event-specific attenuation factors are shown in Table 881-9.

Table 881-9. Comparison of Building-Specific Attenuation Factors for 1,1-DCE by Event

	E1 (Fall)	E2 (Winter)	E3 (Spring)	E4 (Summer)
Maximum Values				
1,1-DCE in Sub-Slab Soil Gas ($\mu g/m^3$)	110,000	1,500	5,300	1,200
1,1-DCE in Outdoor Air ($\mu g/m^3$)	<0.14	<0.13	<0.13	<0.3
1,1-DCE in Indoor Air ($\mu g/m^3$)	0.2	<0.14	0.36	0.44
1,1-DCE in Indoor Air ($\mu g/m^3$) Corrected for Outdoor Air Contribution	0.2	0.14	0.36	0.44
Attenuation Factor	1.8E-06	9.3E-05	6.8E-05	**3.7E-04**

These serve as the best estimates of attenuation at this building. The results can vary from day to day due to differences in rates of vapor intrusion and rates of building ventilation. Overall, the most conservative estimate of a building-specific attenuation factor for Building 881 is 3.7E-04 based on 1,1-DCE during E4.

Temporal Variability in Attenuation Factor – As shown in Table 881-9, there was about two orders of magnitude of temporal variability in the calculated attenuation factors observed for 1,1-DCE between the four sampling events. To be as conservative as possible, the maximum values were used in calculating the attenuation factor for each event. The sampling location with the maximum value per event varied. In general, the low spatial variability in indoor air results means that roughly comparable attenuation factors would be obtained whichever indoor air value was used in the calculations.

NON-DETECT EVALUATION

Table 881-10 below lists the analytes in sub-slab soil gas that have ND RLs greater than the screening levels. The table also includes the indoor air results for each of the analytes. If a sub-slab soil gas analyte has ND RL exceedances, but all results and ND RLs in indoor air are below the screening levels, no further evaluation is warranted. If an analyte was identified as an AOI in sub-slab soil gas (detected results > screening level), it is excluded from the ND evaluation. Also, if an ND analyte has an 0% detection frequency for all sampling events and all ND RLs met the screening level during at least one event, no further ND evaluation is warranted.

Table 881-10. Non-Detect Evaluation for Building 881

Soil Gas Analytes with ND RL > SL	Indoor Air Result Summary
1,1,2,2-Tetrachloroethane	0% Detection Frequency, All ND RLs < EGLE SSC
1,1,2-Trichloroethane	0% Detection Frequency, All ND RLs < EGLE SSC
1,2,4-Trichlorobenzene	0% Detection Frequency, Half of ND RLs < EGLE SSC
1,2-Dibromoethane (EDB)	0% Detection Frequency, E3 & E4 ND RLs < EGLE SSC
alpha-Chlorotoluene	0% Detection Frequency, All ND RLs < EGLE SSC
Dibromochloromethane	0% Detection Frequency, All ND RLs < EGLE SSC
Dibromomethane	0% Detection Frequency, All ND RLs < EGLE SSC
Hexachlorobutadiene (HCBD)	0% Detection Frequency, E3 & E4 ND RLs < EGLE SSC
Naphthalene	0% Detection Frequency, All ND RLs < EGLE SSC

WEIGHT-OF-EVIDENCE SUMMARY

Building 881 was confirmed as a VI Path Forward Group 4A building due to its potential for VI based on sub-slab soil gas exceedances of the EGLE SSC for 1,1-DCE, chloroform, and TCE. However, after further investigation and evaluation, the following evidence supports the conclusion that VI is insignificant at Building 881:

- No exceedances of EGLE SSCs in indoor air with the exception of TCE, which was due to active workplace chemical use and storage of TCE aerosol degreaser cans and not attributable to VI.

- The sub-slab soil gas results have demonstrated decreasing concentrations with no evidence of increasing over time.

- The data do not support the hypothesis that wintertime should have the highest indoor air impacts. The highest sub-slab soil gas concentrations generally were measured in the fall. The highest indoor air concentrations varied between the seasons for different analytes.

- Sub-slab soil gas only had somewhat more temporal variability than indoor air, which suggests that any indoor air emissions of the AOIs do not vary greatly over time if they are in regular use in the building.

Based on the CSM for Building 881, VI is an insignificant exposure pathway for current building utilization.

PATH FORWARD

Based on the evaluation of the four seasonal confirmation sampling events and the results of the further investigation, the VI pathway continues to be insignificant for Building 881, based on current use. However, based on the sub-slab soil gas results and given the potential for future VI, Building 881 has been placed in VI Path Forward Building Group 4A, as lines of evidence indicate that VI is insignificant and the presence and use of degreasers in Building 881 indicate active workplace chemical use. Weight of evidence based on seasonal confirmation sampling, as documented in email notifications provided to EGLE throughout 2019, supports Building 881 as a Group 4A building, which is defined as: Building seasonal confirmation sample results demonstrate a lack of correlated sub-slab soil gas and indoor air exceedances (EGLE SSC and/or TSRIASL$_{12}$) and other lines of evidence indicate VI is insignificant and IA exceedances are likely due to work place chemical use. The sub-slab soil gas results have demonstrated decreasing concentrations with no evidence of increasing over time.

Sufficient information exists to make a human exposure under control EI determination. However, while currently there is no evidence of potential VI, for future use, LTM is warranted and the building-specific Interim Monitoring Plan is discussed below.

Building-specific Interim Monitoring Plan

Dow presented an interim monitoring plan for Building 881 during the April 2020 Corrective Action status meeting. Dow will implement the interim monitoring plan at Building 887 until a revised program or more permanent corrective action plan is developed for the site.

Indoor air will be monitored at location 881-IA-01. This location was selected for continued monitoring since it demonstrated the highest sub-slab soil gas results. Monitoring will be performed for 1,1-DCA, chloroform and TCE. An outdoor air sample will also be collected at the time of each monitoring event. Interim monitoring will be performed semi-annually for a minimum of two years and monitoring results will undergo trend analysis. Monitoring will begin winter 2020/2021. If results continue to be consistent and below screening levels, monitoring will be conducted on an annual basis. If indoor air results are observed to be increasing, further evaluation will be performed, which may include collection of a sub-slab soil gas sample(s) and an increase in monitoring frequency. Results from each monitoring event will be reported in the annual CAIP. In the event an indoor air result(s) exceeds screening levels, EGLE will be provided a brief email notification. A collocated indoor air and sub-slab soil gas sample will be collected from that location within 45 days. If both sub-slab soil gas and indoor air results indicate that VI continues to be insignificant, monitoring will continue at an appropriate frequency. If both sub-slab soil gas and indoor air results indicate that VI is significant and confirm Group 4 conditions, the building will be moved to Group 4 for follow-up actions.

Dow may propose changes to the frequency or other aspects of this interim monitoring plan in the future based on an evaluation of the data, changes in building use or implementation of other corrective actions to address the potential VI pathway.

5.5.6 VI Seasonal Confirmation Sampling Results Evaluation for Building 1037

INTRODUCTION

Building 1037 is a Category 2 building in Zone 3 Phase 1, located in the southwestern quadrant of the Midland facility (Figure 5.5.6-1). Building 1037 contains a control room with a kitchen, but otherwise the remainder of the structure is predominantly warehouse or process space, with some of the process space being located outdoors. A structure has existed on this plot since pre-1938 per aerial photographs. The present structure, with a footprint of 19,396.65 ft^2 was constructed in the 1970s. The 2018 CAIP concluded that the VI pathway at Building 1037 was an insignificant exposure pathway based on current use. However, based on the sub-slab soil gas results and given the potential for future VI, Building 1037 was placed in VI Path Forward Building Group 2. Group 2 is a designation for buildings that have sub-slab soil gas AOI(s), but all indoor air results are less than screening levels. Any building placed in Group 2 is scheduled for seasonal confirmation sampling.

The results of the initial sampling event (E1) were evaluated in the 2018 CAIP. The 2019 CAIP evaluated three seasonal sampling events (through E3). The remaining seasonal event (E4) has been completed (see Table 1037-1) and the results of all four sampling events are included and evaluated herein. 1,2,4-Trichlorobenzene (1,2,4-TCB), 1,4-Dichlorobenzene (1,4-DCB), and benzene were detected above the EGLE SSC in sub-slab soil gas. All indoor air results were less than the EGLE SSC.

Table 1037-1. Summary of Seasonal Confirmation Sampling Events for Building 1037

Building 1037	
Initial Sampling Event	**Completed**
E1	September 2018 (Fall)
Seasonal Sampling Event	**Completed**
E2	April 2019 (Spring)
E3	August 2019 (Summer)
E4	December 2019 (Winter)

Based on the evaluation of the four seasonal confirmation sampling events the VI pathway continues to be insignificant. Sufficient information exists to make a human exposure under control EI determination.

SUB-SLAB SOIL GAS RESULTS EVALUATION

Sub-slab soil gas samples were collected from nine locations from within the building. Indoor air samples were collected at nine locations corresponding to the soil gas sample locations, along with an outdoor air sample from the main air intake. The sampling locations are shown on Figure 5.5.6-2. Summary statistics and screening comparison results are presented for sub-slab soil gas on Table 5.5.6-1 and indoor and outdoor air on Table 5.5.6-2. The analytical data is presented in Appendix A. Field sampling forms are provided in Appendix B. Table 1037-2 presents the sub-slab soil gas results that exceed the EGLE SSCs.

Table 1037-2. Summary of Sub-Slab Soil Gas Exceedances for Building 1037

Analyte (Sampling Event)	Detection Frequency	Measured Range of Detects (μg/m^3)	% Detections > EGLE SSC (μg/m^3)	EGLE SSC (μg/m^3)
1,2,4-Trichlorobenzene (1)	11%	28,000	11%	200
1,2,4-Trichlorobenzene (2)	11%	3,100	11%	200
1,2,4-Trichlorobenzene (3)	0%	ND	0%	200
1,2,4-Trichlorobenzene (4)	0%	ND	0%	200
1,4-Dichlorobenzene (1)	100%	16 - 3,300	22%	1,000
1,4-Dichlorobenzene (2)	78%	5.9 - 1,800	11%	1,000
1,4-Dichlorobenzene (3)	78%	12 - 7,500	11%	1,000
1,4-Dichlorobenzene (4)	67%	6.6 - 160	0%	1,000
Benzene (1)	100%	28 - 31,000	67%	510
Benzene (2)	100%	12 - 30,000	56%	510
Benzene (3)	89%	12 - 30,000	56%	510
Benzene (4)	100%	2.9 – 8,600	22%	510

Table 1037-3 summarizes the indoor air results relative to the sub-slab soil gas exceedances, since VI only potentially occurs if the analyte is present in both sub-slab soil gas and indoor air. Therefore, the table below provides the analyte detected above applicable screening levels in sub-slab soil gas as well as the corresponding indoor air sample result. The outdoor air sample result is also provided to determine if the analytes were present in indoor air due to migration from outdoor air.

Table 1037-3. Vapor Intrusion Evaluation for Building 1037

Analyte (Sampling Event)	Indoor Air Detection Frequency	Indoor Air Measured Range (μg/m^3)	Indoor Air EGLE SSC (μg/m^3)	Outdoor Air Result (μg/m^3)
1,2,4-Trichlorobenzene (1)	0%	ND	6.2	ND
1,2,4-Trichlorobenzene (2)	0%	ND	6.2	ND
1,2,4-Trichlorobenzene (3)	0%	ND	6.2	ND
1,2,4-Trichlorobenzene (4)	0%	ND	6.2	ND

Analyte (Sampling Event)	Indoor Air Detection Frequency	Indoor Air Measured Range ($\mu g/m^3$)	Indoor Air EGLE SSC ($\mu g/m^3$)	Outdoor Air Result ($\mu g/m^3$)
1,4-Dichlorobenzene (1)	22%	0.19 - 0.2	30	ND
1,4-Dichlorobenzene (2)	100%	0.28 - 1	30	ND
1,4-Dichlorobenzene (3)	100%	0.47 - 1.6	30	ND
1,4-Dichlorobenzene (4)	100%	1.6 – 4.3	30	0.35
Benzene (1)	100%	1.7 - 6.5	15.4	2.7
Benzene (2)	100%	0.82 - 1.8	15.4	0.72
Benzene (3)	100%	1.5 - 8.5	15.4	1.2
Benzene (4)	100%	2.3 – 5.5	15.4	2.1

In sub-slab soil gas, 1,2,4-TCB was detected above the EGLE SSC in one sample in both E1 and E2; however, 1,2,4-TCB was never detected in indoor air. 1,4-DCB was detected at a concentration greater than the EGLE SSC in a total of four sub-slab samples across E1, E2 and E3. While it was also detected consistently in indoor air, all results were less than the EGLE SSC. Benzene was detected in sub-slab soil gas at concentrations greater than the EGLE SSC in each of the four seasonal confirmation sampling events. It was detected in all indoor air samples, but at concentrations less than the EGLE SSC. Benzene was also detected in all four outdoor air samples at concentrations that demonstrate that outdoor air may contribute to the detected indoor air concentrations.

VAPOR INTRUSION CONCEPTUAL SITE MODEL

VI is an exposure pathway that results from the migration of volatilized chemicals from the subsurface to indoor air in overlying occupied buildings. A source, migration route and a human receptor must be present for the VI pathway to be complete. The focus of this building specific investigation is to evaluate the potential VI exposure pathway for employees and contractors at Building 1037. The CSM is illustrated in Figure 5.5.6-3.

Building 1037 contains a control room with a kitchen, but otherwise the remainder of the structure is predominantly warehouse or process space, with some of the process space being located outdoors. A structure has existed on this plot since pre-1938 per aerial photographs. The present structure, with a footprint of 19,396.65 ft^2 was constructed in the 1970s. The structure is slab-on-grade construction (with the grade having been built up approximately 3 ft above natural ground surface), with no basement or elevator. The floor in the building is predominantly painted concrete. The building is predominantly one-story with the exception of a small area located on the western side of the building; however, the ceiling heights throughout the majority of the structure are comparable to the height of a two-story structure.

The building has seven bay doors, many of which are open more frequently during warmer months and are open during colder months only for loading trucks and moving materials and equipment in and out of the building. The control room area located in the western portion of the building has a central AC unit, and another unit is located on the northern side of the building. The entire structure is heated via steam radiation. The building has two intakes: one is located near the southwestern corner and the other is located on the northern side of the building. There are also two large vents located on the south and east sides of the building. The surrounding ground cover outside of the building is predominantly concrete or asphalt with some gravel areas located to the south. Propane-fueled fork trucks are used in the building and occupants use a washer/dryer on site.

Approximately 10-15 occupants work in Building 1037, on 8-hour shifts Monday through Friday. The typical parameters for non-residential exposures are assumed to apply but likely overestimate exposure for the personnel stationed at this building (i.e., 40 hours/week, 50 weeks/year exposure).

A building survey was completed before the initial sampling event. Drains and other openings were screened with a PID and no soil gas entry points were identified. The chemical inventory performed during the building survey identified various potential indoor emission sources, including soap, cleaners, air freshener, various epoxy resins, and a fluorosurfactant.

EVALUATION OF SEASONAL CONFIRMATION SAMPLING EVENTS

Four seasonal sampling events have been completed at Building 1037. The sampling events encompass more than one year of time and include sampling during each season of the year. The results from the four seasonal confirmation sampling events were evaluated with respect to spatial variability, temporal variability, and seasonal trend analysis.

Building specific attenuation factors (α) were calculated and compared between events to evaluate temporal variability and determine the best estimate of a building-specific attenuation factor. This evaluation serves to confirm that the existing study design is appropriate, and also provides insight for the determination of the path forward for this building.

This evaluation focused on any analytes detected in the sub-slab soil gas samples that met the criterion for inclusion in one or more of the following categories:

1) Analytes detected in sub-slab soil-gas at concentrations that exceeded EGLE SSCs;

2) Analytes detected in sub-slab soil-gas at concentrations of 1,000 µg/m^3 or greater in one or more samples. Data for analytes detected above 1,000 µg/m^3 should provide the clearest signal and be the simplest to interpret when assessing data trends. The same data trends observed for these analytes are expected to apply to other similar analytes present at lower concentrations; and

3) PCE and TCE. These two analytes are of particular interest for many VI evaluations at industrial sites.

For this building, the only analytes detected in the sub-slab soil gas at concentrations above the EGLE SSC were 1,2,4-TCB, 1,4-DCB and benzene. 1,2,4-TCB was only detected twice in sub-slab soil gas and had a 0% detection frequency in indoor air so a trend evaluation could not be evaluated; however, because the two detected sub-slab soil gas results exceeded the EGLE SSC the results are provided below and evaluated where possible. Five additional analytes had detected concentrations ≥1,000 µg/m^3, 4-methyl-2-pentanone, acetone, chlorobenzene, ethylbenzene, and total xylenes; however, due to minimal detections throughout sampling, 4-methyl-2-pentanone, acetone, and chlorobenzene were excluded from additional evaluation, as were PCE and TCE. PCE was detected but sub-slab concentrations were low and well below 1,000 µg/m^3. TCE was ND in sub-slab soil gas throughout the four sampling events. Sample results for 1,2,4-TCB, 1,4-DCB, benzene, ethylbenzene and total xylenes are included in this evaluation and provided below in the following data tables.

Table 1037-4 Summary of Results for 1,2,4-Trichlorobenzene

Sample Type	Screening Level (µg/m³)	Sample ID	Measured Concentration (µg/m³)			
			Sept. 2018	Apr. 2019	Aug. 2019	Dec. 2019
			E1	E2	E3	E4
Outdoor Air	-	1037-OA-01	<5.6 <5.9	<6.2	<6.3	<6.5
Indoor Air	6.2 (EGLE SSC) 19 ($TSRIASL_{12}$)	1037-IA-01	<6.1	<6.7	<6.9	<6.3
		1037-IA-02	<6	<5.4	<6.6	<6.9
		1037-IA-03	<6.1	<6.1	<6.8	<6.5
		1037-IA-04	<5.6	<6.2	<7.4	<6.9
		1037-IA-05	<6.2	<6	<6.6	<6.9
		1037-IA-06	<5.8	<6.1	<6.8	<7.3
		1037-IA-07	<5.4	<5.8	<6.3	<6.7
		1037-IA-08	<5.9	<6.2	<6.6	<6.7
		1037-IA-09	<5.9	<5.9	<6.3	<6.3
Sub-Slab Soil Gas	200 (EGLE SSC) 610 ($TSRIASL_{12}$)	1037-SS-01	<23	<22	<24	<24
		1037-SS-02	<23	<22	<24	<30
		1037-SS-03	<110	<25	<24	<25
		1037-SS-04	<240	<250	<220	<24
		1037-SS-05	<220	<23	<340	<25
		1037-SS-06	<230	**3,100**	<24	<25
		1037-SS-07	<240	<67	<500	<24
		1037-SS-08	<220	<190	<460	<61
		1037-SS-09	**28,000**	<230	<160	<320

-	not applicable
	EGLE SSC Exceedance
BOLD	$TSRIASL_{12}$ Exceedance

Table 1037-5 Summary of Results for 1,4-Dichlorobenzene

Sample Type	Screening Level (µg/m³)	Sample ID	Measured Concentration (µg/m³)			
			Sept. 2018	Apr. 2019	Aug. 2019	Dec. 2019
			E1	E2	E3	E4
Outdoor Air	-	1037-OA-01	<0.18 <0.19	<0.2	<0.2	0.35
Indoor Air	30 (EGLE SSC) 300 (TSRIASL12)	1037-IA-01	<0.2	0.28	0.57	1.6
		1037-IA-02	<0.19	0.68	1.6	4.3
		1037-IA-03	<0.2	0.7	0.99	3.6
		1037-IA-04	<0.18	0.69	0.7	3.5
		1037-IA-05	<0.2	0.91	1.1	3.8
		1037-IA-06	<0.19	0.82	0.53	3
		1037-IA-07	<0.18	0.82	0.51	2.2
		1037-IA-08	0.2	0.87	0.54	2.2
		1037-IA-09	0.19	1	0.47	2.3
Sub-Slab Soil Gas	1,000 (EGLE SSC) 10,000 (TSRIASL12)	1037-SS-01	16	14	<4.9	<4.9
		1037-SS-02	18	<4.6	15	7
		1037-SS-03	210	140	180	140
		1037-SS-04	3,300	1,800	7,500	140
		1037-SS-05	230	5.9	880	50
		1037-SS-06	300	180	12	6.6
		1037-SS-07	450	270	310	160
		1037-SS-08	440	290	160	<12
		1037-SS-09	1,100	<48	<33	<66

-	not applicable
	EGLE SSC Exceedance
BOLD	TSRIASL12 Exceedance

Table 1037-6 Summary of Results for Benzene

Sample Type	Screening Level (µg/m³)	Sample ID	Measured Concentration (µg/m³)			
			Sept. 2018	Apr. 2019	Aug. 2019	Dec. 2019
			E1	E2	E3	E4
Outdoor Air	-	1037-OA-01	2 2.7	0.72	1.2	2.1
Indoor Air	15.4 (EGLE SSC) 54 ($TSRIASL_{12}$)	1037-IA-01	4.6	0.82	1.5	2.3
		1037-IA-02	3.9	1	7.4	3.6
		1037-IA-03	1.7	1.1	8	3.7
		1037-IA-04	3.2	1.1	8.3	4.5
		1037-IA-05	4.5	1.2	8.4	5.5
		1037-IA-06	3.4	1.2	7.8	5
		1037-IA-07	4.6	1.3	8.1	4.4
		1037-IA-08	6.5	1.4	8.5	4.3
		1037-IA-09	6.2	1.8	8.4	4.3
Sub-Slab Soil Gas	510 (EGLE SSC) 1,800 ($TSRIASL_{12}$)	1037-SS-01	50	48	<2.6	2.9
		1037-SS-02	28	12	14	8
		1037-SS-03	140	32	24	9.4
		1037-SS-04	**5,500**	**30,000**	**30,000**	360
		1037-SS-05	**6,600**	610	**2,200**	94
		1037-SS-06	**31,000**	370	12	9
		1037-SS-07	**27,000**	**1,600**	**13,000**	59
		1037-SS-08	**14,000**	**4,800**	**14,000**	**1,600**
		1037-SS-09	**4,300**	**5,600**	**4,000**	8,600

-	not applicable
(shaded)	EGLE SSC Exceedance
BOLD	$TSRIASL_{12}$ Exceedance

Table 1037-7 Summary of Results for Ethylbenzene

Sample Type	Screening Level (µg/m³)	Sample ID	Measured Concentration (µg/m³)			
			Sept. 2018	Apr. 2019	Aug. 2019	Dec. 2019
			E1	E2	E3	E4
Outdoor Air	-	1037-OA-01	<0.13 0.54	<0.14	<0.15	0.2
Indoor Air	48 (EGLE SSC) 480 ($TSRIASL_{12}$)	1037-IA-01	0.83	0.17	<0.16	0.22
		1037-IA-02	0.94	0.6	0.26	0.44
		1037-IA-03	1	1	0	0
		1037-IA-04	2	1	0	1
		1037-IA-05	2.8	0.8	0.21	0.63
		1037-IA-06	0.63	0.85	0.32	0.64
		1037-IA-07	1	1	0	1
		1037-IA-08	1	1	1	1
		1037-IA-09	0.5	1.6	0.56	0.61
Sub-Slab Soil Gas	1,600 (EGLE SSC) 16,000 ($TSRIASL_{12}$)	1037-SS-01	6.7	4.3	<3.5	<3.6
		1037-SS-02	99	12	10	8.1
		1037-SS-03	1,200	23	30	23
		1037-SS-04	<34	1,200	<33	110
		1037-SS-05	330	82	<50	1.8
		1037-SS-06	130	32	28	13
		1037-SS-07	42	400	<72	26
		1037-SS-08	65	<28	<67	12
		1037-SS-09	190	<34	<24	77

-	not applicable
	EGLE SSC Exceedance
BOLD	$TSRIASL_{12}$ Exceedance

Table 1037-8 Summary of Results for Total Xylenes

Sample Type	Screening Level (μg/m³)	Sample ID	Measured Concentration (μg/m³)			
			Sept. 2018	Apr. 2019	Aug. 2019	Dec. 2019
			E1	E2	E3	E4
Outdoor Air	-	1037-OA-01	<0.39 2.26	<0.43	<0.45	0.62
Indoor Air	680 (EGLE SSC) 2,000 ($TSRIASL_{12}$)	1037-IA-01	3.58	0.81	0.44	0.92
		1037-IA-02	3.1	3.01	1.73	2.67
		1037-IA-03	3.08	3.28	1.75	2.87
		1037-IA-04	9.3	3.47	1.62	3.79
		1037-IA-05	12	4	1.26	4.17
		1037-IA-06	2.77	4.38	2.21	4.19
		1037-IA-07	2.49	4.29	2.58	4.23
		1037-IA-08	2	4.74	5.24	4.06
		1037-IA-09	2.01	8.6	4.14	4.23
Sub-Slab Soil Gas	22,000 (EGLE SSC) 67,000 ($TSRIASL_{12}$)	1037-SS-01	13.9	14.2	<7	19.1
		1037-SS-02	395	44.1	38.8	28.7
		1037-SS-03	5,400	81	114	75
		1037-SS-04	143	7,700	105	540
		1037-SS-05	1,160	322	<100	11.8
		1037-SS-06	520	101	77	33.9
		1037-SS-07	138	1,300	<144	78
		1037-SS-08	221	28	<134	31.5
		1037-SS-09	750	86	53	276

-	not applicable
	EGLE SSC Exceedance
BOLD	$TSRIASL_{12}$ Exceedance

EVALUATION OF VI DATA TRENDS

Data trends for Building 1037 are discussed below for both sub-slab soil gas and indoor air. When data exhibit a narrow range of variability, it is typical practice to express the range as a percentage (e.g., relative percent difference [RPD]). When data exhibit a large range of variability, however, it is more useful to express the range in orders of magnitude (i.e., factors of 10). This can be expressed mathematically as the log of the ratio of maximum/minimum values. If the values differ by a factor of 10, the log of the ratio is 1, if the values differ by a factor of 100, the log of the ratio is 2, and so on.

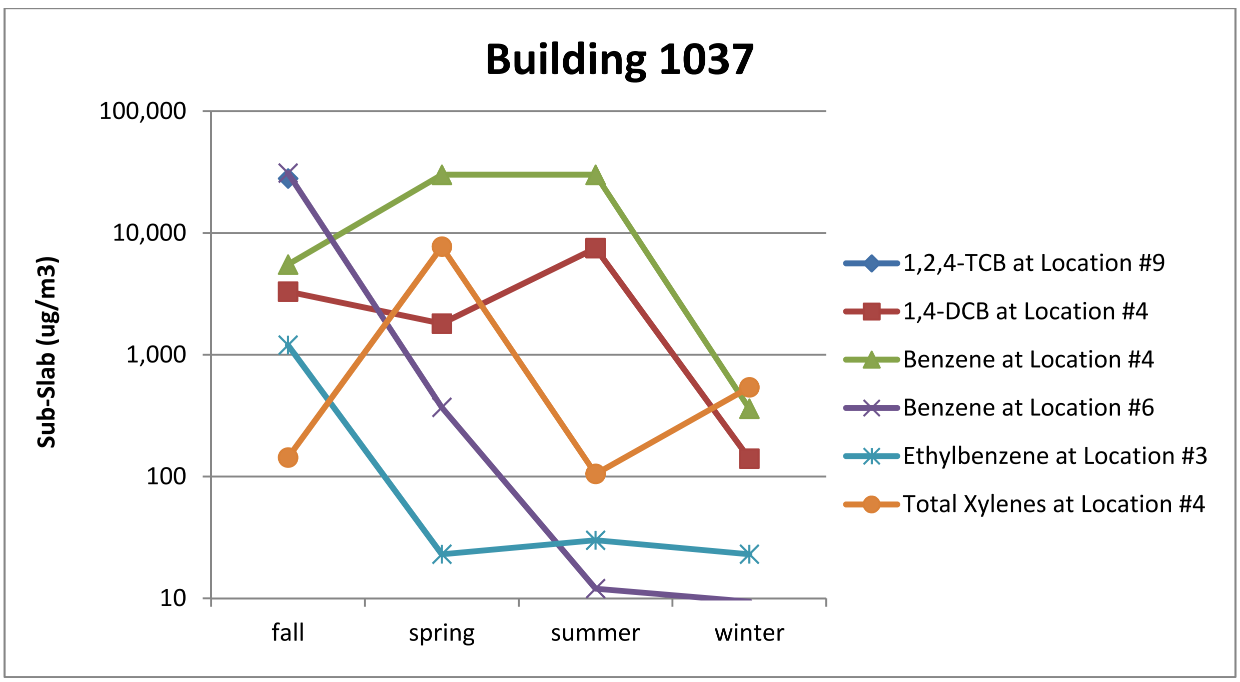
The variability across all locations over all sampling events is the total variability. This encompasses different types of variability, including spatial variability (i.e., how do the results vary from location to location), temporal variability (i.e., how do the results at a given location vary over time), and measurement variability. Measurement variability can be determined by evaluating results of duplicate or collocated samples and includes both sampling variability and analytical variability.

Sub-Slab Soil Gas Data Trends

Spatial Variability of Sub-Slab Soil Gas – The soil gas exhibit less than four orders of magnitude of spatial variability. For example, sub-slab soil gas detections of 1,4-DCB vary from 16 to 3,300 μg/m^3 (log of max./min. = 2.3) across all nine locations for E1. Detections of benzene vary from 28 to 31,000 μg/m^3 (log of max./min. = 3.0) across all nine locations for E1. Detections of ethylbenzene vary from 6.7 to 1,200 μg/m^3 (log of max./min. = 2.3) across all nine locations for E1.

Temporal Variability of Soil Gas – The soil gas concentrations exhibit less than four orders of magnitude of temporal variability. For 1,4-DCB, sub-slab soil gas concentrations of vary from 140 to 7,500 μg/m^3 at location 1037-SS-04 (log max/min = 1.7). Benzene at location 1037-SS-06 varies from 9 to 31,000 μg/m^3 (log max/min = 3.5). Sub-slab soil gas detected concentrations for ethylbenzene vary from 23 to 1,200 μg/m^3 at location 1037-SS-03 (log max/min = 1.7). Overall, temporal variability is similar to spatial variability, which is contrary to expectations.

Seasonal Confirmation Sampling Trend Analysis – No formal statistical tests were performed, but the data exhibits a general decrease in concentration over time . This is demonstrated by the graph below, which shows the five analytes selected above at locations where they were detected at relatively high concentrations. 1,2,4-TCB only had two detected results and the maximum is represented on the graph below during E1. Note that the y-axis is a log scale. Sub-slab results have generally been consistent over time at other buildings at this site, which suggests that the trend observed for Building 1037 is not a seasonal effect. The plotted compounds include various petroleum hydrocarbons and these compounds are amenable to aerobic biodegradation, which may explain the observed trend.



The data set was examined to see what the potential consequences would have been had only a single sampling event been performed. For 1,2,4-TCB, benzene, and ethylbenzene, the highest sub-slab soil gas concentrations were collected during the fall (E1) and the lowest concentrations for benzene and ethylbenzene occurred during the winter (E4). For 1,4-DCB, the highest sub-slab concentration was collected during the summer (E3) and the lowest concentration occurred during the winter (E4). Unlike the others, total xylenes had the highest concentration occur during the spring (E2) and the lowest during the summer (E3). Overall, the minimum and maximum values appear to be consistent between sampling events.

Since the two of the three analytes that exceeded sub-slab soil gas screening levels had the highest results occur during E1, there was no negative bias introduced by results from other seasonal sampling events. For 1,4-DCB at location 1037-SS-04, the value increased from 3,300 ug/m^3 during E1 to 7,500 ug/m^3 during E3. If only the first sampling event had been performed, a negative bias of 127% would have been introduced (i.e., the 1,4-DCB value for E3 was 127% higher than the 1,4-DCB value for E1). Therefore, implementing four seasonal confirmation sampling events provided some insight regarding maximum concentration levels, but the larger data set mostly served to increase the confidence in the findings.

Indoor Air Data Trends

Spatial Variability of Indoor Air – The indoor air exhibit one order of magnitude or less of spatial variability. For 1,4-DCB during E4, indoor air concentrations vary from 1.6 to 4.3 μg/m^3 (log max./min. = 0.43). For benzene, the highest spatial variability occurred during E3 where indoor air concentrations vary from 1.5 to 8.5 μg/m^3 (log max./min. = 0.75). For ethylbenzene, the highest spatial variability occurred during E4 where indoor air concentrations vary from 0.17 to 1.6 μg/m^3 (log max./min. = 0.97). The data suggests the air within the building is well-mixed.

Temporal Variability of Indoor Air – The indoor air has, at most, one order of magnitude of temporal variability. For example, indoor air concentrations of 1,4-DCB at location 1037-IA-09 varied from 0.19 to 2.3 μg/m^3 (log of max./min. = 1.1). For benzene at location 1037-IA-08, concentrations varied from 1.4 to 8.5 μg/m^3 (log max./min. = 0.78). For ethylbenzene the highest temporal variability occurred at location 1037-IA-05, concentrations varied from 0.21 to 2.8 μg/m^3 (log max./min. = 1.1). Overall, temporal variability across the four seasons sampled is relatively small.

Additional Analyses

Comparison of Sub-Slab Soil Gas and Indoor Air Data Sets – As expected, the sub-slab soil gas data exhibit greater spatial variability than the indoor air data set. The sub-slab soil gas also exhibits greater temporal variability than the indoor air data set, which is contrary to expectations.

Seasonal Effects – The sub-slab soil gas data exhibit some variability from event to event. Maximum sub-slab soil gas results for 1,2,4-TCB, benzene, and ethylbenzene, the highest sub-slab soil gas concentrations occurred during the fall (E1). Maximum indoor air values for varied between seasons from fall, summer and winter the four analytes evaluated with detections in indoor air. The data does not support the hypothesis that wintertime should have the highest indoor air impacts.

Comparison of Attenuation Factors by Event – Attenuation factors were calculated for benzene based on maximum values, as benzene had 100% detection frequency in both media. The indoor air maximum concentration was corrected for contribution of outdoor air to indoor air (e.g., outdoor air detected concentration was subtracted from indoor air concentration). The calculated event-specific attenuation factors are shown in Tables 1037-9.

Table 1037-9. Comparison of Building-Specific Attenuation Factors for Benzene by Event

	E1 (Fall)	E2 (Winter)	E3 (Spring)	E4 (Summer)
Maximum Values				
Benzene in Sub-Slab Soil Gas (μg/m³)	31,000	30,000	30,000	8,600
Benzene in Outdoor Air (μg/m³)	2.7	0.72	1.2	2.1
Benzene in Indoor Air (μg/m³)	6.5	1.8	8.5	5.5
Benzene in Indoor Air (μg/m³) Corrected for Outdoor Air Contribution	3.8	1.08	7.3	3.4
Attenuation Factor	1.2E-04	3.6E-05	2.4E-04	**4.0E-04**

These serve as the best estimates of attenuation at this building. The results can vary from day to day due to differences in rates of vapor intrusion and rates of building ventilation. Overall, the most conservative estimate of a building-specific attenuation factor for Building 1037 is 4.0E-04 based on benzene during E4.

Temporal Variability in Attenuation Factor – As shown in Table 1037-9, there was about one order of magnitude of temporal variability in the calculated attenuation factors observed for benzene between the four sampling events. To be as conservative as possible, the maximum values were used in calculating the attenuation factor for each event. The sampling location with the maximum value per event varied. In general, the low spatial variability in indoor air results means that roughly comparable attenuation factors would be obtained whichever indoor air value was used in the calculations.

NON-DETECT EVALUATION

Table 1037-10 below lists the analytes in sub-slab soil gas that have ND RLs greater than the screening levels. The table also includes the indoor air results for each of the analytes. If a sub-slab soil gas analyte has ND RL exceedances, but all results and ND RLs in indoor air are below the screening levels, no further evaluation is warranted. If an analyte was identified as an AOI in sub-slab soil gas (detected results > screening level), it is excluded from the ND evaluation. Also, if an ND analyte has an 0% detection frequency for all sampling events and all ND RLs met the screening level during at least one event, no further ND evaluation is warranted.

Table 1038-10. Non-Detect Evaluation for Building 1037

Soil Gas Analytes with ND RL > SL	Indoor Air Result Summary
1,1,2,2-Tetrachloroethane	0% Detection Frequency, All ND RLs < EGLE SSC
1,1,2-Trichloroethane	0% Detection Frequency, All ND RLs < EGLE SSC
1,2-Dibromoethane (EDB)	0% Detection Frequency, E3 & E4 ND RLs < EGLE SSC
alpha-Chlorotoluene	0% Detection Frequency, All ND RLs < EGLE SSC
Dibromomethane	0% Detection Frequency, All ND RLs < EGLE SSC
Hexachlorobutadiene (HCBD)	0% Detection Frequency, E3 & E4 ND RLs < EGLE SSC
Naphthalene	3% Detection Frequency, All ND RLs < EGLE SSC

WEIGHT-OF-EVIDENCE SUMMARY

Building 1037 was confirmed as a VI Path Forward Group 2 building due to its potential for VI based on sub-slab soil gas exceedances of the EGLE SSC for 1,2-TCB, 1,4-DCB and benzene. However, the following evidence supports the conclusion that VI is insignificant at Building 1037:

- No exceedances of screening levels in indoor air during any of the sampling events.
- The sub-slab soil gas data do not show any increase over time and generally show a decrease .

- The data do not support the hypothesis that wintertime should have the highest indoor air impacts. The highest sub-slab soil gas concentrations generally were measured in the fall and the highest indoor air concentrations varied between seasons.

- The indoor air data show relatively little spatial variability, despite the greater spatial variability in the sub-slab soil gas values. This evaluation confirms that the vapor intrusion impacts were low and relatively constant from season to season.

Based on the CSM for Building 1037, VI is an insignificant exposure pathway for current building utilization.

PATH FORWARD

Based on the evaluation of the four seasonal confirmation sampling events and the results of the further investigation, the VI pathway continues to be insignificant for Building 1037 and the sub-slab soil gas results have demonstrated relatively stable concentrations and no evidence of increasing over time. Sufficient information exists to make a human exposure under control EI determination. However, while currently there is no evidence of potential VI, for future use, LTM is warranted and the building-specific Interim Monitoring Plan is discussed below.

Building-specific Interim Monitoring Plan

Dow presented an interim monitoring plan for Building 1037 during the April 2020 Corrective Action status meeting. Dow will implement the interim monitoring plan at Building 1037 until a revised program or more permanent corrective action plan is developed for the site.

Indoor air will be monitored at locations 1037-IA-04 and 1037-IA-09. These locations were selected for continued monitoring since they demonstrated the highest sub-slab soil gas results. Monitoring will be performed for 1,2,4-TCB, 1,4-DCB and benzene. An outdoor air sample will also be collected at the time of each monitoring event. Interim monitoring will be performed semi-annually for a minimum of two years and monitoring results will undergo trend analysis. Monitoring will begin winter 2020/2021. If results continue to be consistent and below screening levels, monitoring will be conducted on an annual basis. If indoor air results are observed to be increasing, further evaluation will be performed, which may include collection of a sub-slab soil gas sample(s) and an increase in monitoring frequency. Results from each monitoring event will be reported in the annual CAIP. In the event an indoor air result(s) exceeds screening levels, EGLE will be provided a brief email notification. A collocated indoor air and sub-slab soil gas sample will be collected from that location within 45 days. If both sub-slab soil gas and indoor air results indicate that VI continues to be insignificant, monitoring will continue at an appropriate frequency. If both sub-slab soil gas and indoor air results indicate that VI is significant and confirm Group 4 conditions, the building will be moved to Group 4 for follow-up actions.

Dow may propose changes to the frequency or other aspects of this interim monitoring plan in the future based on an evaluation of the data, changes in building use or implementation of other corrective actions to address the potential VI pathway.

5.5.7 VI Seasonal Confirmation Sampling Results Evaluation for Building 1042

INTRODUCTION

Building 1042 is a Category 2 building in Zone 3 Phase 1. This structure, with a footprint of 5,600 ft^2, is predominantly warehouse space aligned with/used by the chemical distribution operation positioned in Building 954, but it also has two small office spaces located in the southeastern corner that are used by an insulator contractor. It is located in the southwestern quadrant of the Midland facility (Figure 5.5.7-1).

The 2018 CAIP concluded that the VI pathway at Building 1042 was an insignificant exposure pathway based on current use, due to a single exceedance of 1,2,4-trichlorbenzene in sub-slab soil gas. Building 1042 was placed into VI Path Forward Building Group 2. Group 2 is a designation for buildings that have sub-slab soil gas AOI(s), but all indoor air results are less than screening levels. Any building placed in Group 2 is scheduled for seasonal confirmation sampling.

The results of the initial sampling event (E1) were evaluated in the 2018 CAIP. The 2019 CAIP evaluated three seasonal sampling events (through E3). The remaining seasonal event (E4) has been completed (see Table 1042-1) and the results of all four sampling events are included and evaluated herein. 1,2,4-Trichlorobenzene was the only analyte detected in sub-slab soil gas that exceeds of the EGLE SSC. Naphthalene was the only analyte detected above screening levels in indoor air. There were no sub-slab soil gas results above the $TSRIASL_{12}$ at Building 1042.

Table 1042-1. Summary of Seasonal Confirmation Sampling Events for Building 1042

Building 1042	
Initial Sampling Event	**Completed**
E1	September 2018 (Fall)
Seasonal Sampling Event	**Completed**
E2	April 2019 (Spring)
E3	August 2019 (Summer)
E4	December 2019 (Winter)

Based on the evaluation of the four seasonal confirmation sampling events, the VI pathway continues to be insignificant. Sufficient information exists to make a human exposure under control EI determination.

SUB-SLAB SOIL GAS RESULTS EVALUATION

Four sub-slab soil gas samples and four indoor air samples were collected (along with one outdoor air sample). The sampling locations are shown on Figure 5.5.7-2. Summary statistics and screening comparison results are presented for sub-slab soil gas on Table 5.5.7-1 and indoor and outdoor air on Table 5.5.7-2. The analytical reports are presented in Appendix A. Field sampling logs are provided in Appendix B. Table 1042-2 presents the sub-slab soil gas results that exceed the EGLE SSC. For all sub-slab samples during each of the sampling events, the reporting limit for 1,2,4-TCB was between 21 and 26 µg/m3 (i.e., well below the EGLE SSC).

Table 1042-2. Summary of Sub-Slab Soil Gas Detects for Building 1042

Analyte (Sample Event)	Detection Frequency	Measured Range of Detects ($\mu g/m^3$)	% Detections > EGLE SSC	EGLE SSC ($\mu g/m^3$)
1,2,4-Trichlorobenzene (1)	50%	100 - 260	25%	200
1,2,4-Trichlorobenzene (2)	0%	ND	0%	200
1,2,4-Trichlorobenzene (3)	25%	32	0%	200
1,2,4-Trichlorobenzene (4)	0%	ND	0%	200

Table 1042-3 summarizes the indoor air results relative to the sub-slab soil gas exceedances, since VI only potentially occurs if the analyte is present in both sub-slab soil gas and indoor air. Therefore, the table below provides the analytes detected above applicable screening levels in sub-slab soil gas as well as the corresponding indoor air sample results. The outdoor air sample results are also provided to determine if the analytes were present in indoor air due to migration from outdoor air.

Table 1042-2. Vapor Intrusion Evaluation for Building 1042

Analyte	Indoor Air Detection Frequency	Indoor Air Measured Range (μg/m³)	Indoor Air EGLE SSC (μg/m³)	Outdoor Air Result (μg/m³)
1,2,4-Trichlorobenzene (1)	0%	ND	6.2	ND
1,2,4-Trichlorobenzene (2)	0%	ND	6.2	ND
1,2,4-Trichlorobenzene (3)	0%	ND	6.2	ND
1,2,4-Trichlorobenzene (4)	0%	ND	6.2	ND

All indoor air results for 1,2,4-trichlorobenzene are ND with reporting limits generally approximately equal to the EGLE SSC. During E1, naphthalene was detected in two samples with one result above the screening level. Naphthalene was detected in a single sub-slab soil gas sample during E1 below the EGLE SSC. Naphthalene was ND in both media during each additional sampling event, indicating that naphthalene was likely due to workplace chemical use and not attributable to VI.

VAPOR INTRUSION CONCEPTUAL SITE MODEL

VI is an exposure pathway that results from the migration of volatilized chemicals from the subsurface to indoor air in overlying occupied buildings. A source, migration route and a human receptor must be present for the VI pathway to be complete. The focus of this building specific investigation is to evaluate the potential VI exposure pathway for Dow employees and contractors at Building 1042. The CSM is illustrated in Figure 5.5.7-3.

Building 1042 is predominantly warehouse space aligned with/used by the chemical distribution operation positioned in Building 954, but it also has two small office spaces located in the southeastern corner that are used by an insulator contractor. The building is a slab-on-grade construction with no elevator and no basement. This structure is approximately 5,600 ft^2 in size. Of note, the office area is on a slightly raised floor.

The only area of the building with any climate control is the office area, which has two individual AC units for cooling and electric baseboards for heating. The building has three bay doors and one railcar door, which are open when moving materials or the track mobile in and out of the building. The bay doors are large enough to allow a fuel-operated vehicle to pull in and out of the warehouse portion of the building. The outdoor ground cover surrounding the building consists of grass and gravel to the north, and asphalt and gravel to the east, south, and west.

Building 1042 only has one occupant who works 10-hour shifts Monday through Thursday. The typical parameters for non-residential exposures are assumed to apply to the various security personnel stationed during rotating work shifts at this building (i.e., 40 hours/week, 50 weeks/year exposure).

A building survey was completed before the initial sampling event. Drains and other openings were screened with a PID and no soil gas entry points were identified. A chemical inventory was completed during the building survey that identified motor oil, cleaners, insect spray, penetrating oil lubricant, and spray enamel and spray paint.

EVALUATION OF SEASONAL CONFIRMATION SAMPLING EVENTS

Four seasonal sampling events have been completed at Building 1042. The sampling events encompass more than one year of time and include sampling during each season of the year. The results from the four seasonal confirmation sampling events were evaluated with respect to spatial variability, temporal variability, and seasonal trend analysis; however, this analysis was very limited by the limited number of analytes detected and the lack of relatively high concentrations among the detected values. The evaluation focused on any analytes detected in the sub-slab soil gas samples that met the criterion for inclusion in one or more of the following categories:

a) Analytes detected in sub-slab soil gas at concentrations that exceeded EGLE SSC;

b) Analytes detected in sub-slab soil gas at concentrations of 1,000 $\mu g/m^3$ or greater in one or more samples. Data for analytes detected above 1,000 $\mu g/m^3$ should provide the clearest signal and be the simplest to interpret when assessing data trends. The same data trends observed for these analytes are expected to apply to other similar analytes present at lower concentrations; and

c) PCE and TCE. These two analytes are of particular interest for many VI evaluations at industrial sites.

For Building 1042, the only analyte detected in the sub-slab soil gas at concentrations above the EGLE SSC is 1,2,4-trichlorobenzene. It was detected at relatively low concentrations ranging from 32 - 260 $\mu g/m^3$ and was only detected in two of the four sampling events. Sample results for 1,2,4-trichlorobenzene are provided in Table 1042-3. There were no analytes detected in sub-slab soil gas at concentrations greater than 1,000 $\mu g/m^3$ at Building 1042 to evaluate. Furthermore, PCE and TCE were not included in this evaluation since TCE was ND in sub-slab soil gas and PCE exhibited a low detection frequency and low detected concentrations (PCE detected results range from 7.9 - 21 $\mu g/m^3$). Therefore, an evaluation of data trends could not be completed for Building 1042 due to limited analytes and results that would qualify to provide value to the analysis.

Table 1042-3 Summary of Results for 1,2,4-Trichlorobenzene

Sample Type	Screening Level (µg/m³)	Sample ID	Measured Concentration (µg/m³)			
			Sept. 2018	Apr. 2019	Aug. 2019	Dec. 2019
			E1	E2	E3	E4
Outdoor Air	-	1042-OA-01	<6.3	<6	<6.2	<5.9
Indoor Air	6.2 (EGLE SSC) 19 (TSRIASL12)	1042-IA-01	<5.9	<6	<6	<5.9
		1042-IA-02	<6.2	<6.1	<6.3	<5.5
		1042-IA-03	<13	<5.8	<6.3	<6.4
		1042-IA-04	<5.9	<6.1	<6.3	<6.2
Sub-Slab Soil Gas	200 (EGLE SSC) 610 (TSRIASL12)	1042-SS-01	100	<23	32	<26
		1042-SS-02	<24	<24	<23	<22
		1042-SS-03	<24	<22	<23	<21
		1042-SS-04	260	<23	<24	<23

-	not applicable
(shaded)	EGLE SSC Exceedance
BOLD	TSRIASL12 Exceedance

NON-DETECT EVALUATION

Table 1042-4 below lists the analytes in sub-slab soil gas that have ND RLs greater than the screening levels. The table also includes the indoor air results for each of the analytes. If a sub-slab soil gas analyte has ND RL exceedances, but all results and ND RLs in indoor air are below the EGLE SSC, no further evaluation is warranted. If an analyte was identified as an AOI in sub-slab soil gas (detected results > screening level), it is excluded from the ND evaluation. Also, if an ND analyte has an 0% detection frequency for all sampling events and all ND RLs met the screening level during at least one event, no further ND evaluation is warranted.

Table 1042-4. Non-Detect Evaluation for Building 1042

Soil Gas Analytes with ND RL > SL	Indoor Air Result Summary
1,2-Dibromoethane (EDB)	0% Detection Frequency, All ND RLs for E3 & E4 < EGLE SSC

All sub-slab soil gas results for EDB were ND with reporting limits below the screening level during all events except for one sample result during E4. For indoor air, all results were ND and all reporting limits during E3 and E4 were below the screening level.

PATH FORWARD

Based on the evaluation of the four seasonal confirmation sampling events, the VI pathway continues to be insignificant for Building 1042 and the sub-slab soil gas results have demonstrated relatively stable concentrations and no evidence of increasing over time. Sufficient information exists to make a human exposure under control EI determination. However, while currently there is no evidence of potential VI, for future use, LTM is warranted and the building-specific Interim Monitoring Plan is discussed below.

Building-specific Interim Monitoring Plan

Dow will implement an Interim Monitoring Plan at Building 1042, as presented in the April 2020 Corrective Action Status meeting, until a revised program or more permanent Corrective Action Plan is developed for the site.

Indoor air will be monitored at location 1042-IA-04. This location was selected for continued monitoring since it demonstrated the highest sub-slab soil gas results. Monitoring will be performed for chloroform. An outdoor air sample will also be collected at the time of each monitoring event. Interim monitoring will be performed semi-annually for a minimum of two years and monitoring results will undergo trend analysis. The initial interim monitoring event will occur in Winter 2020/2021. If results continue to be consistent and below screening levels, monitoring will be conducted on an annual basis. If indoor air results are observed to be increasing, further evaluation will be performed, which may include collection of a sub-slab soil gas sample(s) and an increase in monitoring frequency. Results from each monitoring event will be reported in the annual CAIP. In the event an indoor air result(s) exceeds screening levels, MDEQ will be provided a brief email notification. A collocated indoor air and sub-slab soil gas sample will be collected from that location within 45 days. If both sub-slab soil gas and indoor air results indicate that VI continues to be insignificant, monitoring will continue at an appropriate frequency. If both sub-slab soil gas and indoor air results indicate that VI is significant and confirm Group 4 conditions, the building will be moved to Group 4 for follow-up actions.

Dow may propose changes to the frequency or other aspects of this Interim Monitoring Plan in the future based on an evaluation of the data, changes in building use or implementation of other corrective actions to address the potential VI pathway.

5.6 Zone 3 Phase 2 Buildings

The Zone 3 Phase 2 buildings were sampled in Fall 2019 and presented in the 2019 CAIP (January 2020). The Zone 3 Phase 2 priority building surveys are included in Appendix D and the sample plans were submitted in the 2018 Revised Workplan and resubmitted to EGLE (posted on SharePoint site) in August 2019. Zone 3 Phase 2 VI results and evaluations are presented for the buildings listed below in the following subsections:

- Section 5.6.1 Building 734;
- Section 5.6.2 Building 938;
- Section 5.6.3 Building 990;
- Section 5.6.4 Building 1018;
- Section 5.6.5 Building 1385;
- Section 5.6.6 Building 439/T-1411;
- Section 5.6.7 Building 732/1300;
- Section 5.6.8 Building 759/1350;
- Section 5.6.9 Building 49;
- Section 5.6.10 Building 146;
- Section 5.6.11 Building 180;
- Section 5.6.12 Building 298;
- Section 5.6.13 Building 374;
- Section 5.6.14 Building 464;
- Section 5.6.15 Building 638;
- Section 5.6.16 Building 774;
- Section 5.6.17 Building 1269;
- Section 5.6.18 Building 27/313/803;
- Section 5.6.19 Building 458/963;
- Section 5.6.20 Building 542/561; and
- Section 5.6.21 Building 719/1360.

5.6.1 Vapor Intrusion Evaluation for Building 734

Building 734 (with a footprint of 16,233 ft^2) was built in the late 1950s to early 1960s and is located in the northeastern quadrant of the Midland facility (Figure 5.6.1-1). Building 734 also has a basement with one-story above grade. The footprint of the basement is approximately 11,278 ft^2. Approximately 4,956 ft^2 of the floor above grade is not underlain by basement; however, this area is unoccupied and was previously associated with the recently demolished structure to the west, Building 1261.

The depth of the basement is approximately 12-15 ft below grade. The foundation walls are made of cinder block, which are painted or covered with drywall in some areas, and the basement floor is concrete, which is typically covered in tile or carpet in most areas. The basement area is unoccupied with no future plans of occupancy, but has office space, bathrooms, and labs. There is a sump pit with two sump pumps located in the northwestern mechanical room in the basement, and the sump had water in it at the time of the survey. There is also an elevator in this building in the southeastern corner.

The first floor of the building consists of offices and labs. There is a bay door located on the south side of the structure and is only opened for the occasional delivery. There are two outdoor air intakes; one of which is located on the west side of the building on ground level, and the other is on the roof on the south side of the building. The building has one building chiller with a chilled water loop to three air-handling units that have steam coils, meaning the building is heated via steam radiation and cooled via central AC. The outdoor ground cover around the building is predominantly asphalt with some gravel in place where Building 1261 formerly stood.

No PID detections were observed in the ambient air throughout the building or from any drains or sumps identified at the time of the survey.

DATA SUMMARY

Building 734 has undergone one sampling event. Seasonal confirmation sampling will be conducted at Building 734 since sub-slab soil gas results from the initial sampling event exceed screening criteria. Analytical results are compared to the June 22, 2018 EGLE SSC (12 hr soil gas screening criteria and AACs) and the $TSRIASL_{12}$, if available.

Table 734-1. Sampling Events

Building 734	
Initial Sampling Event	**Completed**
E1	September 2019 (Fall)
Seasonal Sampling Event	**Scheduled**
E2	*Winter 2020/21 (Scheduled)*
E3	*Spring 2021 (Scheduled)*
E4	*Summer 2021 (Scheduled)*

As shown on Figure 5.6.1-2, sub-slab soil gas samples were collected at four locations from the footprint of the first floor of the building that did not have basement under it, as sub-slab soil gas samples are not collected from basements. Nine additional soil gas samples were collected outside the building from the perimeter of the building's basement. Groundwater samples were also collected from the nine perimeter sample locations around the building, in addition to the collection of one water sample from the basement sump. Indoor air samples were collected at 18 locations throughout the building, nine samples from the basement and nine samples from the first floor. Four of the indoor air samples collected from the first floor of the building corresponded to the sub-slab soil gas sample locations. An outdoor air sample was also collected from the main air intake. Summary statistics and screening comparison results are presented for perimeter soil gas samples on Table 5.6.1-1, sub-slab soil gas samples on Table 5.6.1-2, and indoor and outdoor air on Table 5.6.1-3. Summary statistics and screening comparison results are presented for groundwater samples on Table 5.6.1-4. The analytical data is presented in Appendix A. Field sampling forms are provided in Appendix B.

The building survey completed before the initial sampling event can be found in Appendix D. Drains and other openings were screened with a PID and no soil gas entry points were identified. A chemical inventory was completed during the building survey and the chemicals found to be stored within the building are listed in the survey.

SUB-SLAB SOIL GAS AND SOIL GAS RESULTS EVALUATION

Analytical results were evaluated based on methodologies presented in the 2018 Revised Vapor Intrusion Work Plan. During the initial event (Fall 2019), hexachlorobutadiene was the only analyte detected in sub-slab soil gas above the EGLE SSC in each of the four sample locations. All results from the nine soil gas samples collected around the perimeter of the basement were below EGLE SSC, including hexachlorobutadiene, which as ND in all nine samples. Analytes detected above the soil gas EGLE SSC are shown on Table 734-2.

Table 734-2. Summary of Soil Gas Exceedances for Building 734

Analyte (Sampling Event)	Detection Frequency	Measured Range of Detects (µg/m³)	% Detections > Screening Level	EGLE SSC (µg/m³)
Hexachlorobutadiene (1)	100%	450-1,200	100%	180

GROUNDWATER RESULTS EVALUATION

All groundwater results from the nine samples collected around the perimeter of the basement were below EGLE SSC (Groundwater in Contact (GWIC) Buildings <50,000 sqft with a basement). All results from the sample collected from the sump in the basement were below screening criteria, except for chloroform. The sump sample result for chloroform is 11 ug/L (screening criteria = 4.9 ug/L). However, chloroform was ND with reporting limits well below the screening criteria in all groundwater samples collected from the perimeter of the building. Hexachlorobutadiene was also ND with reporting limits below the screening criteria in all groundwater samples, including the sump sample.

EVALUATION OF VAPOR INTRUSION

Table 734-3 summarizes the indoor air results relative to the sub-slab soil gas exceedances, since VI only potentially occurs if the analyte is present in both sub-slab soil gas and indoor air. Therefore, the table below provides the analytes detected above applicable screening levels in soil gas as well as the corresponding indoor air sample results. The outdoor air sample results are also provided to determine if the analytes were present in indoor air due to migration from outdoor air.

Table 734-3. Vapor Intrusion Evaluation for Building 734

Analyte (Sampling Event)	Indoor Air Detection Frequency	Indoor Air Measured Range (µg/m³)	EGLE SSC (µg/m³)	Outdoor Air Result (µg/m³)
Hexachlorobutadiene (1)	0%	<3.8	5.4	ND

Hexachlorobutadiene did exceed sub-slab soil gas criteria; however, hexachlorobutadiene was ND with reporting limits below the screening criteria in all 18 indoor air samples throughout the building. All indoor air results during the initial sampling event were below indoor air screening criteria, except for a single result for 1,2-dichloroethane. 1,2-Dichloroethane exceeded the EGLE indoor air screening criteria at a single sample location (734-04) in a laboratory on the southeast side of the first/ground floor. In the basement, all nine indoor air sample results for 1,2-dichloroethane were below screening criteria. Furthermore, all sub-slab soil gas and perimeter soil gas results for 1,2-dichoroethane were below screening criteria. Chloroform did exceed the groundwater criteria in the sump sample; however, all indoor air results for chloroform were below indoor air screening criteria in all 18 indoor air samples throughout the building.

CONCLUSIONS AND RECOMMENDATIONS

Based on the indoor air results, the VI pathway at Building 734 is an insignificant exposure pathway based on current use. However, based on the sub-slab soil gas results during the initial sampling event and given the potential for future VI, Building 734 has been placed in VI Path Forward Building Group 2, as lines of evidence indicate that VI is insignificant and all indoor air results are less than screening levels. The next seasonal confirmation sampling event is scheduled for Winter 2020/21. A full evaluation and trend analysis will be presented in the 2021 CAIP.

5.6.2 Vapor Intrusion Evaluation for Building 938

BACKGROUND

Building 938 was built in the 1960s and is located in the northwestern quadrant of the Midland facility (see Figure 5.6.2-1). This building contains a permit writing area, control room area, kitchen/break area, switch room, mechanical room, bathroom, and a lab. The building is a one-story structure of slab-on-grade construction with no elevators or basement and has a footprint of approximately 2,758 ft^2.

The building's heat is produced via steam radiation. Two AC units exist for this building, with one used as a backup. The intake for this building is located on the north side of the building near the northwestern corner at ground level. No bay doors/overhead doors exist on this structure. The immediate area outside of the building is covered by asphalt or concrete. Occupants use the washers and dryers at Building 298 and a contracted weekly laundry service.

No PID readings were detected in the ambient air or in any drain-like features observed in the building.

DATA SUMMARY

The initial sampling event for Building 938 occurred in Fall 2019. The analytical results from each of the sampling events were compared to the June 22, 2018 EGLE SSCs and $TSRIASL_{12}$, if available. Sub-slab soil gas samples were collected from three (3) locations from within the building. Indoor air samples were collected at three (3) locations corresponding to the soil gas sample locations, along with an outdoor air sample from the main air intake. The sampling locations are shown on Figure 5.6.2-2. Summary statistics and screening comparison results are presented for sub-slab soil gas on Table 5.6.2-1 and indoor and outdoor air on Table 5.6.2-2. The analytical data is presented in Appendix A. Field sampling forms are provided in Appendix B.

The building survey completed before the initial sampling event can be found in Appendix D. Drains and other openings were screened with a PID and no soil gas entry points were identified. A chemical inventory was completed during the building survey and the chemicals found to be stored within the building are listed in the survey.

SUB-SLAB SOIL GAS RESULTS EVALUATION

Analytical results were evaluated based on methodologies presented in the 2018 Revised Vapor Intrusion Work Plan. During the Fall 2019 initial sampling event, twenty-eight of the 65 analytes were ND in each of the samples. Thirty-seven analytes were detected in sub-slab soil gas and only one analyte (benzene) was detected above the EGLE SSCs. All results were less than the $TSRIASL_{12}$, if available. Table 938-1 summarizes the results that were detected above an EGLE SSC.

Table 938-1. Summary of Sub-Slab Soil Gas Exceedances for Building 938

Analyte (Sampling Event)	Detection Frequency	Measured Range of Detects ($\mu g/m^3$)	% Detections > EGLE SSC	EGLE SSC ($\mu g/m^3$)
Benzene (1)	100%	94-1,000	33%	510

EVALUATION OF VAPOR INTRUSION

Table 938-2 summarizes the indoor air results relative to the sub-slab soil gas exceedances, since VI only potentially occurs if the analyte is present in both sub-slab soil gas and indoor air. Therefore, the table below provides the analytes detected above applicable EGLE SSCs in sub-slab soil gas as well as the corresponding indoor air sample results. The outdoor air sample results are also provided to determine if the analytes were present in indoor air due to migration from outdoor air.

Table 938-2. Vapor Intrusion Evaluation for Building 938

Analyte (Sampling Event)	Indoor Air Detection Frequency	Indoor Air Measured Range ($\mu g/m^3$)	EGLE SSC ($\mu g/m^3$)	Outdoor Air Result ($\mu g/m^3$)
Benzene (1)	100%	0.38-0.4	15.4	0.5

For the 19 analytes detected in indoor air, all results were below the EGLE SSCs and $TSRIASL_{12}$, if available. Fifteen analytes were detected in the outdoor air sample collected immediately upwind of the building and all 15 analytes were detected in indoor air, which indicates the potential for the presence of detected analytes to be attributed to outdoor air. A full ND evaluation will be performed upon the completion of seasonal confirmation sampling.

CONCLUSIONS AND RECOMMENDATIONS

Based on the indoor air results, the VI pathway at Building 938 is an insignificant exposure pathway based on current use. However, based on the sub-slab soil gas results and given the potential for future VI, Building 938 has been placed in VI Path Forward Building Group 2, as lines of evidence indicate that VI is insignificant and all indoor air results are less than the EGLE SSCs. Seasonal confirmation sampling is recommended for Building 938 and seasonal confirmation sampling event 2 is scheduled for Winter 2020/2021. A full evaluation of Building 938 will be conducted upon completion of seasonal confirmation sampling.

5.6.3 Vapor Intrusion Evaluation for Building 990

BACKGROUND

Building 990 was built in in the 1950s-1960s and is located in the northeastern quadrant of the Midland facility (see Figure 5.6.3-1). The building consists of Trinseo office space, conference rooms, a mod control room, kitchen/break area, and bathrooms. The structure is a one-story slab-on-grade construction with no basement or elevators and has a footprint of 7,968 ft^2.

The building is centrally heated and cooled with the AC being pulled from a nearby cooling tower and the heating produced via hot air circulation. The building has no bay doors and the outdoor ground cover is asphalt.

No PID detections were observed in the ambient air throughout the building or from the drains observed in the men and women's bathrooms at the time of the survey.

DATA SUMMARY

The initial sampling event for Building 990 occurred in Fall 2019. The analytical results from each of the sampling events were compared to the June 22, 2018 EGLE SSCs and $TSRIASL_{12,}$ if available. Sub-slab soil gas samples were collected from six (6) locations from within the building. Indoor air samples were collected at six (6) locations corresponding to the soil gas sample locations, along with an outdoor air sample from the main air intake. The sampling locations are shown on Figure 5.6.3-2. Summary statistics and screening comparison results are presented for sub-slab soil gas on Table 5.6.3-1 and indoor and outdoor air on Table 5.6.3-2. The analytical data is presented in Appendix A. Field sampling forms are provided in Appendix B.

The building survey completed before the initial sampling event can be found in Appendix D. Drains and other openings were screened with a PID and no soil gas entry points were identified. A chemical inventory was completed during the building survey and the chemicals found to be stored within the building are listed in the survey.

SUB-SLAB SOIL GAS RESULTS EVALUATION

Analytical results were evaluated based on methodologies presented in the 2018 Revised Vapor Intrusion Work Plan. During the Fall 2019 initial sampling event, 41 of the 65 analytes were ND in each of the samples. Twenty-four analytes were detected in sub-slab soil gas and only two analytes were detected above the EGLE SSCs, cumene and ethylbenzene. All results were less than the $TSRIASL_{12}$, if available. Table 990-1 summarizes the results that were detected above an EGLE SSC.

Table 990-1. Summary of Sub-Slab Soil Gas Exceedances for Building 990

Analyte (Sampling Event)	Detection Frequency	Measured Range of Detects ($\mu g/m^3$)	% Detections > EGLE SSC	EGLE SSC ($\mu g/m^3$)
Cumene (1)	17%	910	17%	360
Ethyl Benzene (1)	83%	6.2-3,100	17%	1,600

EVALUATION OF VAPOR INTRUSION

Table 990-2 summarizes the indoor air results relative to the sub-slab soil gas exceedances, since VI only potentially occurs if the analyte is present in both sub-slab soil gas and indoor air. Therefore, the table below provides the analytes detected above applicable EGLE SSCs in sub-slab soil gas as well as the corresponding indoor air sample results. The outdoor air sample results are also provided to determine if the analytes were present in indoor air due to migration from outdoor air.

Table 990-2. Vapor Intrusion Evaluation for Building 990

Analyte (Sampling Event)	Indoor Air Detection Frequency	Indoor Air Measured Range ($\mu g/m^3$)	Indoor Air EGLE SSC ($\mu g/m^3$)	Outdoor Air Result ($\mu g/m^3$)
Cumene (1)	0%	<1.5	11.4	ND
Ethyl Benzene (1)	100%	1.9-2.1	48	1.8

For the 14 analytes detected in indoor air, all results were below the EGLE SSCs and $TSRIASL_{12}$, if available. Six analytes were detected in the outdoor air sample collected immediately upwind of the building and all six analytes were detected in indoor air, which indicates the potential for the presence of detected analytes to be attributed to outdoor air. A full ND evaluation will be performed upon the completion of seasonal confirmation sampling.

CONCLUSIONS AND RECOMMENDATIONS

Based on the indoor air results, the VI pathway at Building 990 is an insignificant exposure pathway based on current use. However, based on the sub-slab soil gas results and given the potential for future VI, Building 990 has been placed in VI Path Forward Building Group 2, as lines of evidence indicate that VI is insignificant and all indoor air results are less than the EGLE SSCs. Seasonal confirmation sampling is recommended for Building 990 and seasonal confirmation sampling event 2 is scheduled for

Winter 2020/2021. A full evaluation of Building 990 will be conducted upon completion of seasonal confirmation sampling.

5.6.4 Vapor Intrusion Evaluation for Building 1081

Building 1018 was constructed in the early 1970s and is located in the northwestern quadrant of the Midland facility (see Figure 5.6.4-1). This building primarily contains office space, locker rooms (which have washers and dryers), a kitchen/break room, and an area referred to as the “old lab space.” The building is a one-story structure slab-on-grade construction with no basement or elevator and has a footprint of approximately 4,992 ft^2.

The entire floor of the building is either concrete covered by paint or an epoxy coating. The building is heated via hot air circulation (although electric baseboards are present, they are now defunct), and cooled via central AC through one unit. An outdoor intake exists on the north side of the building connecting to the HVAC room, although the intake for the air handler is located inside the HVAC room and is not directly connected to the outside intake. This building has no bay doors/overhead doors and the ground cover surrounding the building is asphalt. Note that although the building has washer and dryers, some occupants use a weekly contracted laundry service for some items.

PID readings were detected in the ambient air in the HVAC room and the janitor’s closet at 0.1 ppm. PID readings were also detected in the drains in the men and women’s locker room (0.1 ppm), the janitor’s closet (3.1 ppm), and the drain in the HVAC room (150 ppm).

DATA SUMMARY

Building 1081 was sampled in Fall 2019. The analytical results from each of the sampling events were compared to the June 22, 2018 EGLE SSCs and $TSRIASL_{12}$, if available. Sub-slab soil gas samples were collected from nine locations from within the building. Indoor air samples were collected at four locations corresponding to the soil gas sample locations, along with an outdoor air sample from the main air intake. The sampling locations are shown on Figure 5.6.4-2. Summary statistics and screening comparison results are presented for sub-slab soil gas on Table 5.6.4-1 and indoor and outdoor air on Table 5.6.4-2. The analytical data is presented in Appendix A. Field sampling forms are provided in Appendix B.

The building survey completed before the initial sampling event can be found in Appendix D. Drains and other openings were screened with a PID and no soil gas entry points were identified. A chemical inventory was completed during the building survey and the chemicals found to be stored within the building are listed in the survey.

Based on the screened results, no indoor air analytes were detected above the $TSRIASL_{12}$ during any of the sampling events at Building 1081. Therefore, no EBS was necessary.

SUB-SLAB SOIL GAS RESULTS EVALUATION

Analytical results were evaluated based on methodologies presented in the 2018 Revised Vapor Intrusion Work Plan. Forty-six of the 65 analytes were ND in each of the samples. Nineteen analytes were detected in sub-slab soil gas but all detected results were below the EGLE SSCs and $TSRIASL_{12}$, if available.

VAPOR INTRUSION RESULTS EVALUATION

VI only potentially occurs if the analyte is present in both sub-slab soil gas and indoor air. There were no sub-slab soil gas exceedances of the EGLE SSCs. For the 12 analytes detected in indoor air, all results were below the EGLE SSCs and $TSRIASL_{12}$, if available. Nine analytes were detected in the outdoor air sample collected immediately upwind of the building and all nine analytes were detected in indoor air, which indicates the potential for the presence of detected analytes to be attributed to outdoor air.

ND RLs for EDB, HCBD, 1,1,1-trichloroethane and 1,2,4- exceed the EGLE SSCs in sub-slab soil gas. All ND RLs met the EGLE SSCs in indoor air. EDB and HCBD require further investigation which will be conducted once the facility-wide priority buildings have been sampled and evaluated. Only one ND RLs exceeded the EGLE SSCs for both 1,1,1-trichloroethane and 1,2,4-TCB.

CONCLUSIONS AND RECOMMENDATIONS

Based on the sampling results, the VI pathway at Building 1081 is an insignificant exposure pathway based on current use. Building 1081 was placed into VI Path Forward Building Group 1 and no further VI evaluation is warranted at this time.

5.6.5 Vapor Intrusion Evaluation for Building 1385

BACKGROUND

Building 1385 (an Electronic Materials Building) was constructed in 1993-1994 and is located in the northwestern quadrant of the Midland facility (see Figure 5.6.5-1). This building is a one- to two-story structure of slab-on-grade construction with no basement or elevator (although one of the process areas has a lift) and a footprint of approximately 13,916 ft^2. This building contains office space, locker rooms, lab space, warehouse space, and process areas (the process areas are roughly 2,902 ft^2). There are sumps located in the process areas that lead to a fire pit.

The building is heated via hot air circulation, and two central AC units cool the building. The bathrooms have ventilation fans, and the outside air intake for the building is located on the rooftop facing north. There is one overhead/bay door that is rarely open with the exception of moving equipment and/or materials in and out of the building. The surrounding ground cover outside the building is predominantly asphalt with large gravel/stone on the south side near the railroad tracks. Building occupants use a contracted laundry service.

No PID detections were observed in the ambient air throughout the building, but a PID detection of 7.7 ppm was observed in the drain in the women's bathroom/locker room.

DATA SUMMARY

The initial sampling event for Building 1385 occurred in Fall 2019. The analytical results from each of the sampling events were compared to the June 22, 2018 EGLE SSCs and $TSRIASL_{12}$, if available. Sub-slab soil gas samples were collected from nine locations from within the building. Indoor air samples were collected at nine locations corresponding to the soil gas sample locations, along with an outdoor air sample from the main air intake. The sampling locations are shown on Figure 5.6.5-2. Summary statistics and screening comparison results are presented for sub-slab soil gas on Table 5.6.5-1 and indoor and outdoor air on Table 5.6.5-2. The analytical data is presented in Appendix A. Field sampling forms are provided in Appendix B.

The building survey completed before the initial sampling event can be found in Appendix D. Drains and other openings were screened with a PID and no soil gas entry points were identified. A chemical inventory was completed during the building survey and the chemicals found to be stored within the building are listed in the survey.

SUB-SLAB SOIL GAS RESULTS EVALUATION

Analytical results were evaluated based on methodologies presented in the 2018 Revised Vapor Intrusion Work Plan. .During the Fall 2019 initial sampling event, 36 of the 65 analytes were ND in each of the samples. Twenty-nine analytes were detected in sub-slab soil gas and seven analytes were detected above the EGLE SSC, including EDB, 1,2-dichloroethane, 1,2-dichloropropane, chloroform, cis-1,2-DCE, PCE, and TCE. cis-1,2-DCE, PCE and TCE each had results that were greater than the $TSRIASL_{12}$. Table 1385-1 summarizes the results that were detected above an EGLE SSC.

Table 1385-1. Summary of Sub-Slab Soil Gas Exceedances for Building 1385

Analyte (Sampling Event)	Detection Frequency	Measured Range of Detects (μg/m³)	% Detections > EGLE SSC	EGLE SSC (μg/m³)
1,2-Dibromoethane (EDB) (1)	11%	8.8	11%	6.6
1,2-Dichloroethane (1)	22%	4.7-260	11%	150
1,2-Dichloropropane (1)	11%	1,200	11%	410
Chloroform (1)	78%	7.4-700	11%	170
cis-1,2-Dichloroethene (1)	11%	3,900	11%	820
Tetrachloroethene (1)	100%	11-7,700	11%	2,700
Trichloroethene (1)	78%	8-2,200	11%	130

EVALUATION OF VAPOR INTRUSION

Table 1385-2 summarizes the indoor air results relative to the sub-slab soil gas exceedances, since VI only potentially occurs if the analyte is present in both sub-slab soil gas and indoor air. Therefore, the table below provides the analytes detected above applicable EGLE SSCs in sub-slab soil gas as well as the corresponding indoor air sample results. The outdoor air sample results are also provided to determine if the analytes were present in indoor air due to migration from outdoor air.

Table 1385-2. Vapor Intrusion Evaluation for Building 1385

Analyte (Sampling Event)	Indoor Air Detection Frequency	Indoor Air Measured Range (μg/m³)	EGLE SSC (μg/m³)	Outdoor Air Result (μg/m³)
1,2-Dibromoethane (EDB) (1)	0%	<0.16	0.2	ND
1,2-Dichloroethane (1)	11%	0.16	4.6	ND
1,2-Dichloropropane (1)	0%	<0.95	12.2	ND
Chloroform (1)	11%	0.36	5.2	ND
cis-1,2-Dichloroethene (1)	100%	0.24-2.1	24	ND
Tetrachloroethene (1)	100%	0.28-2.7	82	ND
Trichloroethene (1)	22%	0.22-.0.65	4	ND

For the 24 analytes detected in indoor air, all results were below the EGLE SSCs and $TSRIASL_{12}$, if available. Eight analytes were detected in the outdoor air sample collected immediately upwind of the building and all eight analytes were detected in indoor air, which indicates the potential for the presence of detected analytes to be attributed to outdoor air. A full ND evaluation will be performed upon the completion of seasonal confirmation sampling.

CONCLUSIONS AND RECOMMENDATIONS

Based on the indoor air results, the VI pathway at Building 1385 is an insignificant exposure pathway based on current use. However, based on the sub-slab soil gas results and given the potential for future VI, Building 1385 has been placed in VI Path Forward Building Group 2, as lines of evidence indicate that VI is insignificant and all indoor air results are less than the EGLE SSCs. Seasonal confirmation sampling is recommended for Building 1385 and seasonal confirmation sampling event 2 is scheduled for Winter 2020/2021. A full evaluation of Building 1385 will be conducted upon completion of seasonal confirmation sampling.

5.6.6 Vapor Intrusion Evaluation for Building 439/T-1411

The combined 439/T-1411 trailers were put in place sometime between 2000-2010 and are located in the northwestern quadrant of the Midland facility (see Figure 5.6.6-1). The two trailers are connected via an enclosed corridor. These trailers contain offices, a library, break room/kitchen area, and bathrooms. The occupants in this building support the activities conducted at Building 1385 located immediately to the southeast. The trailers, combined, are a one-story structure with a crawl space underneath and have a footprint of approximately 4,199 ft^2. The trailers are heated by electric baseboard and have two central AC units located on the west side of T-1411. The outdoor ground cover is predominantly asphalt.

No PID readings were detected in the ambient air or from any drain features in the trailers at the time of the survey.

DATA SUMMARY

Building 439/T-1411 was sampled in Fall 2019. Due to the unique characteristic of this building, three samples were collected in the crawl space underneath the building yet above ground surface. Two samples were collected underneath the 439 trailer and one sample was collected underneath T-1411. The sampling locations are shown on Figure 5.6.6-2.

As an added level of conservatism, the analytical results from each of the crawl space samples were compared to the June 22, 2018 EGLE SSCs and $TSRIASL_{12,}$ if available. Summary statistics and screening comparison results are presented for the air samples collected in the crawl space of the building on Table 5.6.6-1. The analytical data is presented in Appendix A. Field sampling forms are provided in Appendix B.

The building survey completed before the initial sampling event can be found in Appendix D. Drains and other openings were screened with a PID and no soil gas entry points were identified. A chemical inventory was completed during the building survey and the chemicals found to be stored within the building are listed in the survey.

Based on the screened results, no air analytes were detected above the $TSRIASL_{12}$ during the sampling event at Building 439/T-1411. Therefore, no EBS was necessary.

RESULTS EVALUATION

A total of 41 of the 65 target analytes were ND in the three samples collected from the crawl space underneath the building (but above ground surface) of Building 439/T-1411. The analytical results of the 24 detected analytes were all less than the EGLE SSCs. ND RLs for 1,2,4-TCB exceed the EGLE SSCs in crawl-space air in two of the three samples; however, as stated above, the EGLE SSCs were used for a conservative evaluation. Additionally, most of the reporting limit exceedances only slightly exceed the EGLE SSCs.

Based on the results of the under trailer crawl space, the collection of indoor air is not warranted. By definition, the potential for VI only occurs if an analyte is present in both sub-slab soil gas and indoor air. Analytes only present in indoor air are almost always due to sources other than VI (e.g. storage and/or use of volatiles indoors, air exchange with outdoor air, etc.). Due to the unique characteristics of Building 439/T-1411, sub-slab soil gas samples were not collected and in their place, the air in the under trailer crawl space was sampled and evaluated. All detected results were less than the EGLE SSCs.

CONCLUSIONS AND RECOMMENDATIONS

Based on the sampling results, the VI pathway at Building 439/T-1411 is an insignificant exposure pathway based on current use. Building 439/T-1411 was placed into VI Path Forward Building Group 1 and no further VI evaluation is warranted at this time.

5.6.7 Vapor Intrusion Evaluation for Building 732/1300

BACKGROUND

Buildings 732 and 1300 have been combined as they are connected to each other with no way of closing off the noted connections. These buildings are located in the northeastern quadrant of the Midland facility with a combined footprint of 22,660 ft^2 (see Figure 5.6.7-1). The 732 portion of the building is a warehouse with a shop area and was built in the 1960s. The 1300 portion of the building contains office space on the eastern end of the building, and lab space, Research & Development (R&D) space, and some warehouse space in the remainder of the building and was built in 1987. The entire 732/1300 structure has six bay doors that are open on occasion for moving materials in and out and are open more frequently during the warmer months (particularly the doors off of the 732 portion). The ground cover around the outside of these buildings consists of asphalt, but an atrium area exists between the two connecting corridors for 732 and 1300 and has trees and other vegetation present.

The 732/1300 structure are a slab-on-grade construction with no basement and no elevator. The air is heated via hot air circulation in the 1300 portion and is heated via steam radiation in the 732 portion. The air is cooled in the 1300 portion via two large central and three individual AC units. Exhaust mechanical fans are present in the 732 portion of the structure. An outside air intake is located on the south side of the 1300 portion of the building near the southeast corner. A second intake is located inside the 1300 portion of the structure in the laundry area. There are trenches throughout the 1300 portion of the building that are used for rinsing down equipment between coating batches. The concrete floor in the main R&D portion of 1300 is painted. These trenches are connected to the sewer system which drains to the Midland facility WWTP.

A propane-fueled jeep/fork truck is frequently used in the 732 portion of this building. The laundry area is located on the southern side of the 1300 portion of the building, and the concrete flooring in the R&D/lab portion of 1300 is painted.

PID detections were observed in the ambient air in the southeastern bathroom (0.1 ppm), the laundry area (0.6-0.8 ppm), the large R&D area (0.1-0.7 ppm), the 732 warehouse (0.1 ppm), the southeastern lab area (0.1 ppm), and the office areas (0.1 ppm). PID detections were observed in the drains in the southeastern HVAC area (20.9 ppm), the drain in the southeastern bathroom (0.3 ppm), and the drain in the southeastern lab area (5.5 ppm).

DATA SUMMARY

The initial sampling event for Building 732/1300 occurred in Fall 2019. The analytical results from each of the sampling events were compared to the June 22, 2018 EGLE SSCs and $TSRIASL_{12,}$ if available. Sub-slab soil gas samples were collected from 10 locations from within the building. Indoor air samples were collected at 10 locations corresponding to the soil gas sample locations, along with an outdoor air sample from the main air intake. The sampling locations are shown on Figure 5.6.7-2. Summary statistics and screening comparison results are presented for sub-slab soil gas on Table 5.6.7-1 and indoor and outdoor air on Table 5.6.7-2. The analytical data is presented in Appendix A. Field sampling forms are provided in Appendix B.

The building survey completed before the initial sampling event can be found in Appendix D. Drains and other openings were screened with a PID and no soil gas entry points were identified. A chemical inventory was completed during the building survey and the chemicals found to be stored within the building are listed in the survey.

SUB-SLAB SOIL GAS RESULTS EVALUATION

Analytical results were evaluated based on methodologies presented in the 2018 Revised Vapor Intrusion Work Plan. During the Fall 2019 initial sampling event, 41 of the 65 analytes were ND in each of the samples. Twenty-four analytes were detected in sub-slab soil gas and only two analytes were detected above the EGLE SSCs, PCE and TCE. All results were less than the $TSRIASL_{12}$, if available. Table 732/1300-1 summarizes the results that were detected above an EGLE SSC.

Table 732/1300-1. Summary of Sub-Slab Soil Gas Exceedances for Building 732/1300

Analyte (Sampling Event)	Detection Frequency	Measured Range of Detects (μg/m³)	% Detections > EGLE SSC	EGLE SSC (μg/m³)
Tetrachloroethene (1)	100%	1,200-18,000	30%	2,700
Trichloroethene (1)	90%	9.4-700	30%	130

EVALUATION OF VAPOR INTRUSION

Table 732/1300-2 summarizes the indoor air results relative to the sub-slab soil gas exceedances, since VI only potentially occurs if the analyte is present in both sub-slab soil gas and indoor air. Therefore, the table below provides the analytes detected above applicable EGLE SSCs in sub-slab soil gas as well as the corresponding indoor air sample results. The outdoor air sample results are also provided to determine if the analytes were present in indoor air due to migration from outdoor air.

Table 732/1300-2. Vapor Intrusion Evaluation for Building 732/1300

Analyte (Sampling Event)	Indoor Air Detection Frequency	Indoor Air Measured Range (μg/m³)	EGLE SSC (μg/m³)	Outdoor Air Result (μg/m³)
Tetrachloroethene (1)	100%	2.4-3.4	82	2
Trichloroethene (1)	100%	0.26-2.2	4	0.41

For the 14 analytes detected in indoor air, all results were below the EGLE SSCs and $TSRIASL_{12}$, if available, with the exception of chloroform. Chloroform had three detections greater than the EGLE site-specific AAC (5.2 ug/m3); however, chloroform detections in sub-slab soil gas were less than screening levels. It is known that chloroform in tap water can be emitted into indoor air (McKone, 1987). Six analytes were detected in the outdoor air sample collected immediately upwind of the building and all six analytes were detected in indoor air, which indicates the potential for the presence of detected analytes to be attributed to outdoor air. A full ND evaluation will be performed upon the completion of seasonal confirmation sampling.

CONCLUSIONS AND RECOMMENDATIONS

Based on the indoor air results, the VI pathway at Building 732/1300 is an insignificant exposure pathway based on current use. However, based on the sub-slab soil gas results and given the potential for future VI, Building 732/1300 have been placed in VI Path Forward Building Group 2, as lines of evidence indicate that VI is insignificant and all indoor air results are less than EGLE SSCs. Additionally, due to the presence of chloroform in indoor air above the EGLE SSC, Building 732/1300 is also included in Group 3, as lines of evidence indicate that VI is insignificant, sub-slab soil gas concentrations are less than the EGLE SSC for chloroform but indoor air results are greater than the EGLE SSC. Seasonal confirmation sampling is recommended for Building 732/1300 and seasonal confirmation sampling event 2 is scheduled for Winter 2020/2021. A full evaluation of Building 732/1300 will be conducted upon completion of seasonal confirmation sampling.

5.6.8 Vapor Intrusion Evaluation for Building 759/1350

BACKGROUND

Building 759/1350 was built in 1991-1992 and is located in the northeastern quadrant of the Midland facility (see Figure 5.6.8-1). The 759 portion of this building is predominantly unoccupied office and shop space; however, it has been combined with 1350 as these two structures share a wall with an opening between the two buildings. Additionally, occupants of 1350 frequently walk through portions of 759 to access process areas located to the west of the combined structure. This building contains office space, conference rooms, laundry areas, kitchen/break rooms, a control room, multiple labs, unoccupied shop space, and locker rooms. This building is a one-story slab-on-grade structure with no basement or elevator and has a combined footprint of 31,753 ft^2.

The surrounding outdoor ground cover for this building is asphalt. Both parts of the building are heated via hot air circulation. Two mechanical rooms are located at the northeast corner and southern side of the 1350 portion of the structure and each room contains air-handling units that are associated with outdoor intakes on either the side of the building or the roof in the noted areas. The 759 portion has an HVAC unit located in the unoccupied instrument shop area with an internal intake. Four overhead/bay doors are located on the 759 portion of the structure. One of the bay doors located near the northwestern corner is open the majority of the time. Occupants of this combined building use washers and dryers located throughout the building.

No PID detections were observed in the ambient air or in any of the drain features observed in this building at the time of the survey.

DATA SUMMARY

The initial sampling event for Building 759/1350 occurred in Fall 2019. The analytical results from each of the sampling events were compared to the June 22, 2018 SSCs and $TSRIASL_{12}$, if available. Sub-slab soil gas samples were collected from 13 locations from within the building. Indoor air samples were collected at 13 locations corresponding to the soil gas sample locations, along with an outdoor air sample from the main air intake. The sampling locations are shown on Figure 5.6.8-2. Summary statistics and screening comparison results are presented for sub-slab soil gas on Table 5.6.8-1 and indoor and outdoor air on Table 5.6.8-2. The analytical data is presented in Appendix A. Field sampling forms are provided in Appendix B.

The building survey completed before the initial sampling event can be found in Appendix D. Drains and other openings were screened with a PID and no soil gas entry points were identified. A chemical inventory was completed during the building survey and the chemicals found to be stored within the building are listed in the survey.

SUB-SLAB SOIL GAS RESULTS EVALUATION

Analytical results were evaluated based on methodologies presented in the 2018 Revised Vapor Intrusion Work Plan. During the Fall 2019 initial sampling event, 40 of the 65 analytes were ND in each of the samples. Twenty-five analytes were detected in sub-slab soil gas and only PCE was detected above both the EGLE SSC and the $TSRIASL_{12}$, if available. Table 759/1350-1 summarizes the results that were detected above an EGLE SSC.

Table 759/1350-1. Summary of Sub-Slab Soil Gas Exceedances for Building 759/1350

Analyte (Sampling Event)	Detection Frequency	Measured Range of Detects ($\mu g/m^3$)	% Detections > EGLE SSC	EGLE SSC ($\mu g/m^3$)
Tetrachloroethene (1)	100%	79-3,400	8%	2,700

EVALUATION OF VAPOR INTRUSION

Table 759/1350-2 summarizes the indoor air results relative to the sub-slab soil gas exceedances, since VI only potentially occurs if the analyte is present in both sub-slab soil gas and indoor air. Therefore, the table below provides the analytes detected above applicable EGLE SSCs in sub-slab soil gas as well as the corresponding indoor air sample results. The outdoor air sample results are also provided to determine if the analytes were present in indoor air due to migration from outdoor air.

Table 759/1350-2. Vapor Intrusion Evaluation for Building 759/1350

Analyte (Sampling Event)	Indoor Air Detection Frequency	Indoor Air Measured Range (μg/m³)	EGLE SSC (μg/m³)	Outdoor Air Result (μg/m³)
Tetrachloroethene (1)	8%	0.77	82	ND

For the 21 analytes detected in indoor air, all results were below the EGLE SSC and $TSRIASL_{12}$, if available. Twelve analytes were detected in the outdoor air sample collected immediately upwind of the building and all 12 analytes were detected in indoor air, which indicates the potential for the presence of detected analytes to be attributed to outdoor air. A full ND evaluation will be performed upon the completion of seasonal confirmation sampling

CONCLUSIONS AND RECOMMENDATIONS

Based on the indoor air results, the VI pathway at Building 759/1350 is an insignificant exposure pathway based on current use. However, based on the sub-slab soil gas results and given the potential for future VI, Building 759/1350 has been placed in VI Path Forward Building Group 2, as lines of evidence indicate that VI is insignificant and all indoor air results are less than the EGLE SSCs. Seasonal confirmation sampling is recommended for Building 759/1350 and seasonal confirmation sampling event 2 is scheduled for Winter 2020/2021. A full evaluation of Building 759/1350 will be conducted upon completion of seasonal confirmation sampling.

5.6.9 Vapor Intrusion Evaluation for Building 49

Building 49 was constructed prior to 1938, per aerial photography, and is located in the northwestern quadrant of the Midland facility (Figure 5.6.9-1). Roughly 75% of the building is a large shop area broken into an auto, valve, and machine shop. The western 25% of the building consists of office space. There is an office annex located on the south-central side of the shop area. There is also a small warehouse structure located on the southeast corner of the building. Approximately 40 to 50 people occupy the building. Most occupants work four 10-hour shifts Monday through Thursday, but some others work five 8-hour shifts Monday through Friday. On occasion, some occupants may work overtime.

The building is a slab-on-grade construction with no basement and has a footprint of 60,851 ft^2. The western office area of the building is four stories. The shop area is roughly two to three stories tall, and the southern office annex is one-story. Most of the office areas throughout this building have an epoxy coating over the concrete floor. There are two elevators in this building: one is located on the south side of the building near the wall shared with the office portion and shop portion of the building, and the other is on the north side of the building.

The building is heated via steam radiation. There are three central AC units: one for the western office areas, one for the office annex, and one for the second-story/deck lunch room located on the north side of the shop. Two large intakes are located on the south side of the building, with an additional one located on the north side of the building on the roof. There are also multiple vents located on the northern and eastern sides of the structure. There are five bay doors that are normally open during the summer and are closed as much as possible during the winter. The ground cover outside of the building is a mixture of grass and asphalt. Occupants use washers and dryers found in the locker room and on the north central side of the large shop area.

PID detections were observed in the ambient air during the initial building survey at:

- The eastern portion of the machine shop: Up to 0.9 ppm;
- The hallway around the seal room: 0.1 ppm;

- The seal room: 0.2-0.3 ppm;
- The washdown area: 0.4-0.6 ppm;
- To the east of the entryway of the southeastern break room: 0.2-4.6 ppm;
- The southeastern warehouse: 0.1-1.1 ppm;
- The value/auto shop area: 0.4 ppm;
- Laundry area: 0.3 ppm;
- Machine shop office: 0.8 ppm; and
- Western part of the machine shop: 0.1-0.6 ppm.

PID detections were observed in:

- The drain just north of the southeastern warehouse: 1.2 ppm;
- The drain in the women's locker room in the office portion of the building: 4.3 ppm;
- The drain in the men's bathroom in the office portion of the building: 0.2 ppm; and
- The drain in the machine shop office's bathrooms: 0.1 ppm.

EXPEDITED REPORTING

An Expedited Building Summary (EBS) was provided in December 2019 based on the Summer 2019 sampling event identifying PCE and trans-1,2-DCE above the $TSRIASL_{12}$ in indoor air. Email notifications were provided to EGLE in October 2019 and April 2020. Seasonal confirmation sampling was initiated for both sub-slab soil gas and indoor air. Additionally, Building 49 underwent further investigation activities with the mobile-GC field team in October 2019 and February 2020. The findings of the further investigation activities are discussed further below (investigation reports are provided in Appendix C).

The EBS submitted in December 2019 concluded that the PCE and trans-1,2-DCE detected in the indoor air at Building 49 is due to indoor sources and is not attributable to VI. The indoor air results suggest a common source, such as work within the pump room, scale shop, seal room, machine shop, and motor/valve shop involving degreasers or other products. During a preliminary further investigation walk-through, the field team identified 44 cans of PCE degreaser throughout the shop areas. Interim Measures are not necessary to address the detections of PCE and trans-1,2-DCE in indoor air at Building 49; however, seasonal confirmation sampling will occur and the building has been scheduled for further investigation activities.

DATA SUMMARY

Building 49 has undergone two sampling events. The analytical results from each of the sampling events were compared to the June 22, 2018 EGLE SSC (12 hr soil gas screening criteria and AACs) and the $TSRIASL_{12,}$ if available.

Table 49-1. Sampling Events for Building 49

Building 49	
Initial Sampling Event	**Completed**
E1	August 2019 (Summer)
E2	December 2019 (Winter)

For each sampling event, sub-slab soil gas samples were collected from 25 locations from within the building. Indoor air samples were collected at 25 locations corresponding to the soil gas sample locations, along with an outdoor air sample from the main air intake. The sampling locations are shown on Figure 5.6.9-2. Summary statistics and screening comparison results are presented for sub-slab soil gas on Table 5.6.9-1 and indoor and outdoor air on Table 5.6.9-2. The analytical data is presented in Appendix A. Field sampling forms are provided in Appendix B. The building survey completed before the initial sampling event can be found in Appendix D. Drains and other openings were screened with a PID and results were listed above. A chemical inventory was completed during the building survey and the chemicals found to be stored within the building are listed in the survey.

SUB-SLAB SOIL GAS RESULTS EVALUATION

Analytical results were evaluated based on methodologies presented in the 2018 Revised Vapor Intrusion Work Plan. During the initial event (Summer 2019), seven analytes were detected above the EGLE SSC and each analyte had at least one result that also exceeded the $TSRIASL_{12}$ (with the exception of 1,4-dioxane). During the Winter 2019 sampling event, six of the same analytes exceeded the EGLE SSC and three of those analytes also had results greater than the $TSRIASL_{12}$ (cis-1,2-dichloroethene, tetrachloroethene and trichloroethene). The results for the seven sub-slab soil gas analytes with exceedances are summarized in Table 49-2 below.

Table 49-2. Summary of Sub-Slab Soil Gas Exceedances for Building 49

Analyte (Sampling Event)	Detection Frequency	Measured Range of Detects (μg/m³)	% Detections > Screening Level	EGLE SSC (μg/m³)
1,1-Dichloroethane (1)	100%	5.1-42,000	16%	2,500
1,1-Dichloroethane (2)	88%	6.4-12,000	12%	2,500
1,1-Dichloroethene (1)	60%	11-100,000	8%	20,000
1,1-Dichloroethene (2)	48%	16-27,000	4%	20,000
1,4-Dioxane (1)	8%	31-1,200	4%	800
1,4-Dioxane (2)	4%	370	0%	800
Chloroform (1)	92%	7-4,100	64%	170
Chloroform (2)	84%	16-1,400	44%	170
cis-1,2-Dichloroethene (1)	72%	16-55,000	20%	820
cis-1,2-Dichloroethene (2)	68%	12-14,000	12%	820
Tetrachloroethene (1)	100%	170-230,000	44%	2,700
Tetrachloroethene (2)	100%	68-180,000	44%	2,700
Trichloroethene (1)	100%	5.6-120,000	72%	130
Trichloroethene (2)	88%	11-30,000	64%	130

EVALUATION OF VAPOR INTRUSION

Table 49-3 summarizes the indoor air results relative to the sub-slab soil gas exceedances, since VI only potentially occurs if the analyte is present in both sub-slab soil gas and indoor air. Therefore, the table below provides the analytes detected above applicable screening levels in sub-slab soil gas as well as the corresponding indoor air sample results. The outdoor air sample results are also provided to determine if the analytes were present in indoor air due to migration from outdoor air.

Table 49-3. Vapor Intrusion Evaluation for Building 49

Analyte (Sampling Event)	Indoor Air Detection Frequency	Indoor Air Measured Range (µg/m³)	EGLE SSC (µg/m³)	Outdoor Air Result (µg/m³)
1,1-Dichloroethane (1)	12%	0.24-0.39	74	ND
1,1-Dichloroethane (2)	16%	0.27-0.75	74	ND
1,1-Dichloroethene (1)	12%	0.084-0.49	620	ND
1,1-Dichloroethene (2)	28%	0.081-1.1	620	ND
1,4-Dioxane (1)	0%	<130	24	ND
1,4-Dioxane (2)	0%	<51	24	ND
Chloroform (1)	32%	0.17-3.8	5.2	ND
Chloroform (2)	40%	0.17-0.5	5.2	ND
cis-1,2-Dichloroethene (1)	12%	0.16-0.38	24	ND
cis-1,2-Dichloroethene (2)	40%	0.22-0.84	24	ND
Tetrachloroethene (1)	100%	1.8-22,000	82	4.4
Tetrachloroethene (2)	100%	4.4-7,600	82	22
Trichloroethene (1)	16%	0.26-0.9	4	ND
Trichloroethene (2)	44%	0.41-2.1	4	ND

PCE and trans-1,2-DCE were the only analytes at Building 49 with detected results above the indoor air $TSRIASL_{12}$; however, trans-1,2-dichloroethene was not detected above the screening level in sub-slab soil gas. PCE also was detected in outdoor air samples during both sampling events. PCE exceeded the $TSRIASL_{12}$ at 10 of 25 sample locations during the initial event and at 19 of 25 sample locations during second sampling event. The indoor air sample locations with PCE exceedances were located mostly in the east side of the building (in the seal room, pump room, and scale shop) and in various locations in the machine shop, as well as the machine shop office and in the motor/valve shop. Of the indoor air PCE $TSRIASL_{12}$ exceedances, seven are co-located with corresponding sub-slab soil gas PCE $TSRIASL_{12}$ exceedances (at locations 02, 03, 05, 06, 08, 10, and 16 during each event). Figure 5.6.9-3 presents the results for PCE in sub-slab soil gas and indoor air at each sample location for each sampling event.

During the initial event, trans-1,2-DCE had a single indoor air $TSRIASL_{12}$ exceedance at one of 25 sample locations (in the pump room in the east side of the building) and all sub-slab soil gas results were below $TSRIASL_{12}$. During the second event, all sub-slab soil gas results for trans-1,2-DCE continued to be detected below screening levels; however, seven sample locations had indoor air results above screening levels. Each of the seven sample locations also had exceedances for PCE and were located mostly in the east side of the building (in the seal room, pump room, and scale shop) and in various locations in the machine shop (see Figure 5.6.9-3).

During the initial event, sub-slab soil gas $TSRIASL_{12}$ exceedances were observed for 1,1-DCA, 1,1-DCE, chloroform, cis-1,2-DCE, PCE, and TCE. For the second event, sub-slab soil gas $TSRIASL_{12}$ exceedances were observed for cis-1,2-DCE, PCE and TCE. For both events, the only chemical with corresponding indoor air and sub-slab soil gas exceedances was PCE.

The maximum indoor air result of PCE detected in Building 49 is 22,000 $\mu g/m^3$, which is 32% of the Dow Industrial Hygiene (IH) OEL. The maximum indoor air result of trans-1,2-DCE detected in Building 49 is 2,500 $\mu g/m^3$, which is 0.3% of the Dow IH OEL. Maximum indoor air concentrations for both analytes occurred during the initial sampling event. During the second sampling event the maximum concentrations for PCE and trans-1,2-DCE were 7,600 $\mu g/m^3$ and 1,200 $\mu g/m^3$, respectively.

Further Investigation Activities

On October 10, 2019, the mobile-GC field team was able to complete a preliminary further investigation walk-through and identified 44 aerosol cans of PCE degreaser throughout the shop areas, most of which were open and appeared to have been recently used (the findings of the investigation were submitted to EGLE in January 2020 and the report is included in Appendix C). The PID readings ranged from 50 - 400 ppbv in the breathing zone of the shop areas and machine shop offices. Levels in the ppm range were detected above rubber mats placed below work benches where the PCE degreasers were actively used. The south offices had PID readings between 10 - 50 ppbv and the vacant offices to the west all had 0 ppbv readings. The preliminary conclusion is that PCE concentrations detected in indoor air at Building 49 is due to active workplace chemical use. Furthermore, there is additional evidence that indicates the presence of indoor sources are not related to VI:

- Forty-four open cans of aerosol PCE degreaser were identified throughout the shop areas of the building and they appeared to have been recently used.

- PCE was detected in the outdoor air sample at 4.4 $\mu g/m^3$. The presence of PCE in outdoor air is indicative of a source of PCE not related to VI.

- The highest PCE concentrations in the indoor air occurred at locations 49-IA-03 and 49-IA-04 (Figure 49-1). At 49-IA-04 the concentration of PCE in indoor air was more than 36 times higher than the concentration of PCE detected in the sub-slab sample, indicating that VI at this location is not the cause of the elevated indoor air concentration. The data suggest that VI is not the main source of any PCE detected in indoor air.

- There is weak spatial correlation between sub-slab soil gas and indoor air PCE and trans-1,2-DCE concentrations. The concentration of trans-1,2-DCE at indoor air sampling location 49-IA-04 is 40 times higher than the corresponding sub-slab soil gas concentration, indicating a source of trans-1,2-DCE not related to VI. The building survey found that trans-1,2-DCE-containing material were present in the pump room (the location of sample 04), indicating that indoor chemical use is responsible for the elevated trans-1,2-DCE concentration.

- The highest PCE concentrations in the indoor air occurred in the pump room and scale shop in the northeast corner of the building. The building survey found that PCE-containing materials are stored in both the pump room and scale shop in the northeast corner of the building. The correlation of the PCE-containing materials and the relatively high PCE concentrations in indoor air suggest that the detected values are the result of the indoor emission sources.

On February 12th the mobile-GC field team returned to Building 49 to continue the investigation (the findings of the further investigation were submitted to EGLE in April 2020 and the report is included in Appendix C). Baseline samples were collected at most of the previous indoor air and sub-slab soil gas locations, as well as additional samples in the west restroom in the machine shop office and at a depression below a glass cleaning machine in the main shop area. There were at least 40 aerosol degreaser cans containing >80% PCE found throughout the shop areas and workers were actively using degreasers on machine parts. While degreasing was not occurring in the West or South offices, doors were opened with direct hallway access from these offices to the shop areas. Except for an occasional quick delivery, bay doors were closed throughout the shop areas to keep heat in the building.

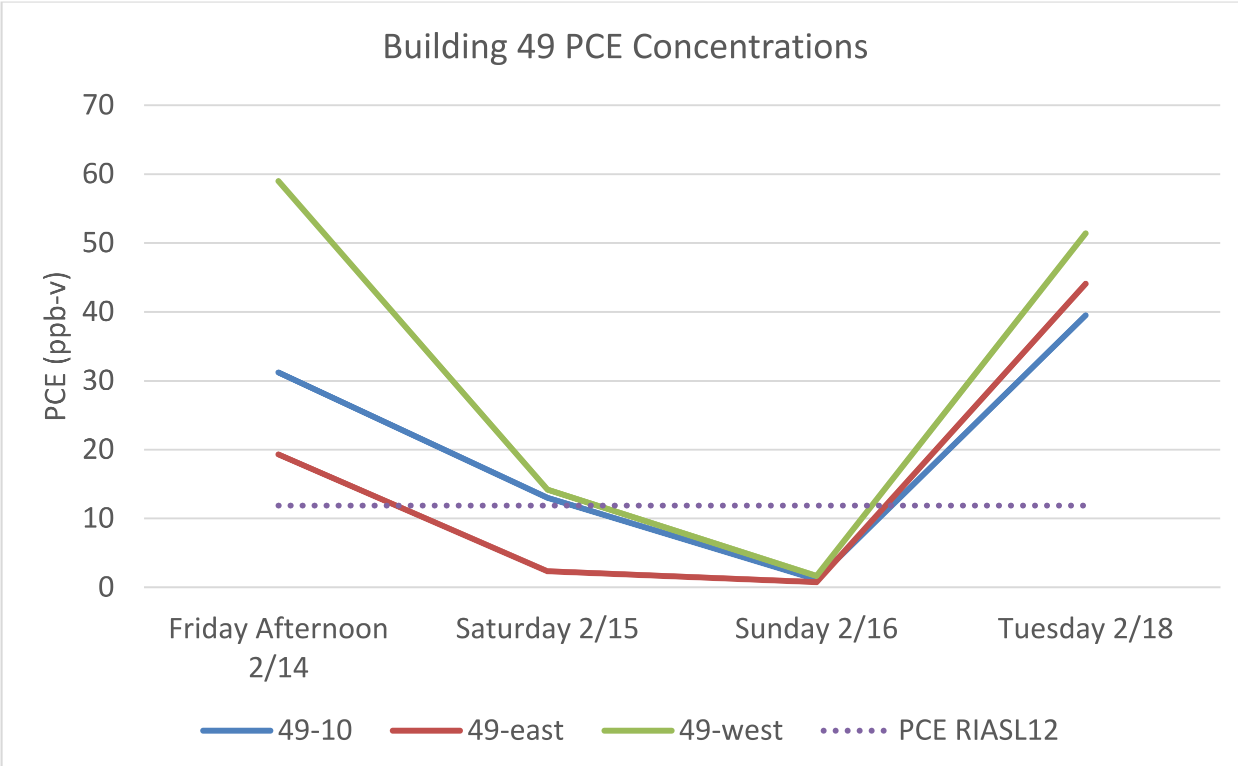
As expected, samples with screening level exceedances for PCE were found near areas with active or recent degreasing such as the shop areas and adjacent machine shop office. All baseline samples were collected in the breathing zone, with the exception of a sample that was collected below ground level at a depression underneath a glass cleaning machine (near location 49-08). This sample had a PCE concentration of 240 ppbv (1,650 $\mu g/m^3$). While it should be noted this result is over the Field GC's calibration range, it was still significantly higher than the nearby 49-08 concentration of 380 $\mu g/m^3$. As sub-slab soil gas concentrations of PCE are known to be significantly elevated in this area, these results prompted further investigation into this depression (49-08D).

To determine if VI was occurring at 49-08D, a depressurization test sealing off the open areas between the machine and floor was conducted the following day. If VI was occurring, depressurizing an area would raise PCE concentrations by forcing soil vapors along the pressure gradient into the depressurized area. The depressurization test did not significantly alter PCE concentrations within the sealed and depressurized trench, and the nearby baseline comparison samples had similar concentrations of PCE throughout testing. This test eliminated this depression as a potential VI source.

During the initial baseline, elevated ppbRAE PID readings were found at a drain in the west restroom in the machine shop office (49-10BR). To determine if VI was occurring, the restroom was also depressurized. Samples were collected in the restroom and 15 feet away in the machine shop office before and after two hours of depressurization. The depressurization test significantly lowered PCE concentrations in the west machine shop office restroom thus eliminating the restroom and its floor drain as a potential VI source.

One additional depressurization test was conducted in the large conference room in the west office area of the building. Sample location 49-23 was the only sample location in the west offices to have a high PCE sub-slab soil gas concentration. Prior to the depressurization test, the conference room doors and door from machine shop into the west offices were left open, allowing building air to freely travel between the machine shop and the conference room. To determine if VI was occurring, the large conference room was depressurized with two box fans sealed with plastic sheeting around the conference room doorway for three hours. Samples were collected in the large conference room before and after 3 hours of depressurization, in addition to a control sample collected 15 feet away down the hallway from the large conference room. The depressurization test significantly lowered PCE concentrations in the large conference room, which is the opposite of what would be expected if PCE were present in indoor air due to VI. Therefore, the indoor air concentrations detected in the large conference room are not attributable to VI.

In order to confirm the elevated indoor PCE concentrations originated from workplace chemical use, samples were collected on Friday, throughout the weekend, and the following Monday and Tuesday. Work within the building stopped Friday afternoon and resumed the following Monday. All bay doors were closed throughout the weekend. Samples were collected at three locations during this experiment: in the machine shop office (49-10), in the western part of the shop area in the valve shop (49-west), and in the eastern part of the machine shop (49-east). As shown in the chart below, PCE concentrations fell rapidly throughout the weekend and were below the indoor air screening level by Sunday afternoon. Additional samples were collected on Tuesday afternoon and PCE concentrations rose rapidly with routine workplace chemical use and operations; indicating that the PCE detected in indoor air is the result of indoor emission sources and not due to VI.



CONCLUSIONS AND RECOMMENDATIONS

The investigative findings concluded that routine workplace chemical use contributed to the elevated PCE concentrations in indoor air. All potential preferential pathways identified in the building were eliminated by performing depressurization tests. Additionally, sample collection over the weekend confirmed the elevated indoor air concentrations were caused by workplace chemical use.

Based on the findings presented above, routine workplace chemical use is the source of the indoor air exceedances in Building 49 and the contribution of VI to the measured indoor air concentrations is insignificant. However, based on the sub-slab soil gas results and given the potential for future VI, Building 49 has been placed in VI Path Forward Building Group 4A. Seasonal confirmation sampling continued in Fall 2020 and the final event is scheduled for Spring 2021. A full evaluation and trend analysis will be presented in the 2021 CAIP.

5.6.10 Vapor Intrusion Evaluation for Building 146

BACKGROUND

Building 146 is predominantly a large enclosed area with rail lines running into it with shop benches located to the side of the rail lines (see Figure 5.6.10-1). Small walled-off areas in this structure are located in the northern, western, and southern corners. These areas contain offices, bathrooms, and storage areas, respectively. This two-story structure was built prior to 1938 per aerial photography and is located in the northwestern quadrant of the Midland facility. The building is slab-on-grade construction with no basement and no elevators.

The building has seven bay doors, six of which are located on the southeastern side and one is located on the southwestern side. These doors are open more often during the summer months and are closed as much as possible during the winter months. The office and bathroom areas are cooled by a central AC unit and individual AC unit, respectively. An outdoor intake for the northern office area is located on the northeast side of the building. There are mechanical fans located throughout the main open area of the structure. The office and bathroom areas are heated by electric baseboards or mounted heaters. The surrounding ground cover outside the building is gravel/grass on the northeast, southeast, and southwest sides of the building; and gravel/asphalt on the northwest side of the building. Occupants either use a contracted weekly laundry service or washers and dryers that are in the men's locker room located on the second floor deck.

At the time of the survey, PID detection of 0.3 ppm was observed in the drain found in the women's bathroom; and PID detections ranging from 0.1, 0.2, and 0.5-0.6 ppm were seen in the ambient air in the main railcar area, the women's bathroom, and chemical storage room, respectively.

DATA SUMMARY

The initial sampling event for Building 146 occurred in Fall 2019. The analytical results from each of the sampling events were compared to the June 22, 2018 EGLE SSCs and $TSRIASL_{12}$, if available. Sub-slab soil gas samples were collected from nine locations from within the building. Indoor air samples were collected at nine locations corresponding to the soil gas sample locations, along with an outdoor air sample from the main air intake. The sampling locations are shown on Figure 5.6.10-2. Summary statistics and screening comparison results are presented for sub-slab soil gas on Table 5.6.10-1 and indoor and outdoor air on Table 5.6.10-2. The analytical data is presented in Appendix A. Field sampling forms are provided in Appendix B.

The building survey completed before the initial sampling event can be found in Appendix D. Drains and other openings were screened with a PID and no soil gas entry points were identified. A chemical inventory was completed during the building survey and the chemicals found to be stored within the building are listed in the survey.

SUB-SLAB SOIL GAS RESULTS EVALUATION

Analytical results were evaluated based on methodologies presented in the 2018 Revised Vapor Intrusion Work Plan. During the Fall 2019 initial sampling event, 35 of the 65 analytes were ND in each of the samples. Thirty analytes were detected in sub-slab soil gas and only two analytes were detected above the EGLE SSCs, chloroform and TCE. All results were less than the $TSRIASL_{12}$, if available. Table 146-1 summarizes the results that were detected above an EGLE SSC.

Table 146-1. Summary of Sub-Slab Soil Gas Exceedances for Building 146

Analyte (Sampling Event)	Detection Frequency	Measured Range of Detects (µg/m³)	% Detections > EGLE SSC	EGLE SSC (µg/m³)
Chloroform (1)	22%	7.7-300	11%	170
Trichloroethene (1)	44%	5.6-190	11%	130

EVALUATION OF VAPOR INTRUSION

Table 146-2 summarizes the indoor air results relative to the sub-slab soil gas exceedances, since VI only potentially occurs if the analyte is present in both sub-slab soil gas and indoor air. Therefore, the table below provides the analytes detected above applicable EGLE SSCs in sub-slab soil gas as well as the corresponding indoor air sample results. The outdoor air sample results are also provided to determine if the analytes were present in indoor air due to migration from outdoor air.

Table 146-2. Vapor Intrusion Evaluation for Building 146

Analyte (Sampling Event)	Indoor Air Detection Frequency	Indoor Air Measured Range (μg/m³)	EGLE SSC (μg/m³)	Outdoor Air Result (μg/m³)
Chloroform (1)	0%	<1.8	5.2	ND
Trichloroethene (1)	11%	0.38	4	ND

For the 16 analytes detected in indoor air, all results were below the EGLE SSCs and $TSRIASL_{12}$, if available. Six analytes were detected in the outdoor air sample collected immediately upwind of the building and five out of six analytes were detected in indoor air, which indicates the potential for the presence of detected analytes to be attributed to outdoor air. A full ND evaluation will be performed upon the completion of seasonal confirmation sampling in the 2020 CAIP.

CONCLUSIONS AND RECOMMENDATIONS

Based on the indoor air results, the VI pathway at Building 146 is an insignificant exposure pathway based on current use. However, based on the sub-slab soil gas results and given the potential for future VI, Building 146 has been placed in VI Path Forward Building Group 2, as lines of evidence indicate that VI is insignificant and all indoor air results are less than EGLE SSCs. Seasonal confirmation sampling is recommended for Building 146 and seasonal confirmation sampling event 2 is scheduled for Winter 2020/2021. A full evaluation of Building 146 will be conducted upon completion of seasonal confirmation sampling.

5.6.11 Vapor Intrusion Evaluation for Building 180

The entire Building 180 structure is located in the southwestern quadrant of the Midland facility (see Figure 5.6.11-1). The railcar area was built prior to 1940, and the office annex was built in the 1970s. This building contains a large enclosed area that has railroad tracks within it for the purpose of maintaining and washing rail cars. The office/shop annex is attached to the southwest side of this building. The building is a slab-on-grade construction with no basement or elevator and has a footprint of 23,031 ft^2. The office annex is one-story tall, and the rail car area is approximately two stories tall. The kitchen floor in the office annex is covered in an epoxy coating.

The office annex is heated via forced hot air circulation and is cooled via a central AC unit located on southern side of the building. The outside air intake for the office annex is located above the bay door to the HVAC room. The entire structure has 11 bay doors, nine of which are on the railcar area of the building, one is located on the south side of the shop, and one is located on the western side of the HVAC room. These bay doors are opened more than they are closed during the summer months and vice versa for the winter months. The surrounding outdoor ground cover is predominantly gravel with some grass with the exception of asphalt located to the southwest. Occupants either use a contracted weekly laundry service or use the washers and dryers located in the men's locker room.

PID readings collected during the survey showed no detections of VOCs in the ambient air or from any drain feature observed.

DATA SUMMARY

Building 180 was sampled in Fall 2019. The analytical results from each of the sampling events were compared to the June 22, 2018 EGLE SSCs and $TSRIASL_{12}$, if available. Sub-slab soil gas samples were collected from 10 locations from within the building. Indoor air samples were collected at 10 locations corresponding to the soil gas sample locations, along with an outdoor air sample from the main air intake. The sampling locations are shown on Figure 5.6.11-2. Summary statistics and screening comparison results are presented for sub-slab soil gas on Table 5.6.11-1 and indoor and outdoor air on Table 5.6.11-2. The analytical data is presented in Appendix A. Field sampling forms are provided in Appendix B.

The building survey completed before the initial sampling event can be found in Appendix D. Drains and other openings were screened with a PID and no soil gas entry points were identified. A chemical inventory was completed during the building survey and the chemicals found to be stored within the building are listed in the survey.

Based on the screened results, no indoor air analytes were detected above the $TSRIASL_{12}$ during the sampling event at Building 180. Therefore, no EBS was necessary.

SUB-SLAB SOIL GAS RESULTS EVALUATION

Analytical results were evaluated based on methodologies presented in the 2018 Revised Vapor Intrusion Work Plan. Thirty-two of the 65 analytes were ND in each of the samples. Thirty-three analytes were detected in sub-slab soil gas but all detected results were below the EGLE SSCs and $TSRIASL_{12}$, if available.

VAPOR INTRUSION RESULTS EVALUATION

VI only potentially occurs if the analyte is present in both sub-slab soil gas and indoor air. There were no sub-slab soil gas exceedances of the EGLE SSCs. For the 16 analytes detected in indoor air, all results were below the EGLE SSCs and $TSRIASL_{12}$, if available. Eight analytes were detected in the outdoor air sample collected immediately upwind of the building and all eight analytes were detected in indoor air, which indicates the potential for the presence of detected analytes to be attributed to outdoor air.

ND RLs for EDB (sub-slab soil gas only) and 1,2,4-TCB (indoor air only) exceed the EGLE SSCs. EDB and requires further investigation which will be conducted once the facility-wide priority buildings have been sampled and evaluated.

CONCLUSIONS AND RECOMMENDATIONS

Based on the sampling results, the VI pathway at Building 180 is an insignificant exposure pathway based on current use. Building 180 was placed into VI Path Forward Building Group 1 and no further VI evaluation is warranted at this time.

5.6.12 Vapor Intrusion Evaluation for Building 298

BACKGROUND

Building 298 is roughly 75-80 years old and is located in the northeastern quadrant of the Midland facility (see Figure 5.6.12-1). This building contains offices, conference rooms, kitchen/break rooms, bathrooms, a lab and laundry room (on the second floor), and a large shop area in the eastern half of the building. Half of the building is one-story, and the other half is two stories. The building is a slab-on-grade construction with no basement or elevator and has an approximate footprint of 14,034 ft^2.

The structure is heated via steam radiation and is cooled via a combination of three central and five individual AC units. The three central AC units have intakes located on the west side and north side of the building. The building has two bay doors off of the shop portion of the building that are open frequently during the summer but are otherwise closed. The surrounding outdoor ground surface of the building is covered with either asphalt or concrete. On occasion, a fork truck or golf cart is stored in the shop portion of the building. Although laundry facilities are present in this building, a contracted weekly laundry service is also available.

No PID detections were observed in the ambient air throughout the building or from any drain-like features observed during the survey.

DATA SUMMARY

The initial sampling event for Building 298 occurred in Fall 2019. The analytical results from each of the sampling events were compared to the June 22, 2018 SSCs and $TSRIASL_{12}$, if available).

Sub-slab soil gas samples were collected from nine locations from within the building. Indoor air samples were collected at nine locations corresponding to the soil gas sample locations, along with an outdoor air sample from the main air intake. The sampling locations are shown on Figure 5.6.12-2. Summary statistics and screening comparison results are presented for sub-slab soil gas on Table 5.6.12-1 and indoor and outdoor air on Table 5.6.12-2. The analytical data is presented in Appendix A. Field sampling forms are provided in Appendix B.

The building survey completed before the initial sampling event can be found in Appendix D. Drains and other openings were screened with a PID and no soil gas entry points were identified. A chemical inventory was completed during the building survey and the chemicals found to be stored within the building are listed in the survey.

SUB-SLAB SOIL GAS RESULTS EVALUATION

Analytical results were evaluated based on methodologies presented in the 2018 Revised Vapor Intrusion Work Plan. During the Fall 2019 initial sampling event, 42 of the 65 analytes were ND in each of the samples. Twenty-three analytes were detected in sub-slab soil gas and four analytes were detected above the EGLE SSCs: chloroform, cis-1,2-DCE, PCE and TCE. Results for cis-1,2-DCE, PCE and TCE each had results greater than the $TSRIASL_{12}$. Table 298-1 summarizes the results that were detected above an EGLE SSC.

Table 298-1. Summary of Sub-Slab Soil Gas Exceedances for Building 298

Analyte (Sampling Event)	Detection Frequency	Measured Range of Detects ($\mu g/m^3$)	% Detections > EGLE SSC	EGLE SSC ($\mu g/m^3$)
Chloroform (1)	89%	5.5-410	33%	170
cis-1,2-Dichloroethene (1)	78%	7-3,400	33%	820
Tetrachloroethene (1)	100%	420-56,000	67%	2,700
Trichloroethene (1)	100%	11-4,700	67%	130

EVALUATION OF VAPOR INTRUSION

Table 298-2 summarizes the indoor air results relative to the sub-slab soil gas exceedances, since VI only potentially occurs if the analyte is present in both sub-slab soil gas and indoor air. Therefore, the table below provides the analytes detected above applicable EGLE SSCs in sub-slab soil gas as well as the corresponding indoor air sample results. The outdoor air sample results are also provided to determine if the analytes were present in indoor air due to migration from outdoor air.

Table 298-2. Vapor Intrusion Evaluation for Building 298

Analyte (Sampling Event)	Indoor Air Detection Frequency	Indoor Air Measured Range ($\mu g/m^3$)	EGLE SSC ($\mu g/m^3$)	Outdoor Air Result ($\mu g/m^3$)
Chloroform (1)	100%	0.19-0.95	5.2	ND
cis-1,2-Dichloroethene (1)	22%	0.15-0.16	24	ND
Tetrachloroethene (1)	100%	0.44-3.3	82	ND
Trichloroethene (1)	78%	0.41-0.7	4	ND

For the 19 analytes detected in indoor air, all results were below the EGLE SSCs and $TSRIASL_{12}$, if available. Nine analytes were detected in the outdoor air sample collected immediately upwind of the building and all nine analytes were detected in indoor air, which indicates the potential for the presence of detected analytes to be attributed to outdoor air. A full ND evaluation will be performed upon the completion of seasonal confirmation sampling.

CONCLUSIONS AND RECOMMENDATIONS

Based on the indoor air results, the VI pathway at Building 298 is an insignificant exposure pathway based on current use. However, based on the sub-slab soil gas results and given the potential for future VI, Building 298 has been placed in VI Path Forward Building Group 2, as lines of evidence indicate that VI is insignificant and all indoor air results are less than the EGLE SSCs. Seasonal confirmation sampling is recommended for Building 298 and seasonal confirmation sampling event 2 is scheduled for Winter 2020/2021. A full evaluation of Building 298 will be conducted upon completion of seasonal confirmation sampling.

5.6.13 Vapor Intrusion Evaluation for Building 374

Building 374 was built in the 1950s and is located in the northeastern quadrant of the Midland facility (see Figure 5.6.13-1). Building 374 is predominantly process area used to make and package Methocel, but small support office areas, break rooms, shop space, and warehouse exist in the southern and southeastern portion of the building. Building 375 is connected to the west side of the southern warehouse portion of Building 374 via a large overhead door, but it is a process area. The structure ranges anywhere from one-story to seven stories in height and has a footprint of approximately 64,809 ft^2. Roughly 36,603 ft^2 of the footprint is process area that ranges from being completely enclosed to having partial walls. The portion of the structure containing non-process areas (offices, warehouse space, etc.) is 28,206 ft^2. The building is a slab-on-grade construction with no basement and a freight elevator is located in the process area.

Building 374 has eight bay/overhead doors that are open for roughly half the year for delivery and ventilation purposes. Much of the building is heated via steam radiation, but some of the enclosed parts are heated via hot air circulation. There are three AC units, one of which is an individual unit for the lunch room area in the warehouse. Intakes for the central units are located on the roof. The surrounding outdoor ground cover is either asphalt or gravel. Occupants use the laundry services via Building 1131. Propane-fueled fork trucks and gasoline-fueled power washers are used in the warehouse portion of the building.

No PID detections were observed in the ambient air throughout the building; however, PID detections were observed from the drains located in a janitor’s closet (1.2 ppm) and the men’s bathroom (0.5 ppm).

DATA SUMMARY

Building 374 was sampled in Fall 2019. The analytical results from each of the sampling events were compared to the June 22, 2018 EGLE SSCs and $TSRIASL_{12,}$ if available. Sub-slab soil gas samples were collected from 12 locations from within the building. Indoor air samples were collected at 12 locations corresponding to the soil gas sample locations, along with an outdoor air sample from the main air intake. The sampling locations are shown on Figure 5.6.13-2. Summary statistics and screening comparison results are presented for sub-slab soil gas on Table 5.6.13-1 and indoor and outdoor air on Table 5.6.13-2. The analytical data is presented in Appendix A. Field sampling forms are provided in Appendix B.

The building survey completed before the initial sampling event can be found in Appendix D. Drains and other openings were screened with a PID and no soil gas entry points were identified. A chemical inventory was completed during the building survey and the chemicals found to be stored within the building are listed in the survey

Based on the screened results, no indoor air analytes were detected above the $TSRIASL_{12}$ during the sampling event at Building 374. Therefore, no EBS was necessary.

SUB-SLAB SOIL GAS RESULTS EVALUATION

Analytical results were evaluated based on methodologies presented in the 2018 Revised Vapor Intrusion Work Plan. Forty of the 65 analytes were ND in each of the samples. Twenty-five analytes were detected in sub-slab soil gas but all detected results were below the sub-slab soil gas EGLE SSCs and $TSRIASL_{12}$, if available.

VAPOR INTRUSION RESULTS EVALUATION

VI only potentially occurs if the analyte is present in both sub-slab soil gas and indoor air. There were no exceedances of the sub-slab soil gas EGLE SSCs. For the 15 analytes detected in indoor air, all results were below the EGLE SSCs and $TSRIASL_{12}$, if available. Twelve analytes were detected in the outdoor air sample collected immediately upwind of the building and nine of the twelve analytes were detected in indoor air, which indicates the potential for the presence of detected analytes to be attributed to outdoor air.

The ND RL in one sample for 1,1,2,2-tetrachloroethane, 1,1,2-TCA, 1,2,4-TCB, EDB, HCBD and naphthalene exceeded the EGLE SSCs in sub-slab soil gas. ND RLs for 1,2,4-TCB, EDB, dibromomethane, and HDBD exceed the EGLE SSCs in indoor air. EDB and HCBD require further investigation which will be conducted once the facility-wide priority buildings have been sampled and evaluated.

CONCLUSIONS AND RECOMMENDATIONS

Based on the sampling results, the VI pathway at Building 374 is an insignificant exposure pathway based on current use. Building 374 was placed into VI Path Forward Building Group 1 and no further VI evaluation is warranted at this time.

5.6.14 Vapor Intrusion Evaluation for Building 464

Building 464 was built in the 1950s (per aerial photography), is located in the northeastern quadrant of the Midland facility (Figure 5.6.14-1). The building has a footprint of approximately 30,103 ft^2. It is a two-story structure that contains offices, a large break room, shop areas, and warehouse space on the first floor and predominantly office space on the second floor. The building is a slab-on-grade construction with no basement and no elevator. The second floor office area is located in the northeastern quadrant of the building. The remaining quadrants consist of a warehouse area that has been broken up to various storage areas, offices, or shop space.

The building is heated via steam radiation. Central AC units are located on the east side of the building for the second floor and in the north central portion of the building for the instrument shop and office area. Outside intakes are located on the east side of the second-story roof and on the north-central side of the building. Five overhead/barn doors exist on the structure that are typically closed during the winter months but are often open during the summer months. Propane-fueled fork trucks and large diesel-fueled JLG lifts are driven around and into the building on a frequent basis. The outdoor ground cover surrounding the building is asphalt. Occupants of the building use washers and dryers located on the second floor of Building 743.

PID detections of 0.1 ppm, 0.3 ppm, and 0.5 ppm were seen in drains found in the east side of the large break room, the vacant offices on the east side of the first floor, and a drain found in the instrument shop, respectively. PID detections of 0.1-1.3 ppm were observed in the grated chemical storage room in the southwest corner of the building, the general western shop area, and the northwestern parts room. The highest readings were seen in the western shop area and northwestern part room as recently used parts were temporarily being stored in the area and were being removed later in the day of the survey.

EXPEDITED REPORTING

An Expedited Building Summary (EBS) was provided in March 2020 based on the Fall 2019 sampling event identifying TCE above the $RIASL_{12}$ in indoor air at a single sample location. An email notification was provided to EGLE in February 2020. Additionally, Building 464 is recommended for a further investigation with the mobile-GC field team; however, due to travel and scheduling difficulties due to Covid-19, the investigation has been delayed.

The EBS submitted in March 2020 concluded that routine workplace chemical use and/or equipment storage are likely contributing to the indoor air concentrations detected in Building 464; however, the potential contribution of VI to the measured indoor air concentration at sample location 464-xx-07 is unknown. Based on these results, Building 464 was categorized as a Group 4B building until further investigation activities with the SRI-GC field team are complete. The SRI-GC field team will conduct further investigation activities at this building the next time they return to the site. Seasonal confirmation sampling was initiated for both sub-slab soil gas and indoor air. As the concentrations of TCE in indoor air in Building 464 are below the $TSRIASL_{12}$, interim response actions are not necessary.

DATA SUMMARY

Building 464 has undergone two seasonal confirmation sampling events. Seasonal confirmation sampling was conducted at Building 464 because sub-slab soil gas results from the initial sampling event exceeded screening levels. The analytical results from each of the sampling events were compared to the June 22, 2018 EGLE SSC (12 hr soil gas screening criteria and AACs) and the $TSRIASL_{12}$, if available.

Table 464-1. Sampling Events

Building 464	
Initial Sampling Event	**Completed**
E1	September 2019 (Fall)
Seasonal Sampling Event	**Completed**
E2	July 2020 (Summer)
E3	*Winter 2020/21 (Scheduled)*
E4	*Spring 2021 (Scheduled)*

For each sampling event, sub-slab soil gas samples were collected from 13 locations from within the building. Indoor air samples were collected at 13 locations corresponding to the soil gas sample locations, along with an outdoor air sample from the main air intake. The sampling locations are shown on Figure 5.6.14-2. Summary statistics and screening comparison results are presented for sub-slab soil gas on Table 5.6.14-1 and indoor and outdoor air on Table 5.6.14-2. The analytical data is presented in Appendix A. Field sampling forms are provided in Appendix B.

The building survey completed before the initial sampling event can be found in Appendix D. Drains and other openings were screened with a PID and results were discussed above. A chemical inventory was completed during the building survey and the chemicals found to be stored within the building are listed in the survey.

SUB-SLAB SOIL GAS RESULTS EVALUATION

Analytical results were evaluated based on methodologies presented in the 2018 Revised Vapor Intrusion Work Plan. The number of analytes detected above the sub-slab soil gas EGLE site-specific screening criteria and the $TSRIASL_{12}$, if available, are discussed below by sampling event and shown on Table 464-2:

1. During the initial event (Fall 2019), hexachlorobutadiene, PCE and TCE were detected above the EGLE EGLE SSC and PCE was also detected above the $TSRIASL_{12}$;

2. During the second event (Summer 2020), hexachlorobutadiene, PCE and TCE were detected above the EGLE EGLE SSC and PCE was also detected above the $TSRIASL_{12}$.

Table 464-2. Summary of Sub-Slab Soil Gas Exceedances for Building 464

Analyte (Sampling Event)	Detection Frequency	Measured Range of Detects (μg/m³)	% Detections > Screening Level	EGLE SSC (μg/m³)
Hexachlorobutadiene (1)	8%	5.1-42,000	16%	2,500
Hexachlorobutadiene (2)	8%	6.4-12,000	12%	2,500
Tetrachloroethene (1)	100%	170-230,000	44%	2,700
Tetrachloroethene (2)	100%	68-180,000	44%	2,700
Trichloroethene (1)	15%	5.6-120,000	72%	130
Trichloroethene (2)	23%	11-30,000	64%	130

EVALUATION OF VAPOR INTRUSION

Table 464-3 summarizes the indoor air results relative to the sub-slab soil gas exceedances, since VI only potentially occurs if the analyte is present in both sub-slab soil gas and indoor air. Therefore, the table below provides the analytes detected above applicable screening levels in sub-slab soil gas as well as the corresponding indoor air sample results. The outdoor air sample results are also provided to determine if the analytes were present in indoor air due to migration from outdoor air.

Table 464-3. Vapor Intrusion Evaluation for Building 464

Analyte (Sampling Event)	Indoor Air Detection Frequency	Indoor Air Measured Range (μg/m³)	EGLE SSC (μg/m³)	Outdoor Air Result (μg/m³)
Hexachlorobutadiene (1)	0%	<5	5.4	ND
Hexachlorobutadiene (2)	0%	<3.8	5.4	ND
Tetrachloroethene (1)	92%	0.25-2.7	82	ND
Tetrachloroethene (2)	100%	0.26-1.7	82	ND
Trichloroethene (1)	100%	0.86-5.8	4	ND
Trichloroethene (2)	100%	0.2-3.3	4	ND

All indoor air results in E1 and E2 were below indoor air screening levels, with the exception of the single TCE result during the initial sampling event. The indoor air sample result collected during the second sample event at the same sample location was below the TCE screening level (3.3 ug/m3). Figure 5.6.14-3 presents the sub-slab soil gas and indoor air results for each sampling event at each sample location for TCE.

The text presented below was taken from the EBS submitted to EGLE in March 2020 regarding the results from the initial sampling event:

> TCE was the only analyte at Building 464 with a detected result above the indoor air $RIASL_{12}$ (4 $\mu g/m^3$). TCE exceeded the indoor air $RIASL_{12}$ at a single sample location (464-IA-07) in the northwest portion area of the building in the shop area near various areas designated for equipment storage. TCE was detected in indoor air throughout the building at all 13 sample locations (100% detection frequency). All indoor air results at the other 12 sample locations were below the $RIASL_{12}$ and all results in the building were below the $TSRIASL_{12}$ (12 $\mu g/m^3$). In sub-slab soil gas, TCE was detected at two sample locations (15% detection frequency). A single detected TCE result of 270 $\mu g/m^3$ exceeded the sub-slab soil gas $RIASL_{12}$ (130 $\mu g/m^3$) at the same sample location as the indoor air exceedance (464-SS-07). All other sub-slab soil gas results for TCE were non-detect (ND), with the exception of sample location 464-SS-06 (23 $\mu g/m^3$).

Sub-slab soil gas $TSRIASL_{12}$ exceedances were observed for PCE at sample locations 464-SS-02, -03, -05 and -07. HCBD had a single sub-slab-soil gas $RIASL_{12}$ exceedance at sample location 464-SS-07. All other sub-slab soil gas and indoor air results at this building were below screening levels. The only analyte at Building 464 with a corresponding indoor air exceedance was TCE.

To demonstrate the level of VI that might be occurring in the building, data for PCE is included in Table 464-4. PCE is well suited for use in the development of a building-specific attenuation factor (α) given the high detection frequency in sub-slab soil gas and minimal contributions from indoor and outdoor sources. PCE was detected in 100% of sub-slab soil gas samples with an average concentration of 2,476 $\mu g/m^3$ and a maximum concentration of 6,900 $\mu g/m^3$. As shown in Table 464-4, four sub-slab soil gas results for PCE were above the $RIASL_{12}/TSRIASL_{12}$ (2,700 $\mu g/m^3$); however, PCE was not detected at concentrations above screening levels in indoor air. PCE was detected at low levels in 92% of the indoor air samples, with a maximum concentration of 2.7 $\mu g/m^3$ ($RIASL_{12}/TSRIASL_{12}$ = 82 $\mu g/m^3$). Assuming that VI is the only source, the building-specific attenuation factor (α) for PCE is 3.9E-04. Applying this attenuation factor to the maximum TCE sub-slab soil gas result indicates that any VI contribution to the measured indoor air values is <0.1 $\mu g/m^3$ (i.e., 240 $\mu g/m^3$ x 0.00039 = 0.094 $\mu g/m^3$). Therefore, it is likely that > 99% of the TCE detected in indoor air is present due to sources other than VI.

Furthermore, there is additional evidence that indicates the presence of indoor sources are not related to VI:

- During the building survey, the highest PID readings (up to 1.3 ppm) were seen in the western shop area and northwestern part room as recently used parts were temporarily being stored in the area. It is likely that the various pieces of equipment being stored in Building 464 could be off-gassing and contributing to the indoor air concentrations being measured.

- Cans of TCE-containing degreaser were identified in the western shop/parts area (near 464-xx-07) during the building survey indicating a source of workplace chemical use.

- As shown in Table 464-4, the attenuation factors calculated for TCE and PCE at sample location 464-xx-07 differ by two orders of magnitude. The ratio for PCE is much lower even though the concentration of PCE in sub-slab soil gas is over an order of magnitude greater than TCE. If significant VI was occurring at that location, the concentration of PCE detected in indoor air would likely be higher.

- TCE was detected throughout the building in all 13 indoor air samples while only two sample locations had detections of TCE in sub-slab soil gas. PCE was detected in 100% of the sub-slab soil gas sample locations at higher concentrations than TCE, while all of the indoor air results for PCE were lower than TCE (concentrations of PCE in indoor air were at least one half or less than the concentrations measured for TCE).

The maximum indoor air result of TCE detected in Building 464 is 5.8 $\mu g/m^3$, which is 0.02% of the Dow Industrial Hygiene (IH) Occupational Exposure Level (OEL).

Table 464-4. Comparison of Results for TCE and PCE

Sample ID	TCE Indoor Air	TCE Sub-Slab Soil Gas	PCE Indoor Air	PCE Sub-Slab Soil Gas
464-OA-1				
464-xx-1	0.86	<4.4	0.25	1000
464-xx-2	0.98	<9.9	0.38	3200
464-xx-3	1.3	<22	0.69	6600
464-xx-4	1	<4	0.29	1900
464-xx-5	1.2	<27	<0.23	3800
464-xx-6	2.5	23	0.71	2100
464-xx-7	5.8	240	2.7	6900
464-xx-8	1.6	<5.2	1	2000
464-xx-9	1.6	<4.3	0.86	300
464-xx-10	1.4	<4.2	0.6	800
464-xx-11	0.98	<8.5	0.38	2700
464-xx-12	1	<4.4	0.43	630
464-xx-13	1	<4.4	0.66	260
Minimum	0.86	<4.2	<0.23	260
Maximum	5.8	240	2.7	6900
Attenuation Factor (based on maximum)	0.024		3.9E-04	

Notes:
TCE Indoor Air $TSRIASL_{12}$ - 12 μg/m^3.
TCE Sub-Slab Soil Gas $TSRIASL_{12}$ - 400 μg/m^3.
PCE Indoor Air $TSRIASL_{12}$ - 82 μg/m^3.
PCE Sub-Slab Soil Gas $TSRIASL_{12}$ - 2,700 μg/m^3.
Shaded - Value > $TSRIASL_{12}$.
< = Non-detect at the reporting limit.
μg/m^3 - Micrograms per cubic meter.
ID - Identification.
TCE - Trichloroethene.
PCE - Tetrachloroethene.
The indoor air values were not adjusted for the outdoor air results.
Maximum attenuation factor based on maximum/maximum.

CONCLUSIONS AND RECOMMENDATIONS

The EBS concluded that during the initial sampling event, routine workplace chemical use and/or equipment storage are likely contributing to the indoor air concentrations detected in Building 464; however, the potential contribution of VI to the measured indoor air concentration at sample location 464-07 is unknown. All indoor air results were below screening levels during the second sample event, including the location where TCE exceeded the indoor air $RIASL_{12}$ during the initial event. Based on these results, Building 464 has been categorized as a Group 4B building until further investigation activities with the SRI-GC field team are complete. The SRI-GC field team will conduct further investigation activities at this building the next time they return to the site. The next seasonal confirmation sampling events are scheduled for Winter 2020/21 and Spring 2021. A full evaluation and trend analysis will be presented in the 2021 CAIP.

5.6.15 Vapor Intrusion Evaluation for Building 638

BACKGROUND

Building 638 was built in 1950 and is located in the northeastern quadrant of the Midland facility with a footprint of approximately 6,619 ft^2 (see Figure 5.6.15-1). This building consists of a large shop area that takes up the western 75% of the building and the eastern 25% is made up of locker rooms/bathrooms, office space, and a kitchen/break room. Building 638 is predominantly used by a contractor on site (JE Johnson). This building is a one-story slab-on-grade construction with no basement or elevator and has one bay door on the south side of the building. However, the ceiling height in the shop portion is roughly two stories tall and has a small upper deck located over part of the shop area. The bay door is closed primarily during the winter months but is open during the summer months when people are working in the shop area. The building is heated via steam radiation, and individual AC units are used for the offices and kitchen/break room area. Note that the grade for the kitchen area has been built up (as the kitchen floor is above the floor in the shop and offices areas). The surrounding ground cover is gravel with patches of asphalt. Fuel-powered vehicles pull into the shop area via the bay door on occasion. No washers or dryers are present in this building.

No PID detections were observed in the ambient air throughout the building. The only PID detection observed in a drain feature was from the drain line just west of the offices at 197.0 ppm.

DATA SUMMARY

The initial sampling event for Building 638 occurred in Fall 2019. The analytical results from each of the sampling events were compared to the June 22, 2018 EGLE SSCs and $TSRIASL_{12}$, if available. Sub-slab soil gas samples were collected from five locations from within the building. Indoor air samples were collected at five locations corresponding to the soil gas sample locations, along with an outdoor air sample from the main air intake. The sampling locations are shown on Figure 5.6.15-2. Summary statistics and screening comparison results are presented for sub-slab soil gas on Table 5.6.15-1 and indoor and outdoor air on Table 5.6.15-2. The analytical data is presented in Appendix A. Field sampling forms are provided in Appendix B.

The building survey completed before the initial sampling event can be found in Appendix D. Drains and other openings were screened with a PID and no soil gas entry points were identified. A chemical inventory was completed during the building survey and the chemicals found to be stored within the building are listed in the survey.

SUB-SLAB SOIL GAS RESULTS EVALUATION

Analytical results were evaluated based on methodologies presented in the 2018 Revised Vapor Intrusion Work Plan. During the Fall 2019 initial sampling event, 42 of the 65 analytes were ND in each of the samples. Twenty-five analytes were detected in sub-slab soil gas and chloroform was the only analyte detected above the EGLE SSCs. All results were less than the $TSRIASL_{12}$, if available. Table 638-1 summarizes the results that were detected above an EGLE SSC.

Table 638-1. Summary of Sub-Slab Soil Gas Exceedances for Building 638

Analyte (Sampling Event)	Detection Frequency	Measured Range of Detects ($\mu g/m^3$)	% Detections > EGLE SSC	EGLE SSC ($\mu g/m^3$)
Chloroform (1)	100%	12-770	20%	170

EVALUATION OF VAPOR INTRUSION

Table 638-2 summarizes the indoor air results relative to the sub-slab soil gas exceedances, since VI only potentially occurs if the analyte is present in both sub-slab soil gas and indoor air. Therefore, the table below provides the analytes detected above applicable EGLE SSCs in sub-slab soil gas as well as the corresponding indoor air sample results. The outdoor air sample results are also provided to determine if the analytes were present in indoor air due to migration from outdoor air.

Table 638-2. Vapor Intrusion Evaluation for Building 638

Analyte (Sampling Event)	Indoor Air Detection Frequency	Indoor Air Measured Range ($\mu g/m^3$)	EGLE SSC ($\mu g/m^3$)	Outdoor Air Result ($\mu g/m^3$)
Chloroform (1)	100%	0.29-0.4	5.2	0.28

For the 26 analytes detected in indoor air, all results were below the EGLE SSCs and $TSRIASL_{12}$, if available. Nineteen analytes were detected in the outdoor air sample collected immediately upwind of the building and all 19 analytes were detected in indoor air, which indicates the potential for the presence of detected analytes to be attributed to outdoor air. A full ND evaluation will be performed upon the completion of seasonal confirmation sampling.

CONCLUSIONS AND RECOMMENDATIONS

Based on the indoor air results, the VI pathway at Building 638 is an insignificant exposure pathway based on current use. However, based on the sub-slab soil gas results and given the potential for future VI, Building 638 has been placed in VI Path Forward Building Group 2, as lines of evidence indicate that VI is insignificant and all indoor air results are less than the EGLE SSCs. Seasonal confirmation sampling is recommended for Building 638 and seasonal confirmation sampling event 2 is scheduled for Winter 2020/2021. A full evaluation of Building 638 will be conducted upon completion of seasonal confirmation sampling.

5.6.16 Vapor Intrusion Evaluation for Building 774

Building 774 was constructed in the late 1950s to mid-1960s and is located in the northeastern quadrant of the Midland facility (Figure 5.6.16-1). The building contains a control room, a kitchen/lunch room, lab space, bathrooms, and office space within a large shop space. The structure is predominantly two stories, with the exception of the eastern portion that contains the control room area, which is only one-story. Building 774 is a slab-on-grade construction with no basement and no elevator and has a footprint of 12,123 ft^2. The large shop area has three bay doors. The large eastern bay door is opened the most, while the other two bay doors are seldom open.

The shop area is heated via steam radiation and the control room area is heated via hot air circulation. There is one central AC unit for the control room area and two individual AC units for enclosed office spaces found in the shop area. All intakes are located indoors and the building has two lab hoods for ventilation in the lab areas. The surrounding ground cover outside the building is asphalt. Fuel-powered vehicles and fork trucks are able to pull into the shop area. Occupants of Building 774 use the laundry facilities found in Building 719.

At the time of the survey, no PID detections were observed in the ambient air throughout the building or from drains found in the bathrooms and shop area.

DATA SUMMARY

Building 774 has undergone two seasonal confirmation sampling events. Seasonal confirmation sampling was conducted at Building 774 because sub-slab soil gas results from the initial sampling event exceeded screening levels. The analytical results from each of the sampling events were compared to the June 22, 2018 EGLE SSC (12 hr soil gas screening criteria and AACs) and the $TSRIASL_{12}$, if available.

Table 774-1. Sampling Events

Building 774	
Initial Sampling Event	**Completed**
E1	September 2019 (Fall)
Seasonal Sampling Event	**Completed**
E2	July 2020 (Summer)
E3	*Winter 2020/21 (Scheduled)*
E4	*Spring 2021 (Scheduled)*

For each sampling event, sub-slab soil gas samples were collected from nine locations from within the building. Indoor air samples were collected at nine locations corresponding to the soil gas sample locations, along with an outdoor air sample from the main air intake. The sampling locations are shown on Figure 5.6.16-2. Summary statistics and screening comparison results are presented for sub-slab soil gas on Table 5.6.16-1 and indoor and outdoor air on Table 5.6.16-2. The analytical data is presented in Appendix A. Field sampling forms are provided in Appendix B.

The building survey completed before the initial sampling event can be found in Appendix D. Drains and other openings were screened with a PID and no soil gas entry points were identified. A chemical inventory was completed during the building survey and the chemicals found to be stored within the building are listed in the survey.

SUB-SLAB SOIL GAS RESULTS EVALUATION

Analytical results were evaluated based on methodologies presented in the 2018 Revised Vapor Intrusion Work Plan. The number of analytes detected above the sub-slab soil gas EGLE site-specific screening criteria and the $TSRIASL_{12}$, if available, are discussed below by sampling event and shown on Table 774-2:

1. During the initial event (Fall 2019), four analytes were detected above the EGLE EGLE SSC and two analytes were detected above the $TSRIASL_{12}$ (PCE and TCE);
2. During the second event (Summer 2020), PCE and TCE were detected above the EGLE EGLE SSC and $TSRIASL_{12}$.

Table 774-2. Summary of Sub-Slab Soil Gas Exceedances for Building 774

Analyte (Sampling Event)	Detection Frequency	Measured Range of Detects (μg/m³)	% Detections > Screening Level	EGLE SSC (μg/m³)
1,1-Dichloroethane (1)	67%	5.5-3,600	11%	2500
1,1-Dichloroethane (2)	78%	3.8-820	0%	2500
cis-1,2-Dichloroethene (1)	33%	520-1,400	11%	820
cis-1,2-Dichloroethene (2)	33%	180-510	0%	820
Tetrachloroethene (1)	100%	210-54,000	67%	2,700
Tetrachloroethene (2)	100%	300-22,000	44%	2,700
Trichloroethene (1)	78%	26-4,500	56%	130
Trichloroethene (2)	78%	20-1,900	33%	130

EVALUATION OF VAPOR INTRUSION

Table 774-3 summarizes the indoor air results relative to the sub-slab soil gas exceedances, since VI only potentially occurs if the analyte is present in both sub-slab soil gas and indoor air. Therefore, the table below provides the analytes detected above applicable screening levels in sub-slab soil gas as well as the corresponding indoor air sample results. The outdoor air sample results are also provided to determine if the analytes were present in indoor air due to migration from outdoor air.

Table 774-2. Vapor Intrusion Evaluation for Building 774

Analyte (Sampling Event)	Indoor Air Detection Frequency	Indoor Air Measured Range (μg/m³)	EGLE SSC (μg/m³)	Outdoor Air Result (μg/m³)
1,1-Dichloroethane (1)	0%	<0.16	74	ND
1,1-Dichloroethane (2)	0%	<0.14	74	ND
cis-1,2-Dichloroethene (1)	0%	<0.16	24	ND
cis-1,2-Dichloroethene (2)	0%	<0.13	24	ND
Tetrachloroethene (1)	89%	0.38-2.6	82	ND
Tetrachloroethene (2)	100%	0.43-2.1	82	0.49
Trichloroethene (1)	11%	0.66	4	ND
Trichloroethene (2)	89%	0.17-2	4	ND

All indoor air results in E1 and E2 were below indoor air screening levels. 1,1-Dichloroethane and cis-1,2-dichloroethaene were both ND in indoor air during both sample events. PCE and TCE each had detected results during E1 and E2; however, all results were below indoor air screening levels. The maximum result of PCE detected in indoor air at Building 774 was 2.6 $\mu g/m^3$, which is < 1% of the Dow OEL. The maximum result of TCE detected in indoor air at Building 774 was 2 $\mu g/m^3$, which is < 1% of the Dow OEL.

CONCLUSIONS AND RECOMMENDATIONS

Based on the indoor air results, the VI pathway at Building 774 is an insignificant exposure pathway based on current use. However, based on the sub-slab soil gas results and given the potential for future VI, Building 774 has been placed in VI Path Forward Building Group 2, as lines of evidence indicate that VI is insignificant and all indoor air results are less than screening levels. The next seasonal confirmation sampling events are scheduled for Winter 2020/21 and Spring 2021. A full evaluation and trend analysis will be presented in the 2021 CAIP.

5.6.17 Vapor Intrusion Evaluation for Building 1269

Building 1269 was built in the late 1980s to early 1990s and is located in the northeastern quadrant of the Midland facility (see Figure 5.6.17-1). The building is a one-story slab-on-grade construction with no basement or elevator. Building 1269 is occupied by an insulator contractor and consists of a large shop space with a bay door, an office, a break room, and two bathroom areas (one of which has a washer/dryer setup). The structure has a footprint of approximately 2,996 ft^2.

The building is heated via hot air radiation and is cooled via an individual AC unit located near the southeastern corner of the building for the office. There are also mechanical and ventilation fans in the building. The surrounding ground surface outside the building is covered with grass to the north, and a mixture of concrete, asphalt, and gravel to the east, south, and west. The bay door on the shop is open more often during warmer months or when supplies are being moved in and out of the shop. The bay door is large enough to allow a fuel-operated vehicle to pull into the building, and a propane-fueled fork truck is used in the warehouse.

No PID detections were observed in the ambient air or any drain features at the time of the survey.

DATA SUMMARY

Building 1269 was sampled in Fall 2019. The analytical results from each of the sampling events were compared to the June 22, 2018 EGLE SSC and $TSRIASL_{12}$, if available. Sub-slab soil gas samples were collected from three locations from within the building. Indoor air samples were collected at 12 locations corresponding to the soil gas sample locations, along with an outdoor air sample from the main air intake.

The sampling locations are shown on Figure 5.6.17-2. Summary statistics and screening comparison results are presented for sub-slab soil gas on Table 5.6.17-1 and indoor and outdoor air on Table 5.6.17-2. The analytical data is presented in Appendix A. Field sampling forms are provided in Appendix B.

The building survey completed before the initial sampling event can be found in Appendix D. Drains and other openings were screened with a PID and no soil gas entry points were identified. A chemical inventory was completed during the building survey and the chemicals found to be stored within the building are listed in the survey.

Based on the screened results, no indoor air analytes were detected above the $TSRIASL_{12}$ during the sampling event at Building 374. Therefore, no EBS was necessary.

SUB-SLAB SOIL GAS RESULTS EVALUATION

Analytical results were evaluated based on methodologies presented in the 2018 Revised Vapor Intrusion Work Plan. Forty-five of the 65 analytes were ND in each of the samples. Twenty analytes were detected in sub-slab soil gas but all detected results were below the sub-slab soil gas EGLE SSCs and $TSRIASL_{12}$, if available.

VAPOR INTRUSION RESULTS EVALUATION

VI only potentially occurs if the analyte is present in both sub-slab soil gas and indoor air. There were no sub-slab soil gas exceedances of the EGLE SSCs. For the 19 analytes detected in indoor air, all results were below the EGLE SSCs and $TSRIASL_{12}$, if available. Fourteen analytes were detected in the outdoor air sample collected immediately upwind of the building and all but one of the 14 analytes were detected in indoor air, which indicates the potential for the presence of detected analytes to be attributed to outdoor air. The ND RL in one sample for 1,2,4-TCB exceeded screening levels in indoor air.

CONCLUSIONS AND RECOMMENDATIONS

Based on the sampling results, the VI pathway at Building 1269 is an insignificant exposure pathway based on current use. Building 1269 was placed into VI Path Forward Building Group 1 and no further VI evaluation is warranted at this time.

5.6.18 Vapor Intrusion Evaluation for Building 27/313/803

The Building 27/313/803 complex is located in the northeastern quadrant of the Midland facility (Figure 5.6.18-1). These buildings were combined as they share walls with openings between them that are permanently open. The entire complex has been built in phases per aerial photography. The eastern portion of 313 was built prior to 1938, and the western portion was built in the 1940s. Building 803 was built in the 1970s and Building 27 in its present layout was constructed in the 1990s-2000s.

The 27/313/803 complex contains two small office spaces, warehouse spaces, and process areas and has a footprint of approximately 36,007 ft^2. The sum area of the footprint attributed to process areas is approximately 6,890 ft^2. The two small office spaces are located in the northwestern corner of the 313 portion of the structure (this office area is referred to as the “shipping office”) and the second is located in south-central area of the 803 portion of the structure. The small office in 803 is used an hour or two a day to monitor the blending processes in 803. The entire structure ranges anywhere from one to five stories and is a slab-on-grade construction with no basement and no elevator.

The complex is heated via steam radiation, and the shipping office and blending area each have their own central AC unit. Vents are present on the northern and western side of 27 and on the western side of 803. Intakes are located on the roof for each central air unit. The complex has nine bay doors, five of which are on 27 and four are on 313. They are typically closed with the exception of a few times during the summer months. The surrounding outdoor ground cover is concrete and asphalt to the north and east and gravel to the west and south. Propane-fueled fork trucks are used in the packaging/warehouse area.

A PID detection of 0.1-0.4 ppm was observed in the ambient air in the 803 blending area at the time of the survey.

DATA SUMMARY

Building 27/313/803 has undergone two seasonal confirmation sampling events. Seasonal confirmation sampling was conducted at Building 27/313/803 because sub-slab soil gas results from the initial sampling event exceeded screening levels. The analytical results from each of the sampling events were compared to the June 22, 2018 EGLE SSC (12 hr soil gas screening criteria and AACs) and the $TSRIASL_{12}$, if available.

Table 27/313/803-1. Sampling Events

Building 27/313/803	
Initial Sampling Event	**Completed**
E1	September 2019 (Fall)
Seasonal Sampling Event	**Completed**
E2	July 2020 (Summer)
E3	*Winter 2020/21 (Scheduled)*
E4	*Spring 2021 (Scheduled)*

For each sampling event, sub-slab soil gas samples were collected from 15 locations from within the building. Indoor air samples were collected at 15 locations corresponding to the soil gas sample locations, along with an outdoor air sample from the main air intake. The sampling locations are shown on Figure 5.6.18-2. Summary statistics and screening comparison results are presented for sub-slab soil gas on Table 5.6.18-1 and indoor and outdoor air on Table 5.6.18-2. The analytical data is presented in Appendix A. Field sampling forms are provided in Appendix B.

The building survey completed before the initial sampling event can be found in Appendix D. Drains and other openings were screened with a PID and no soil gas entry points were identified. A chemical inventory was completed during the building survey and the chemicals found to be stored within the building are listed in the survey.

SUB-SLAB SOIL GAS RESULTS EVALUATION

Analytical results were evaluated based on methodologies presented in the 2018 Revised Vapor Intrusion Work Plan. The number of analytes detected above the sub-slab soil gas EGLE site-specific screening criteria and the $TSRIASL_{12}$, if available, are discussed below by sampling event and shown on Table 27/313/803-2:

1. During the initial event (Fall 2019), chloroform was the only analyte at a single sample location detected above the EGLE EGLE SSC;

2. During the second event (Summer 2020), all analytes were below the EGLE EGLE SSC.

Table 27/313/803-2. Summary of Sub-Slab Soil Gas Exceedances for Building 27/313/803

Analyte (Sampling Event)	Detection Frequency	Measured Range of Detects ($\mu g/m^3$)	% Detections > Screening Level	EGLE SSC ($\mu g/m^3$)
Chloroform (1)	7%	220	7%	170
Chloroform (2)	20%	3.9	0%	170

EVALUATION OF VAPOR INTRUSION

Table 27/313/803-3 summarizes the indoor air results relative to the sub-slab soil gas exceedances, since VI only potentially occurs if the analyte is present in both sub-slab soil gas and indoor air. Therefore, the table below provides the analytes detected above applicable screening levels in sub-slab soil gas as well as the corresponding indoor air sample results. The outdoor air sample results are also provided to determine if the analytes were present in indoor air due to migration from outdoor air.

Table 27/313/803-3. Vapor Intrusion Evaluation for Building 27/313/803

Analyte (Sampling Event)	Indoor Air Detection Frequency	Indoor Air Measured Range (μg/m³)	EGLE SSC (μg/m³)	Outdoor Air Result (μg/m³)
Chloroform (1)	93%	0.16-0.73	5.2	ND
Chloroform (2)	93%	0.25-0.91	5.2	ND

All indoor air results during E1 and E2 were below indoor air screening levels. The maximum result of chloroform detected in indoor air at Building 27/313/803 was 0.91 $\mu g/m^3$, which is well below the EGLE SSC of 5.2 ug/m3 and is < 0.01% of the Dow OEL.

CONCLUSIONS AND RECOMMENDATIONS

Based on the indoor air results, the VI pathway at Building 27/313/803 is an insignificant exposure pathway based on current use. However, based on the sub-slab soil gas results during the initial sampling event and given the potential for future VI, Building 27/313/803 has been placed in VI Path Forward Building Group 2, as lines of evidence indicate that VI is insignificant and all indoor air results are less than screening levels. The next seasonal confirmation sampling events are scheduled for Winter 2020/21 and Spring 2021. A full evaluation and trend analysis will be presented in the 2021 CAIP.

5.6.19 Vapor Intrusion Evaluation for Building 458/963

BACKGROUND

The oldest part of Building 458/963 was built in the 1960s and is located in the northeastern quadrant of the Midland facility (see Figure 5.6.19-1). Buildings 458 and 963 are connected via a corridor on their western side and eastern sides, respectively, that cannot be closed off; therefore, these buildings will be combined for further assessment. The combined footprint of this complex is approximately 95,174 ft^2. The combined portion of the footprint attributed to process areas is 25,770 ft^2. Of the non-process footprint, roughly 46,347 ft^2 consists of open areas with high ceiling heights (> 16 ft). The enclosed office areas cover approximately 23,057 ft^2.

The Building 458 portion is used predominantly as a warehouse for the Ion Exchange Anion operation; however, there are office areas located in its northeastern corner and western warehouse area. A vacant lab that is in disrepair is located just to the south of the northeastern office area. There is also a shop area with offices located on the eastern side of the western warehouse area. There are some process areas associated with the packaging areas throughout the structure.

The Building 458 portion is a slab-on-grade construction with no basement or elevators. However, some areas of the grade have been built up or dug into, such as the warehouse for the purpose of loading/unloading trucks or for packaging/process purposes, respectively. The structure is roughly one to three stories tall, with warehouse areas having ceiling heights that are approximately two to three stories high. The 458 portion of the complex is heated via steam radiation through one internal pass. Central AC is used to cool the northeastern office area of 458 via cooling towers located on the roof. The shop offices and shipping office found in the western warehouse are cooled via individual AC units. There are also some mechanical fans throughout the building. An outdoor intake is located on the north side of the building. The building has 10 bay doors, seven of which are truck bays, and the other three are slider doors. These bay/slider doors are typically shut during the winter and are open for deliveries and more frequently during the summer. The ground cover outside of the building consists of mainly concrete and asphalt, but there is some gravel on the north side near the railroad tracks. Propane-fueled fork trucks are used throughout 458. Occupants use washers and dryers found on the second-story of the northeastern office area.

Part of Building 963 (occupied by the Cation/Ion Exchange operation) was built in the 1970s, but the southern portion containing predominantly office space and locker rooms was added in 1991-1992. The Building 963 portion of the 458/963 complex contains offices, a control room, safe work permit writer area, locker rooms, laundry facilities, a kitchen/break room, labs, and a large process area on the north side. This portion of the complex is mostly a three-story structure of slab-on-grade construction that is heated via hot air circulation and cooled via central AC. The 963 portion has two handlers with scrubbers, one of which is located west of the control room and labs on the first floor, and the second is located on the east side of the third floor. Outside air intakes are associated with both of these air handlers. The control room area has an epoxy coating on its floor. The building does not have a basement and also does not have any bay doors/overhead doors. The building does have an elevator, which is located just inside the southern entrance. The ground cover outside of the building is predominantly concrete and asphalt.

For the 458 portion of the complex, PID detections were observed in the ambient air in the western warehouse (0.2 ppm), the shop area (0.1 ppm), the corridor connecting the western warehouse area to the eastern half of the building (1-1.6 ppm), and in the northeastern office area (0.1 ppm). However, no PID hits were observed from any drains encountered while walking through the 458 portion of the complex during the survey. A PID detection of 0.1 ppm was observed at the time of the survey in the laundry room and the control room area of the 963 portion of the complex.

DATA SUMMARY

The initial sampling event for Building 458/963 occurred in Fall 2019. The analytical results from each of the sampling events were compared to the June 22, 2018 EGLE SSCs and $TSRIASL_{12}$, if available. Sub-slab soil gas samples were collected from 18 locations from within the building. Indoor air samples were collected at 18 locations corresponding to the soil gas sample locations, along with an outdoor air sample from the main air intake. The sampling locations are shown on Figure 5.6.19-2. Summary statistics and screening comparison results are presented for sub-slab soil gas on Table 5.6.19-1 and indoor and outdoor air on Table 5.6.19-2. The analytical data is presented in Appendix A. Field sampling forms are provided in Appendix B.

The building survey completed before the initial sampling event can be found in Appendix D. Drains and other openings were screened with a PID and no soil gas entry points were identified. A chemical inventory was completed during the building survey and the chemicals found to be stored within the building are listed in the survey.

SUB-SLAB SOIL GAS RESULTS EVALUATION

Analytical results were evaluated based on methodologies presented in the 2018 Revised Vapor Intrusion Work Plan. During the Fall 2019 initial sampling event, 36 of the 65 analytes were ND in each of the samples. Twenty-nine analytes were detected in sub-slab soil gas and only three analytes were detected above the EGLE SSC, cis-1,2-DCE, PCE and TCE. Results for PCE and TCE exceeded $TSRIASL_{12}$. Table 458/963-1 summarizes the results that were detected above an EGLE SSC.

Table 458/963-1. Summary of Sub-Slab Soil Gas Exceedances for Building 458/963

Analyte (Sampling Event)	Detection Frequency	Measured Range of Detects (μg/m³)	% Detections > EGLE SSC	EGLE SSC (μg/m³)
cis-1,2-Dichloroethene (1)	11%	30-1,900	6%	820
Tetrachloroethene (1)	100%	43-82,000	33%	2700
Trichloroethene (1)	17%	84-1,700	11%	130

EVALUATION OF VAPOR INTRUSION

Table 458/963-2 summarizes the indoor air results relative to the sub-slab soil gas exceedances, since VI only potentially occurs if the analyte is present in both sub-slab soil gas and indoor air. Therefore, the table below provides the analytes detected above applicable EGLE SSCs in sub-slab soil gas as well as the corresponding indoor air sample results. The outdoor air sample results are also provided to determine if the analytes were present in indoor air due to migration from outdoor air.

Table 458/963-2. Vapor Intrusion Evaluation for Building 458/963

Analyte (Sampling Event)	Indoor Air Detection Frequency	Indoor Air Measured Range (μg/m³)	EGLE SSC (μg/m³)	Outdoor Air Result (μg/m³)
cis-1,2-Dichloroethene (1)	0%	<2.1	24	ND
Tetrachloroethene (1)	0%	0.26-2.3	82	ND
Trichloroethene (1)	100%	0.38-2.1	4	1.5

For the 28 analytes detected in indoor air, all results were below the EGLE SSCs and $TSRIASL_{12}$, if available, with the exception of 1,2-dichloroethane. 1,2-Dichloroethane exceeds the EGLE SSC in three sample locations in indoor air; however, these locations are ND in sub-slab soil gas. 1,2-Dichloroethane was detected in three sub-slab soil gas samples ranging in concentration from 3.2 – 17 ug/m3 (EGLE SSC 150 ug/m3). The sub-slab soil gas samples with detections do not correlate with those indoor air samples with EGLE SSC exceedances.

Seventeen analytes were detected in the outdoor air sample collected immediately upwind of the building and all 17 analytes were detected in indoor air, which indicates the potential for the presence of detected analytes to be attributed to outdoor air. A full ND evaluation will be performed upon the completion of seasonal confirmation sampling.

CONCLUSIONS AND RECOMMENDATIONS

Based on the indoor air results, the VI pathway at Building 458/963 is an insignificant exposure pathway based on current use. However, based on the sub-slab soil gas results and given the potential for future VI, Building 458/963 have been placed in VI Path Forward Building Group 2, as lines of evidence indicate that VI is insignificant and all indoor air results for analytes with exceedances in sub-slab soil gas are less than the EGLE SSC. However, Building 458/963 is also included in Group 3 due to the presence of 1,2-dichloroethane in indoor air at concentrations above the EGLE SSC that are not correlated with sub-slab soil gas detections. For Group 3 buildings, lines of evidence indicate that VI is insignificant for analytes that have sub-slab soil gas concentrations less than EGLE SSCs but indoor air results are greater than the EGLE SSCs. Seasonal confirmation sampling is recommended for Building 458/963 and seasonal confirmation sampling event 2 is scheduled for Winter 2020/2021. A full evaluation of Building 458/963 will be conducted upon completion of seasonal confirmation sampling.

5.6.20 Vapor Intrusion Evaluation for Building 542/561

BACKGROUND

Building 542/561 was built sometime during the 1940s-1960s and is located in the northeastern quadrant of the Midland facility (see Figure 5.6.20-1). These warehouses are used to store finished and/or intermediate product for the Ion Exchange and Copolymer operations. Electric fork trucks are used throughout the structure, and occasionally a gas-powered sweeper is used. The warehouses, 542 and 561, have been combined for this assessment as they are connected to each other via two corridors located in their northeastern and southwestern quadrants, respectively. The combined footprint for this building is 162,427 ft^2. Office areas located in 561 and a small office-like area in 542 have a combined footprint of 7,472 ft^2, whereas the large, open warehouse areas have a combined footprint of 154,955 ft^2.

The structure is a slab-on-grade construction with no basement and no elevators. The building is anywhere from one to two stories (the office area in the northeast corner of 561 has two stories). The ceiling height of the open warehouse areas are roughly two to three stories tall. The ground cover outside around the structure is predominantly asphalt with some gravel located to the north and west.

Building 542/561 is heated via steam radiation. There are intakes located on the roof on the northern side of the building for the unoccupied office areas. The occupied office area located on the east central side of 561 has an individual AC unit that is located inside the warehouse. The entire structure has over 20 bay doors, with the bay doors attached to the truck bays on the eastern side of 561 being opened the most frequent. Occupants of this building would use the laundry facilities found in Building 719.

PID detections were observed in the ambient air at:

- The northeastern office/shop area of 561 (0.1-0.2 ppm);
- The northern warehouse area of 561 (0.1 ppm);
- The area near the eastern bathrooms of 561 (0.1-1.6 ppm);
- The southeast corner of 561 (0.2-0.4 ppm); and
- The northwest quadrant of 542 (0.1-0.4 ppm).

DATA SUMMARY

The initial sampling event for Building 542/561 occurred in Fall 2019. The analytical results from each of the sampling events were compared to the June 22, 2018 EGLE SSCs and $TSRIASL_{12}$, if available.

Sub-slab soil gas samples were collected from 30 locations from within the building. Indoor air samples were collected at 30 locations corresponding to the soil gas sample locations, along with an outdoor air sample from the main air intake. The sampling locations are shown on Figure 5.6.20-2. Summary statistics and screening comparison results are presented for sub-slab soil gas on Table 5.6.20-1 and indoor and outdoor air on Table 5.6.20-2. The analytical data is presented in Appendix A. Field sampling forms are provided in Appendix B.

The building survey completed before the initial sampling event can be found in Appendix D. Drains and other openings were screened with a PID and no soil gas entry points were identified. A chemical inventory was completed during the building survey and the chemicals found to be stored within the building are listed in the survey.

SUB-SLAB SOIL GAS RESULTS EVALUATION

Analytical results were evaluated based on methodologies presented in the 2018 Revised Vapor Intrusion Work Plan. During the Fall 2019 initial sampling event, 35 of the 65 analytes were ND in each of the samples. Thirty analytes were detected in sub-slab soil gas and only four analytes were detected above the EGLE SSC and $TSRIASL_{12}$, if available and include: chloroform, ethylbenzene, PCE and TCE. Table 542/561-1 summarizes the results that were detected above an EGLE SSC.

Table 542/561-1. Summary of Sub-Slab Soil Gas Exceedances for Building 542/561

Analyte (Sampling Event)	Detection Frequency	Measured Range of Detects (μg/m³)	% Detections > EGLE SSC	EGLE SSC* (μg/m³)
Chloroform (1)	43%	4.5-3,500	113%	170
Ethyl Benzene (1)	375	3.8-2,100	3%	1,600
Tetrachloroethene (1)	93%	15-69,000	20%	2,700
Trichloroethene (1)	30%	13-980	17%	130

EVALUATION OF VAPOR INTRUSION

Table 542/561-2 summarizes the indoor air results relative to the sub-slab soil gas exceedances, since VI only potentially occurs if the analyte is present in both sub-slab soil gas and indoor air. Therefore, the table below provides the analytes detected above applicable EGLE SSCs in sub-slab soil gas as well as the corresponding indoor air sample results. The outdoor air sample results are also provided to determine if the analytes were present in indoor air due to migration from outdoor air.

Table 542/561-2. Vapor Intrusion Evaluation for Building 542/561

Analyte (Sampling Event)	Indoor Air Detection Frequency	Indoor Air Measured Range (μg/m³)	EGLE SSC (μg/m³)	Outdoor Air Result (μg/m³)
Chloroform (1)	0%	<2.9	5.2	ND
Ethyl Benzene (1)	100%	2.7-18	48	0.71
Tetrachloroethene (1)	7%	2.5-3.6	82	1.5
Trichloroethene (1)	0%	<3.2	4	ND

For the 12 analytes detected in indoor air, all results were below the EGLE SSC and $TSRIASL_{12}$, if available, with the exception of 2,2,4-trimethylpentane and styrene. 2,2,4-Trimethylpentane was detected at a single indoor air sample location (542/561-IA-11) at a concentration of 12,000 ug/m3 which exceeded the EGLE SSC (10,800 ug/m3). While it was detected in all sub-slab soil gas samples, the maximum detected concentration in sub-slab soil gas was 12,000 ug/m3 (542/561-SS-13), compared to a sub-slab soil gas EGLE SSC of 360,000 ug/m3. The detected concentration in sub-slab soil gas at 542/561-SS-11 was 72 ug/m3. Styrene was detected at a single indoor air sample location (542/561-IA-18) at a concentration of 440 ug/m3 which exceeded the EGLE SSC (200 ug/m3). Styrene was detected in three sub-slab soil gas samples ranging in concentration from 4 – 53 ug/m3 (EGLE SSC 7,000 ug/m3). For both analytes, the maximum sub-slab soil gas detections are below EGLE SSCs and do not correlate with the indoor air EGLE SSC exceedances.

Fourteen analytes were detected in the outdoor air sample collected immediately upwind of the building and all but two of the 17 analytes were detected in indoor air, which indicates the potential for the presence of detected analytes to be attributed to outdoor air. A full ND evaluation will be performed upon the completion of seasonal confirmation sampling.

CONCLUSIONS AND RECOMMENDATIONS

Based on the indoor air results, the VI pathway at Building 542/561 is an insignificant exposure pathway based on current use. However, based on the sub-slab soil gas results and given the potential for future VI, Building 542/561 have been placed in VI Path Forward Building Group 2, as lines of evidence indicate that VI is insignificant and all indoor air results for analytes with exceedances in sub-slab soil gas are less than the EGLE SSC; however, Building 542/561 is also included in Group 3 due to the presence of 2,2,4-trimethylpentane and styrene in indoor air above the EGLE SSC that are not correlated with sub-slab soil gas exceedances. For Group 3 buildings, lines of evidence indicate that VI is insignificant for analytes that have sub-slab soil gas concentrations less than EGLE SSCs but indoor air results are greater than the EGLE SSCs. Seasonal confirmation sampling is recommended for Building 542/561 and seasonal confirmation sampling event 2 is scheduled for Winter 2020/2021. A full evaluation of Building 542/561 will be conducted upon completion of seasonal confirmation sampling.

5.6.21 Vapor Intrusion Evaluation for Building 719/1360

BACKGROUND

Building 719/1360 is located in the northeastern quadrant of the Midland facility (see Figure 5.6.21-1). Buildings 719 and 1360 are connected to each other via an opening in a shared warehouse space located in their northwest and southeast corners, respectively. The 719 portion was built sometime in the late 1950s to mid-1960s. The 1360 portion was built sometime in the 1980s to early 1990s. The combined footprint of these structures is approximately 74,964 ft^2. The process areas for both of these buildings have a combined footprint of 10,846 ft^2. The large warehouse and process spaces have a combined footprint of 67,514 ft^2, and the enclosed office areas have a footprint of 7,450 ft^2.

The 719 portion (59,763 ft^2) of the complex contains office space near its northwestern corner, and a process area on its west central side just south of the office area. The process area (4,818 ft^2) is used to complete the finishing and screening of product. To the south of the process area is a narrow corridor that contains an office, locker room, and control room. An additional control room exists in the north central portion of the warehouse. The majority of the 719 structure is warehouse space used to store final product. The office area and warehouse areas are both one-story, but the ceiling height in the warehouse is roughly two stories tall. The process area is approximately four stories.

The 1360 portion (8,171 ft^2) of the complex is predominantly process areas that range from being open air, partially walled, to fully enclosed. The process areas range anywhere from two-to three stories tall up to seven stories and have a footprint of 6,027 ft^2. There is some warehouse space located on its eastern and southern sides of the structure, which is one-story tall with ceiling heights roughly equivalent to two stories. A small lab and storage area are located just to the south of the partially enclosed portion of the process area. The lab/storage area is only one-story tall.

Both parts of the structure are a slab-on-grade construction with no basement. Note that the grade has been built up in some portions of 719 to facilitate loading/unloading trucks. Any elevator or lift-like devices are located in process areas. Both structures are heated via steam radiation. The office areas of 719 and the lab/storage area of 1360 are cooled via central AC. The control rooms in 719 have individual AC units. The air intake for the 719 office area is inside the warehouse and the air intake for the 1360 lab/storage area is on its roof. There are multiple louvered vents on the southwest and northeast sides of 1360 as well as on the southwest corner and eastern side of 719. The structure has a combined total of 12 bay doors. The bay doors are typically only open for deliveries, pickups, or moving equipment in and out of the buildings; however, sometimes these doors are left open during warmer months while the buildings are occupied. The surrounding ground cover outside these buildings consists of gravel to the northwest of 1360 and to the east and northeast of 719 with the remainder of the ground surface around these buildings being covered by asphalt and concrete. Propane-fueled fork trucks move throughout this structure, and occupants would use the washers and dryers available in the locker rooms found in 719.

No PID detections were observed in the ambient air or from the drains observed in the lab/storage area in 1360. A minor PID detection of 0.1 ppm was observed in the ambient air in the offices of 719. A drain in the western office bathroom area of 719 had a detection of 0.3 ppm, and the drain in the women's locker room had a reading of > 2,000 ppm. However, the women's locker room was very humid and the drain had water in it. False positive readings on a PID may occur in the presence of excess water vapor. High humidity can cause lamp fogging and decreased sensitivity. This can be significant when moisture levels are high in the general area to be measured.

DATA SUMMARY

The initial sampling event for Building 719/1360 occurred in Fall 2019. The analytical results from each of the sampling events were compared to the June 22, 2018 EGLE EGLE SSCs and $TSRIASL_{12}$, if available. Sub-slab soil gas samples were collected from 16 locations from within the building. Indoor air samples were collected at 16 locations corresponding to the soil gas sample locations, along with an outdoor air sample from the main air intake. The sampling locations are shown on Figure 5.6.21-2. Summary statistics and screening comparison results are presented for sub-slab soil gas on Table 5.6.21-1 and indoor and outdoor air on Table 5.6.21-2. The analytical data is presented in Appendix A. Field sampling forms are provided in Appendix B.

The building survey completed before the initial sampling event can be found in Appendix D. Drains and other openings were screened with a PID and no soil gas entry points were identified. A chemical inventory was completed during the building survey and the chemicals found to be stored within the building are listed in the survey.

SUB-SLAB SOIL GAS RESULTS EVALUATION

Analytical results were evaluated based on methodologies presented in the 2018 Revised Vapor Intrusion Work Plan. During the Fall 2019 initial sampling event, 40 of the 65 analytes were ND in each of the samples. Twenty-five analytes were detected in sub-slab soil gas and only two analytes were detected above the EGLE SSC and $TSRIASL_{12}$, if available and include: CFC-12 and PCE. Table 719/1360 -1 summarizes the results that were detected above an EGLE SSC.

Table 719/1360-1. Summary of Sub-Slab Soil Gas Exceedances for Building 719/1360

Analyte (Sampling Event)	Detection Frequency	Measured Range of Detects (µg/m³)	% Detections > EGLE SSC	EGLE SSC* (µg/m³)
CFC-12 (1)	100%	21-140,000	6%	34,000
Tetrachloroethene (1)	94%	28-3,900	6%	2,700

EVALUATION OF VAPOR INTRUSION

Table 719/1360 -2 summarizes the indoor air results relative to the sub-slab soil gas exceedances, since VI only potentially occurs if the analyte is present in both sub-slab soil gas and indoor air. Therefore, the table below provides the analytes detected above applicable EGLE SSCs in sub-slab soil gas as well as the corresponding indoor air sample results. The outdoor air sample results are also provided to determine if the analytes were present in indoor air due to migration from outdoor air.

Table 719/1360-2. Vapor Intrusion Evaluation for Building 719/1360

Analyte (Sampling Event)	Indoor Air Detection Frequency	Indoor Air Measured Range (µg/m³)	EGLE SSC* (µg/m³)	Outdoor Air Result (µg/m³)
CFC-12 (1)	100%	1.6-5.1	1020	2.5
Tetrachloroethene (1)	63%	1.1-2.6	82	1.3

For the 27 analytes detected in indoor air, all results were below the EGLE SSC and $TSRIASL_{12}$, if available, with the exception of styrene and TCE. Styrene was detected at concentrations that exceeded the EGLE SSC in 12 out of 16 samples, ranging from 560 – 1,900 ug/m3; however, the detected concentrations in sub-slab soil gas were all less than the EGLE SSC. Styrene was detected in all but two of the 16 total sub-slab soil gas samples ranging in concentration from 3.3 – 1,600 ug/m3 (EGLE SSC 7,000 ug/m3). TCE was detected in only one indoor air sample at a concentration (4.4 ug/m3) that exceeded the EGLE SSC (4 ug/m3). All sub-slab soil gas results were ND for TCE.

Thirteen analytes were detected in the outdoor air sample collected immediately upwind of the building and all but two of the 13 analytes were detected in indoor air, which indicates the potential for the presence of detected analytes to be attributed to outdoor air. A full ND evaluation will be performed upon the completion of seasonal confirmation sampling.

CONCLUSIONS AND RECOMMENDATIONS

Based on the indoor air results, the VI pathway at Building 719/1360 is an insignificant exposure pathway based on current use. However, based on the sub-slab soil gas results and given the potential for future VI, Building 719/1360 have been placed in VI Path Forward Building Group 2, as lines of evidence indicate that VI is insignificant and all indoor air results for analytes with exceedances in sub-slab soil gas are less than the EGLE SSC. However, Building 719/1360 is also included in Group 3 due to the presence of styrene and TCE in indoor air at concentrations above the EGLE SSC that are not correlated with sub-slab soil gas exceedances. For Group 3 buildings, lines of evidence indicate that VI is insignificant for analytes that have sub-slab soil gas concentrations less than EGLE SSCs but indoor air results are greater than the EGLE SSCs. Seasonal confirmation sampling is recommended for Building 719/1360 and seasonal confirmation sampling event 2 is scheduled for Winter 2020/2021. A full evaluation of Building 719/1360 will be conducted upon completion of seasonal confirmation sampling.

5.7 Zone 3 Phase 3 Buildings

The 2018 Revised VI Work Plan included the sampling plans for priority buildings in Zone 3 that were initially referred to as Zone 3 Phase 1. As stated in the September 26, 2018 email to EGLE, only nine Zone 3 buildings were sampled in the fall of 2018 which were identified as Zone 3 Phase 1. The additional Zone 3 buildings presented in the workplan were reprioritized so that Dow could focus on additional investigations for priority buildings in Zones 1 and 2. The remainder of the buildings initially identified as Zone 3 Phase 1 became Zone 3 Phase 2 and were sampled in Fall 2019. All remaining priority buildings identified in Zone 3 became Zone 3 Phase 3. The Zone 3 Phase 3 buildings were sampled in Fall or Winter 2020; however, the results were not available in time for evaluation in this report. Buildings 433A, 433W and 433B were the only three buildings sampled in Winter 2020. Results from the sampling efforts will be communicated to EGLE during a monthly Corrective Action meeting in early 2021, unless results warrant notification and expedited reporting. The results will also be reported in the 2021 CAIP.

The Zone 3 geographical area contains 214 buildings and structures that were visited and categorized. Following the VI Categorization Flowchart (Figure 5-2), there are 15 buildings in Zone 3 Phase 3 categorized as priority buildings (Category 1 and 2). These buildings were identified for further evaluation, including the completion of a building survey and future sampling activities. Building 1351, which was identified as a Category 2 building in the 2019 CAIP, has been recategorized to a Category 3 building upon further review.

Surveys for the Zone 3 priority buildings were completed from March 12, 2018 through May 4, 2018. As part of the surveys, a brief kick-off meeting was conducted with primary building contacts to complete the survey questionnaire and any obtained pertinent information, such as floor plans. After this meeting, the building survey was completed including gathering a chemical inventory (if one was not provided) and taking PID readings of the ambient air and drain features were recorded.

The surveys for the Zone 3 Phase 3 priority buildings, which include the survey, floorplan, chemical inventory and PID readings, are found in Appendix D. The sampling plans are included in Appendix E.

Zone 3 Phase 3 contains 15 buildings, including nine (9) Category 1 buildings and six (6) Category 2 buildings.

Category 1 buildings:

- Building 25 – Remediation – AECOM/Dow;
- Building 354 – Saran, Converted Products & Dow Auto;
- Building 433A – Styron Polymer/Shipping;
- Building 574 – Computer Systems;
- Building 608 – Buttles Street Gate;
- Building 845 – Control Room for 588 (6-2590);
- Building 1319 – Offices for 845;
- Building 1354 – Electronic Storage Device Materials; and
- Building 1616 – Mech Dev & Operations.

Category 2 buildings:

- Building 695 – Shop & Fabrication Area;
- Building 856 – Res Service Glass Fab Shop;
- Building 872 – MRO;
- Building 1302 – Storage Barn;
- Building 433W – Shipping; and
- Building 433B – Styrene Polymers.

The following subsections summarize the findings of the surveys completed at these buildings.

Category 1 Buildings

5.7.1 Building 25

Building 25 was built in the 1990s-2000s and is located in the northwestern quadrant of the Midland facility. The building consists of office space, conference rooms, bathrooms, and a kitchen/break room. It is a slab-on-grade construction with no basement or elevator and has a footprint of 7,368 ft^2. The 20-25 full time occupants typically work for 8 hours a day Monday through Friday. On occasion, staff may work 10 to 12-hour days or on a weekend but it is rare that they would be in the structure for that whole duration. The air is heated via hot air circulation and the air is cooled via central AC. The outside air intake is located on the west side of the building. The structure has no bay doors and the outside ground cover is asphalt. Some occupants have a few clothing items laundered by a contracted laundry service, but normally use this service via another building (Building 833). At the time of the survey, no PID detections were observed in any drain features or the ambient air throughout the building.

5.7.2 Building 354

Most of Building 354 was constructed in the 1940s but part of the west side of the building was added/modified in the 1980s-1990s. Building 354 is located in the northeastern quadrant of the Midland facility and has a footprint of 21,919 ft^2. The building consists of office space in the eastern 25% of the structure, with the remainder of the building being used for large R&D/T,S&D labs for SK Saran and Dow Polyurethane. The structure is a slab-on-grade construction with no basement, but there is an elevator in the office area. The floors are a painted concrete in the SK Saran portion of the labs and are an epoxy-coated concrete in the Dow Polyurethane portion of the lab. Building 354 is two stories, but the lab area ceiling are two stories high. Four people hold offices in this building and at most 12 people are in the building on any given weekday. Occupants typically work 8 to 10-hour days Monday through Friday with the first occupants showing up at 7AM and the last occupant leaving at 5PM.

The building is heated via steam radiation that is heated via natural gas, and the building is cooled via central AC via a combination of multiple cooling towers and medium to large AC units. There are multiple outside intakes, which are found on the south and north sides of the structure. The building has three bay doors, two are located on the west side and one is located on the south side. The bay doors on the west side are frequently opened more during the summer, and the one on the south side has a poor seal. The outdoor ground cover around the building consists of grass on the north side and asphalt to the south, west, and east. A propane-fueled fork truck is used to move containers/equipment in and out of the lab areas. Occupants occasionally use a contracted laundry service.

During the survey, a PID detection of 0.3 ppm was observed in the ambient air in the SK Saran portion of the lab space, and PID detections of 70.6 ppm and 4.0 ppm were observed from the drains found in the southeastern and northwestern corners of the SK Saran lab. No PID detections were observed in the ambient air throughout the office space or in the Dow Polyurethane lab areas nor were detections observed in any other drain features throughout the building.

5.7.3 Building 433A

Building 433A was built in 1943 and is located in the northeastern quadrant of the Midland facility. Building 433A is sometimes referred to as two different structures, 433 and 433A. The 433A numbering often refers to the eastern lab wing of the structure (and is painted on the outside of the building); however, the entire structure is most commonly referred to as Building 433. The southern warehouse shares a firewall with the structures referred to as Buildings 433W and 433B, but these structures are presently owned by Trinseo and are considered Category 2 structures. Building 433A has an approximate footprint of 122,396 ft^2. The large warehouse area has a footprint of 50,693 ft^2, and the enclosed office and lab areas have a footprint of 71,702 ft^2.

Building 433A contains many offices, T,S&D labs (located in the eastern wing and northwestern/west side of the building), and a large warehouse space on the south side. Approximately 150-200 people occupy this building. The occupants work anywhere from 8 to 12-hour days Monday through Friday starting at 6AM and ending at 6PM. Occasionally, some people come in on the weekend. The structure is a slab-on-grade construction (with the grade having been built up above the natural ground surface) and has no basement. Two elevators are located in the occupied areas as the building has four floors in some portions of the structure. There is also a freight elevator located on the southern side of the warehouse. The flooring in the eastern wing and in the labs consists of either painted concrete or concrete covered with an epoxy coating.

The building is heated via steam radiation and has several central AC cooling towers/units, most of which are found on the roof. Multiple intakes are found on the roof, and a large intake is located on the west side of the building. The building has six bay doors that are typically only opened for the purposes of deliveries or for moving equipment/materials in or out. The surrounding outdoor ground surface is asphalt. Propane-fueled fork trucks are often used in the large labs or warehouse to move around equipment and materials. There are a few washers and dryers dispersed throughout the building, and a few occupants use a contracted laundry service on occasion.

No PID detections were observed at the time of the survey in the ambient air of from any drain features found throughout the building.

5.7.4 Building 574

Building 574 was built between 1952 and 1958 and is located in the northeastern quadrant of the Midland facility. Building 574 is attached to another structure located to the east, Building 633, via a second-story pedestrian bridge. However, the pedestrian bridge is closed and Building 633 is presently unoccupied with no immediate future plans for occupation. The northern 75% of the structure is office space and the southern 25% consists of a shop, break room, and large mechanical room. Building 574 is a two-story slab-on-grade construction with no basement and has an approximate footprint of 26,538 ft^2. There is an elevator located on the eastern side of the building. Approximately 125 people occupy this building and work 8 to 10-hour shifts Monday through Friday.

The building is heated via hot air circulation and is cooled via central AC. The AC is provided by an air chiller in the spring and fall, and a cooling tower is used for the summer. A large air intake is located on the southeast side of the building. The building pulls 100% of its air from the outside and has positive air pressure. One bay door exists on the southwestern corner. This door is open on a daily basis for hours at a time and is occasionally open to exhaust hot air out of the lab if the AC is not functioning properly. The bay door is large enough that a vehicle could pull into the shop area. The outside ground cover around the building consists of asphalt to the south, west, and east; grass and some bushy vegetation is present on northern side between the building and D street.

No PID detections were observed in the ambient air nor from any drain features in the building at the time of the survey.

5.7.5 Building 608

Building 608 was built between 1993 and 2015 per aerial photography and is located in the northwestern quadrant of the Midland facility. It is a small structure (961.98 ft^2) used to house a guard at the Buttles Street Gate. The guard works a 12-hour shift from 6AM to 6PM Monday through Friday. The building consists of a small area for the guard to sit, a break area, a mechanical room, a janitor’s closet, and a bathroom. The building is a slab-on-grade construction with no basement, no elevator, and no bay doors. The building is heated either via hot air circulation or an electric baseboard (depending on which one is functioning properly at any point in time). The building is cooled via a central AC unit located on the southwestern side of the building. The outside ground cover around the building is predominantly a combination of sidewalk, gravel beds, and asphalt. Some patches of grass exist in the beds located between the sidewalk and asphalt. No PID detections were observed in the ambient air nor in the drains observed in the building at the time of the survey.

5.7.6 Building 845

Building 845 was built in the 1970s and is located in the northeastern quadrant of the Midland facility. On average, Building 845 is a three-story structure. The building consists of a long north-south corridor that has office space, bathrooms, locker rooms, and break areas and is predominantly two stories. Off of this corridor are seven “Mods” numbered 1 through 6 with an additional Mod numbered as ”4.5”. These Mods are anywhere between two- to four-stories tall. The Mods are used for various R&D/lab purposes; however, Mods 4, 4.5, 5, and 6 are actively being stripped of their contents in 2018 to possibly be repurposed in the future. Mod 1 is a laboratory and Mod 3 is presently being used as a storage area. Mod 2 is actively in use and has an associated lab located just to the north of it. Building 845 is a slab-on-grade construction with no basement and has a footprint of 25,326 ft^2. The building has eight bay doors that are open more frequently during warmer weather and are open to move things in and out of the structure. There is also a freight elevator in the building.

The air in the building is cooled through a combination of large central AC units and individual AC units. The air is heated via steam radiation and there are multiple outdoor intakes located on the roof and around Mods 1 through 3. The floor in Mod 1 has an epoxy coating, but the other Mods mainly have bare concrete floors. The ground cover outside the building is predominantly asphalt with some gravel located to the northeast. Approximately 10 to 20 people occupy this building and work anywhere from 8 to 12 hours a day Monday through Friday. The occupants use washers and dryers in the building and propane-fueled fork trucks are often used in the Mods. The bay doors on the Mods are large enough to allow a vehicle to pull inside.

No PID detections were observed in the ambient air throughout the building or from any drains identified during the survey.

5.7.7 Building 1319

Building 1319 was built sometime between 1982 and 1993 (per aerial photography) and is located in the northeastern quadrant of the Midland facility. The building contains office space used to support Building 845, which is located to the east of Building 1319. Approximately 10 to 20 occupants sit in this building 8 to 12 hours a day Monday through Friday. This one-story building is a slab-on-grade construction with no basement or elevator and has a footprint of 6,120 ft^2. The outdoor intake is located on the north side of the building near the northeastern corner (outside of the mechanical/HVAC room) and is associated with one chiller and air handler. The building is heated via steam radiation, and no bay doors are present on this structure. The ground cover outside of the building is asphalt. No PID detections were observed in the ambient air or from any drain features identified during the survey.

5.7.8 Building 1354

Building 1354 was constructed in the last 5-10 years and is located in the northeastern quadrant of the Midland facility. The structure is a slab-on-grade construction with no basement or elevators and has a footprint of 8.636 ft^2. The building consists of offices, a control room, kitchen/break room, conference rooms, locker rooms, and a lab. The building is used as a support building for Silicone, Sealants, and Adhesives operations. There are roughly 50 to 60 people who pass through this building on a daily basis, but roughly 20% of those people occupy the building in 12-hour shifts that span from Monday to Friday. The shifts will change once the operations for Silicone, Sealants, and Adhesives is fully operational.

The building has central heating and cooling. Three AC units are located on the west side of the building along with three outdoor intakes. The building has no bay doors. The ground cover outside of the building is covered with either concrete or asphalt. Occupants in the building use a contracted laundry service for some clothing worn at work.

No PID detections were observed in the ambient air or from any drains observed at the time of the survey.

5.7.9 Building 1616

Building 1616, which houses the Materials Engineering Center, was built in the 1990s and is located in the northeastern quadrant of the Midland facility. About 35 people occupy this building for 8 to 10 hours a day anytime from 6:30AM to 5PM Monday through Friday. It is a slab-on-grade construction with no basement or elevators and has a footprint of 40,077 ft^2. The northern third of the building consists of offices, kitchen/break rooms, and conference rooms. The southern two thirds of the building are predominantly occupied by labs and a large machine shop area with a few offices, a large kitchen, and a locker room. The building is mostly one-story but has a partial second-story located in the central part of the building. The building is heated via steam radiation and is cooled via central AC by a large cooling tower located on the west central portion of the roof. The outside intake is also located on the west central portion of the roof. The ground cover immediately outside the building consists mainly of grass with some asphalt areas to the north and west.

Building 1616 has one large bay door located near the southeastern corner, which opens up into the large shop area. The bay door is only opened for the purpose of deliveries. However, the door is large enough for fuel-powered vehicles to come into the building. A propane-fueled fork truck is sometimes used in the large shop area. The ceiling height in the large shop area is roughly two stories tall and has an epoxy coating on its concrete floor.

No PID detections were observed in the ambient air throughout the building of from any drains observed at the time of the survey.

Category 2 Buildings

5.7.10 Building 695

Building 695 was constructed sometime between 1965 to 1982 (per aerial photography) and is located in the northeastern quadrant of the Midland facility immediately to the southeast of Building 845. Only one person occupies this building and they work anywhere from 8 to 12 hours a day Monday through Friday; however, they do not spend the entire shift in this building. It is a single-story slab-on-grade construction with no basement or elevator and has a footprint of 1,695 ft^2. The building is predominantly three large shop spaces, but on the eastern side of the building there is a bathroom, kitchen/break room, and office. There is one bay door located on the west side of the building that is rarely open. There is central AC in the office/kitchen area. The building is heated either via an electric baseboard (bathroom) or through forced hot air from a furnace located in the shop area. The ground cover outside the building is asphalt. No PID detections were observed in the ambient air or from any drain features during the survey.

5.7.11 Building 856

Building 856 was built in the late 1960s to early 1970s and is located in the northeastern quadrant of the Midland facility. It is occupied by two scientific glassware fabricators who work 10-hour days Monday through Thursday from 7AM to 5PM. The building is predominantly a shop area, with two offices located near the southeast corner. The eastern part of the building consists of a secondary shop area and parts storage. The building is one-story with the exception of the eastern 25%, which has a second-story. The second floor of this building is not used and is rarely entered. The building is a slab-on-grade construction with no basement or elevator and has a footprint of 11,906 ft^2. The floors are concrete but are painted with a clear coating.

The building is heated via steam radiation and electric baseboards. The intake for the building is located on the east side at ground level near the southeastern corner. The building is cooled via a combination of central and individual AC units. There are also mechanical and bathroom ventilation fans in the building. The ground cover outside of the building is predominantly asphalt, with the exception of some gravel on the west side of the building. Occupants use the washers and dryers located in the southwest corner of the building.

No PID detections were observed in the ambient air throughout the building, and no detections were observed from any drain features in the building.

5.7.12 Building 872

Building 872 (68,616 ft^2) was built between 1965 to 1982 (per aerial photography) and is located in the northeastern quadrant of the Midland facility. The building is operated by the Dow Maintenance group. Approximately 20 people occupy this building and work four 10-hour days a week (Monday through Thursday) from 7AM to 5-5:30PM. The structure is a slab-on-grade construction with no basement, but the majority of the building has been built on grade and has been built up approximately 3 ft above the natural ground surface due to the truck bays. Building 872 has no basement or elevators. The building is predominantly warehouse space with offices areas and locker rooms located on the eastern side of the building. The large, high-ceiling warehouse area has a footprint of roughly 48,813 ft^2. There are also two enclosed office areas/break room areas located in the central portion of the warehouse. All enclosed offices, locker rooms, and break room areas have a footprint of 19,803 ft^2.

Building 872 is approximately two to three stories tall, with the office and locker room areas having one-story ceiling heights and the warehouse area having ceiling heights comparable to two to three stories. The kitchen/breakroom area in the warehouse has two stories, whereas the other warehouse office location is only one-story. The eastern outer corridor of the warehouse has a second level deck. Along the eastern and western sides of the eastern outer warehouse corridor there are large 3 ft-wide grates that open up to the natural ground surface.

The building is heated via steam radiation and is blown throughout the building via mechanical fans. There are intakes located on the east side of the building off of the upper deck. There are two individual AC units off of the offices/break room areas in the warehouse. The eastern office area is cooled by central AC unit connected to an air handler located to the southeast of the men's locker room.

Building 872 has 28 bay doors. Several of the bay doors on the southern side of the warehouse are inaccessible due to shelving units. The bay doors are typically closed unless equipment/materials are being moved in and out of the building. The ground cover outside the building is predominantly asphalt with some gravel to the west near the railroad tracks. Propane-operated fork trucks are used in this warehouse.

No PID detections were observed in the ambient air or from any drain features in the building at the time of the survey.

5.7.13 Building 1302

Building 1302 was constructed in the 1980s-1990s and is located in the northwestern quadrant of the Midland facility. The structure is used by Dow Remediation and their contractor, AECOM, as a warehouse/work space and for a document library. There is no full-time occupancy; however, occupants from Building 25 frequently access the building and may work in it for hours at a time. The 3,004 ft^2 one-story building is a slab-on-grade construction with no basement or elevator. The ceiling height in the warehouse portion of the structure is close to two stories in height.

The building is not heated, but there is an individual AC unit for the library located on the east side of the building. The building has two bay doors, one near the northwestern corner on the west side and one on the south side. These doors are typically closed unless equipment/materials are being moved in or out of the structure, or if someone is working in the building during warmer months. The ground cover outside of the building is grass on the east side, asphalt to the west, and gravel to the north and south. Fuel-powered vehicles are sometimes driven into the warehouse and parked overnight or for several days.

No PID detections were observed in the ambient air while completing this survey.

5.7.14 Building 433W

Building 433W was built in the 1940s-1950s and is located in the northeastern quadrant of the Midland facility. Buildings 433W (433 Warehouse) is owned by Trinseo and is connected to the southern warehouse of Building 433A on its northern side via a firewall with large bay door-sized openings (which is owned by Dow). The building is predominantly a large warehouse space for the storage of final product but has enclosed areas that consist of an unoccupied lab, locker rooms (which have washers and dryers), a kitchen/break room, offices, storage, and a control room. There are also rail lines that run through the central part of the structure that enter from rail doors located along the southern wall. Propane-fueled and electric fork trucks are used throughout the structure, and railcars and track mobiles are frequently moved in and out of the structure. Approximately 10 people are working in the building at any given time. The workers are present Monday through Friday for 8-hour work shifts that start at 7AM and last until 3-3:30PM.

The footprint of 433W is approximately 117,511 ft^2. The large warehouse space of this structure has a footprint of approximately 111,666 ft^2, whereas the enclosed office, lab, and break room areas have a combined footprint of 5,845 ft^2. The building is a slab-on-grade construction (although the grade is built up above the natural ground surface) with no basement. The entire structure is approximately four stories tall. A freight elevator is located on the northern side of the shared firewall between 433W and 433A. The ground cover immediately outside of the building is predominantly a combination of asphalt and concrete, with gravel patches located in some areas.

Building 433W is heated via steam radiation, and has a combination of mechanical fans, central, and individual AC units to cool the building. The central AC units have outdoor intakes located on the southern and eastern sides of the structure. Building 433W has 12 bay doors. The bay doors on the eastern side of the warehouse are only open for when a truck comes in for a delivery or pickup. The rail doors on the southern side of the building are open more frequently.

At the time of the survey, a PID detection was observed in the ambient air in the control room and the old trucker office (which is now storage) at 0.1 ppm and 0.3 ppm, respectively. No PID detections were observed from the drains located in the locker room.

5.7.15 Building 433B

Building 433B was built in the 1940s-1950s and is located in the northeastern quadrant of the Midland facility. Building 433B is owned by Trinseo and is connected to the southern warehouse of Building 433A (which is owned by Dow). The entire structure is approximately four stories tall and consists of an enclosed area that contains process areas, office space, warehouse space, and shop space. A large portion of the process area is partially enclosed or open air and is located to the east and south of the main structure. One operational personnel is always present on an 8-hour shift. Operational staff are present 24 hours a day, 365 days a year. Maintenance staff works an 8 to 9.5-hour shift from 7AM to 4:30PM Monday through Friday. The ground cover outside of the building is predominantly concrete or asphalt with some minor gravel patches.

The footprint of 433B is 39,687 ft^2. The non-process areas associated with this structure have a footprint of approximately 17,217 ft^2. The building is a slab-on-grade construction (although the grade is built up above the natural ground surface) with no basement. Building 433B has two elevators on the east side of the building, one of which is not functioning and the other is used to facilitate the process area of 433B. The enclosed portion of the building has two bay doors, which are typically closed during the winter and are opened during the summer for the purpose of cooling the building. The entire combined structure is heated via steam radiation. There are mechanical fans throughout the building, and there is an individual AC unit for the break room area. Occupants of this building use laundry facilities that are located in 433W and 1350. The occupants in shop areas/general areas use propane-fueled forklifts and electric golf carts to move around the building.

No PID detections were observed from any drains in the building at the time of the survey. PID detections were observed in the ambient air in the expendable storage area (0.1 ppm) and in the kitchen/breakroom (0.4 ppm).

5.8 Zone 4 Buildings

Episodic events of ammonia odors in the basement of Building 1790, which is located in the campus area of Zone 4 (see Figure 5-1), led to an investigation in early 2020. Ultimately, the source of the ammonia identified at Building 1790 was found to be emanating from Building 1710, also in the campus area of Zone 4. These buildings were identified for further VI evaluation, including the completion of a building survey, sampling, and investigation activities.

The surveys for the two Zone 4 buildings (provided in Appendix F) were completed during late winter 2020, and include the survey, floorplan, chemical inventory and PID readings. The sampling plans are also included in Appendix F. The following subsections summarize the investigation, VI results and evaluations completed at these buildings throughout 2020.

5.8.1 Vapor Intrusion Evaluation for Building 1790

BACKGROUND

Building 1790 is located in the campus area, in the northern portion of the Midland facility (Figure 5.8.1-1). The 54,000 ft^2 building was completed in 1993 and is two stories with an elevator, with a first floor square footage of approximately 24,000 ft^2 and a 3,000 ft^2 basement on the west side of the building. Building 1790 is a category 1A building that is occupied by Dow management and human resources and consists of office space, conference rooms and a café area. Building 1790 is cooled via two central AC units with associated intakes located on the west side of the building near the northwest corner. The building is heated via steam radiation. There are two bay doors and the doors are open infrequently for deliveries. The outside ground cover surrounding Building 1790 consists of grass and concrete.

There have been episodic events of ammonia odors in the basement of Building 1790 and in January 2020 the ammonia odor became more persistent which lead to the building occupants being asked to temporarily relocate until the source of the issue could be resolved. Prior to the building-specific VI investigation, it was discovered that a miss operating sump pump system had sporadically allowed groundwater to enter the basement. Based on the findings from these mitigation efforts, it was determined that groundwater was the source of the ammonia odors. Once mitigation and corrective efforts were conducted to prevent groundwater from entering the basement, ammonia odors quickly decreased.

Corrective measures to improve sump pump performance included removal of the filter fabric and replacement of the gravel backfill put in place at the time of the installation of the sump with a limestone-free and fines-free pea stone. Additionally, a pH-control treatment system was also put in place in the sump to prevent calcification. Since these measures were completed, groundwater has not entered the basement.

A supplemental investigation was conducted to better understand and document the source and distribution of ammonia in indoor air and to determine if other contaminants may be present in sub-slab soil gas or indoor air. A standard vapor intrusion (VI) investigation was conducted, which included the collection of collocated sub-slab soil gas and indoor air samples, in addition to an outdoor investigation that involved the collection of soil gas and groundwater samples near the building/basement footprint. In addition, the real-time VI assessment team was able to investigate and collect baseline samples in the building with the Field GC to determine if there was evidence of VI.

Ultimately, the source of the ammonia identified at Building 1790 was found to be emanating from the north east wing of Building 1710. This is further discussed in Section 5.8.2. The 2020 Dow Campus Ammonia Investigation Summary is included in Appendix G.

REAL-TIME VI INVESTIGATION ACTIVITIES

The goals for the February 2020 real time building-specific VI investigation for Building 1790 were to collect preliminary results pertaining to the analytes commonly assessed with the Field GC (TCE, PCE, and chloroform) and to gain a better understanding of the distribution of ammonia in the building after mitigation efforts pertaining to the sump pump system had been put in place. The Summary of VI Investigative Findings for Building 1790 was submitted to EGLE in April 2020 and is included in Appendix C.

The investigative findings concluded that indoor air and sub-slab soil gas samples analyzed by the Field GC did not contain any significant concentrations of TCE, PCE, or chloroform. Ammonia was present at very low levels of approximately 1 ppm in the sub-slab soil gas throughout the first floor of the building; however, ammonia concentrations measured in penetrations of the basement floor show ammonia is likely present at elevated concentrations in the sub-slab soil gas under the basement due to the ammonia-impacted shallow groundwater underlying the basement. In indoor air, ammonia was only detected in the basement and the janitor’s closet, and a small amount of ammonia is expected to be present in the janitor’s closet due to cleaning products. The ammonia concentrations observed in the indoor air of the basement during the investigation were all below the $RIASL_{12}$.

DATA SUMMARY

Indoor and outdoor VI sampling was conducted at Building 1790 in February 2020. Co-located sub-slab soil gas and indoor air samples, in addition to soil gas and groundwater samples from outside the building footprint, were collected and analyzed for the facility target analyte list (TAL), which includes 65 volatile compounds known to be present in soil and groundwater at the facility. The sub-slab soil gas, soil gas and groundwater analytical results were compared to the June 22, 2018 EGLE site-specific 12 hr Soil Gas and 12 hr Groundwater Not In Contact (GWNIC) screening criteria. Indoor air results were compared to the EGLE site-specific Nonresidential Acceptable Air Concentrations (AAC).

Ammonia is not included in the facility TAL, as ammonia is a unique concern to Building 1710 and 1790. All ammonia indoor air and sub-slab soil gas results from inside the building were collected with a MultiRAE ammonia sensor (sensitivity ~1ppm). Outdoor soil gas results for ammonia were analyzed by OSHA Method ID-188 (detection limit ~1ppm) and groundwater results were analyzed by Method 350.1. Screening criteria for ammonia were selected as follows:

- Indoor air – August 2017 Media-Specific Interim Response Screening Level (nonresidential time-sensitive $RIASL_{12}$), 1,200 ug/m3
- Soil gas – Dow Silicones Site-Specific Criteria for buildings <50,000 ft^2 with a basement, 40,000 ug/m3
- Groundwater – Dow Silicones Site-Specific Criteria for buildings <50,000 ft^2 with a basement, 3,600 ug/L

As shown on Figures 5.8.1-2 and 5.8.1-3, for the indoor sampling event, sub-slab soil gas samples were collected from 11 locations from within the building. Indoor air samples were collected at 11 locations corresponding to the sub-slab soil gas sample locations, in addition to three indoor air samples in the basement and two indoor air samples on the first floor above the basement. A water sample was collected from the sump in the basement. Also, an outdoor air sample was collected from the main air intake to determine if the analytes present in indoor air are due to migration from outdoor air. As shown on Figure 5.8.1-4, for the outdoor sampling event, three soil-gas samples were collected from locations near the building/basement footprint and two groundwater samples were collected from wells upgradient of the building/basement. Summary statistics and screening comparison results are presented for soil gas on Table 5.8.1-1, sub-slab soil gas on Table 5.8.1-2, indoor and outdoor air on Table 5.8.1-3, and groundwater on Tables 5.8.1-4 and 5.8.1-5. The analytical data is presented in Appendix A. Field sampling forms are provided in Appendix B.

The building survey conducted during the sampling event can be found in Appendix F. Drains and other openings were screened with a PID. Outside of the sumps and sawcuts observed in the basement, none of the drains observed on the first floor of the building had any impacts observed via the PID screening. The chemical inventory performed during the building survey identified various potential indoor emission sources, including soap, air freshener, and various cleaning products.

VAPOR INTRUSION RESULTS EVALUATION

Analytical results were evaluated and screened based on methodologies presented in the 2018 Revised Vapor Intrusion Work Plan. As shown in Tables 5.8.1-1 through 5.8.1-4, all soil gas, sub-slab soil gas, indoor air, and groundwater results for the 65 analytes on the facility TAL are below the EGLE SSC. Field GC results for PCE, TCE and chloroform were also all below VI screening levels (See Summary of Investigative Findings in Appendix C).

For ammonia, all indoor air and first-floor sub-slab soil gas readings were below the VI screening criteria; however, the readings from the penetrations of basement slab were above indoor air screening criteria (See Summary of Investigative Findings in Appendix C). All outdoor soil gas ammonia results were ND. However, as shown on Table 5.8.1-5, the groundwater results from one of the two upgradient wells (9527) had a result of 1,500,000 ug/L, which is above the VI screening criteria (3,600 ug/L). The other upgradient well (9531) had a result of 1,700 ug/L. Also shown on Table 5.8.1-5, the ammonia result from the water sample collected from the sump (130,000 ug/L) was above the VI groundwater screening criteria.

CONCLUSIONS AND RECOMMENDATIONS

Based on the indoor air and sub-slab soil gas results and further investigation findings, the VI pathway at Building 1790 is an insignificant exposure pathway based on current use for the 65 analytes on the facility TAL. For ammonia, once mitigation and corrective efforts were conducted to prevent groundwater from entering the basement, ammonia odors quickly decreased to concentrations below screening criteria. However, based on the groundwater results, Building 1790 has been placed in VI Path Forward Building Group 2, as lines of evidence indicate that VI is insignificant but ammonia is present in groundwater above the VI screening criteria. Therefore, quarterly indoor air monitoring will be conducted for ammonia in the basement and first floor of the building. The quarterly monitoring will utilize a MultiRAE electrochemical ammonia sensor in order to detect ammonia with a sensitivity of 1 ppm. High-level email summary updates will be provided to EGLE

5.8.2 Vapor Intrusion Evaluation for Building 1710

BACKGROUND

Building 1710 is located in the northeastern quadrant of the Midland facility in what is referred to as the “campus area” (Figure 5.8.2-1). The southern portion of the structure was built in the late 1950s to early 1960s. Most of the northern portion of the building was built between 1965 and 1985. A small addition with a basement was added to the western side of the northern portion in the early 1990s. The approximately 40 occupants of the building work Monday through Friday and occupants are typically present in the building anytime between 6AM to 6PM.

The building is a one story structure with an overall footprint of 65,400 ft^2 with the majority of it underlain by a basement. The basement has a footprint of 42,900 ft^2; therefore 22,500 ft^2 of the overall footprint of the building is not underlain by basement.

The depth of the basement is approximately 12-15 ft below grade. The foundation walls are made of poured concrete, which is painted or covered with drywall in some areas, and the basement floor is concrete, which is covered in tile or carpet in several areas. The basement area is occupied and consists of mechanical rooms, storage space, office space, restrooms, laboratories, and a kitchen. There are three primary sump crocks located in the basement: one in the northeastern corner of the northeastern mechanical room as well as one in each of the south central mechanical rooms. There is also an elevator which is located centrally in the building. Five stairwells connect the basement to the first floor, and one chase that is centrally located in the basement connects the basement to the first floor.

The first floor of the building consists of offices, labs, shops, restrooms, and conference rooms. There is a bay door located on the east central side of the structure in one of the shops that is primarily used for shipping and receiving. This bay door is often left open during the summer months, but typically remains closed during other times of the year. There are several chases located on the first floor. There are two large outdoor air intakes located on the northern side of the structure, both of which are located at or near ground level. The building has two industrial air conditioning units, one located on the western side of the building and one located on the eastern side of the building. The building is heated via hot air circulation created via steam coils and cooled via central air conditioning. The outdoor ground cover around the building is predominantly grass with concrete sidewalks on the north and south side of the building. Asphalt is the predominant cover on the north and eastern sides.

No PID detections were observed in the ambient air throughout the building or from any drains or sumps identified at the time of the survey.

SOURCE INVESTGATION SUMMARY

Using real-time groundwater results for ammonia (NH_3) using the YSI Pro DSS instrument, the source of the ammonia identified at Building 1790 was found to be emanating from the north east wing of Building 1710. Background ammonia (NH_3) concentrations were typically in the 0.01 mg/L range while ammonia (NH_3) concentrations adjacent to the northeast wing of 1710 building were in the 1000-3000 mg/l range. These results confirmed that 1710 was the source of the ammonia through their discharge of ammonium hydroxide.

After confirmation that the 1710 Building appeared to be the source of the ammonia (NH_3), additional activities were completed to identify the specific source within 1710 Building. A lab in the northeast wing of 1710 Building discharges ammonium hydroxide (a 4% NH_3 aqueous solution) to the Dow MiOps chemical sewer system through a floor drain located in the lab. To verify the integrity of the floor drain, the process producing the ammonium hydroxide was stopped and a sewer camera was inserted into the floor drain. This revealed that the floor drain was damaged and likely discharging ammonium hydroxide to the soils beneath the floor drain. Therefore, a dye test was performed to confirm that the drain was damaged and an observer was placed at the manhole where 1710 discharges its sanitary. After introduction of the dye, the observer noted no evidence of dye at the 1710 sewer system discharge over a period of 2 hours, indicating that the sanitary water was draining to the soils beneath the damaged floor drain and not discharging to the sewer. Upon conclusion that the source of the ammonia in groundwater at 1790 Building was the damaged floor drain in the laboratory of 1710 Building, the lab was instructed not to run the process producing ammonium hydroxide until an alternate method of discharging the sanitary water was implemented. The 2020 Dow Campus Ammonia Investigation Summary is included in Appendix G.

DATA SUMMARY

Groundwater was sampled around Building 1710 in the spring of 2020. Indoor air sampling was conducted at Building 1710 in August 2020. Co-located sub-slab soil gas samples were not able to be collected at that time to due to utilities located within the slab presenting drilling safety concerns; however, a complete sampling event including sub-slab soil gas samples is scheduled to be collected in winter 2021. Indoor air samples from within the building and groundwater samples from outside the building footprint were collected and analyzed for the facility target analyte list (TAL), which includes 65 volatile compounds known to be present in soil and groundwater at the facility. The groundwater analytical results were compared to the June 22, 2018 EGLE site-specific 12 hr Soil Gas and 12 hr Groundwater Not In Contact (GWNIC) screening criteria. Indoor air results were compared to the EGLE site-specific Nonresidential Acceptable Air Concentrations (AAC). Ammonia is not included in the facility TAL, as ammonia is a unique concern to Building 1710 and 1790. Ammonia groundwater results were analyzed by Method 350.1 and compared to the Dow Silicones Site-Specific Criteria for buildings <50,000 ft^2 with a basement, (3,600 ug/L).

As shown on Figures 5.8.2-2 and 5.8.2-3, for the indoor sampling event, indoor air samples were collected from 36 locations from within the building. Indoor air samples were collected at 18 locations on the first floor, in addition to 18 indoor air samples from the basement. Also, an outdoor air sample was collected from the main air intake to determine if the analytes present in indoor air are due to migration from outdoor air. As shown on Figure 5.8.2-4, for the outdoor sampling event, 10 groundwater samples were collected from wells around the north, east and south side of the building. Summary statistics and screening comparison results are presented for indoor and outdoor air on Table 5.8.2-1 and for groundwater on Tables 5.8.2-2 and 5.8.2-3. The analytical data is presented in Appendix A. Field sampling forms are provided in Appendix B.

The building survey conducted during the sampling event can be found in Appendix F. Drains and other openings were screened with a PID. The chemical inventory performed during the building survey identified various potential indoor emission sources, including soap, air freshener, and various cleaning products.

VAPOR INTRUSION RESULTS EVALUATION

Analytical results were evaluated and screened based on methodologies presented in the 2018 Revised Vapor Intrusion Work Plan. As shown in Tables 5.8.2-1 and 5.8.2-2, all indoor air and groundwater results for the 65 analytes on the facility TAL are below the EGLE SSC, except for chloroform in indoor air at two of 36 sample locations. Sample locations 1710-IA-34 and 1710-IA-35 had chloroform results of 6.8 ug/m3 and 8.5 ug/m3, respectively. Both results are below the $TSRIASL_{12}$ (52 ug/m3) and are located in the basement in a separate room identified as the mechanical room, which is not near any offices (See Figure 5.8.2-3). All chloroform results in groundwater collected around the building are below EGLE VI screening criteria.

For ammonia, as shown on Table 5.8.2-3, the groundwater results from four of ten wells had results above the VI screening criteria (3,600 ug/L). The locations of these exceedances correspond to the location of the drain identified to be the source of ammonia.

CONCLUSIONS AND RECOMMENDATIONS

Building 1710 cannot be placed into a VI Path Forward Building Group until sampling is complete and evaluated. A full sampling event, including sub-slab soil gas and an indoor air screen for ammonia, is scheduled to be completed in winter 2021. Further sampling and/or monitoring decisions will be made once the winter 2021 sampling event is complete and the results of that evaluation will be discussed in an EGLE CA Status Meeting when available.

5.9 2021 VI Activities

In 2021, the 12 add-on buildings identified in Section 5.1 are scheduled to be sampled in Fall 2021. Seasonal confirmation sampling will continue for Group 2 and 4 buildings in Zone 3 Phase 2 and Zone 3 Phase 3. Monitoring will continue for the two Zone 4 buildings. Monitoring will also continue for all buildings with interim monitoring plans.

6.0 Direct Contact to Soil Pathway

Soil Direct Contact (DC) is an exposure pathway that includes exposure via long-term dermal contact with and ingestion of soils throughout the soil column, regardless of depth. The focus of this on-site investigation is to evaluate the potential shallow surface soil DC exposure pathway for site workers and contractors.

The Midland Facility is a 1,900-acre industrial facility. The facility's land use is non-residential and includes nearly 400 acres of industrial ponds. The surface cover at the site currently includes approximately 600 acres of buildings and pavement. Roughly 220 acres of the Midland Plant are vegetated final cover installed from 1980 to 1989 for closed WMUs. Nearly 70 acres of new topsoil and vegetative cover have been placed on areas of the plant as part of Phase I Enhanced Exposure Control activities and other greenbelt enhancements. An additional 100 acres of vegetative stormwater detention areas were constructed from 2009 to 2011.

Significant work has been completed to date to improve surface cover at the Midland Plant; however, there are still areas that are eligible for assessment in order to determine if surface improvements are warranted. In order to conduct this evaluation for the DC pathway, the site was split up into manageable areas, primarily referred to as Zones (Figure 6-1). Since 2016, Dow has worked through a systematic method of reviewing this acreage and determining how these soils will be evaluated and to what extent. The approach includes defining exposure units and decision units for the on-site areas of interest in support of further characterization including techniques to evaluate potential exposures, such as incremental composite sampling.

In 2016, Zone 1 was selected for evaluation, covering approximately 300 acres. The Campus Area and Greenbelt Areas were also included for evaluation in 2016 to expedite the sampling and evaluation of those areas. In 2017, implementation activities were focused on Zone 2 which covers approximately 280 total acres. Zone 2 encompasses an area in the east (approximately 245 acres) and a small area in the west of the facility (approximately 35 acres). Zone 3 which was covered in 2018 contains most of the remaining area of the facility east of the Tittabawassee River, which is approximately 400 acres. Zone 4, addressed in 2019, is located west of the Tittabawassee River. For 2020, work focused on the final zone of work, Zone 5, which is the Tittabawassee Floodplain, as well as additional follow-up sampling located in the previously sampled Zones 1-4.

Soils relocated within the Midland Plant and from areas of the Tittabawassee River Floodplain are managed in specific areas within the Midland Plant. A listing of these relevant soil relocation activities for 2020 is provided in Tables 6-1 and 6-2.

6.1 Direct Contact Work Completed in Fall 2019 and 2020

Multiple DUs were sampled in Fall 2019 to close data gaps and the sample analysis was not completed in time to present the results evaluation in the 2019 CAIP.

The late Fall 2019 sampling effort included the following activities:

- Barrier design clarification sampling completed to further delineate impacts observed during the initial sampling event or confirmation sampling event;
- Additional dioxins and furans TEQ triplicate sampling for DUs with dioxins and furans TEQ results between 550 ppt and 1,000 ppt; and
- Arsenic triplicate sampling for all DUs with arsenic results that exceeded the projected 95% lower confidence level based on dioxin and furan results.

Section 6.6 presents the results for the Fall 2019 sampling effort.

DC field sampling and interim measures activities were completed in 2020. The following DC field sampling was conducted:

- Zone 5 along the Tittabawassee Flood Plain;
- Confirmation sampling for was conducted in Zone 4 for DUs within the applied range of uncertainty (550 – 1,600 ppt) which included 8 Zone 4 DUs;
- Conceptual site model confirmation sampling was completed for Category 3 (Greenbelt 2000 – present) at 29 DUs and for Category 4 (Relocated Soils with Imported Top Soil) at 13 DUs. For Category 6 (Vegetated Cap Closed by Dow), 10% triplicate sampling was completed for 4 DUs; and
- Baseline sampling for remedy areas.

Long-term barrier implementation was completed at 1G, 5C2T, 5KKN, 5KKS, and 2D.

Section 6.7 discusses the 2020 sampling results and completed interim measures in further detail.

6.2 Direct Contact Exposure Characterization Overview

A CSM for DC to the on-site soil at the Midland facility is presented in Figure 6-2. This CSM identifies the potential soil exposure pathways and types of sources for the on-site properties. The initial step for each phase (zone) of this project is to determine the types of surface cover in the area to be evaluated and to identify the gravel or grass-covered areas that have not been assessed or recently covered during Dow's surface cover enhancements. In addition to determining the types of surface cover, an evaluation is performed considering historical use in each of the areas to be assessed, as well as the present use and maintenance required to evaluate the types of potential exposure that could occur (e.g., land use and activities that occur on or near those areas). Figure 6-3 presents the Dow Midland Facility Direct Contact Category Flowchart. The flowchart categorizes and describes the property types present, possible sources, exposure types, use (e.g., frequency of activity), and the path forward for sampling.

Exposure and current use are evaluated for each property type in the area to be assessed. Exposure categories include intermittent event-based exposure with regular use, limited exposure with regular to low frequency use, limited access with low frequency use, and limited access or no access with very low frequency use. The combination of property type, possible sources, exposure, and use led to the development of nine categories for DC sampling and evaluation at the Dow Midland Facility. These nine categories are presented in the Table 6-3 along with the sampling frequency for each category. An additional category was created for 2020, Category 8, to describe the Tittabawassee River Flood Plain.

No sampling was proposed for areas with restricted access (limited to very infrequent maintenance, including the wastewater treatment tanks and dike areas), and areas where pavement or building footprint and slab areas under process areas impede exposure to soil via DC. However, the Rail Yard and Electrical Substation (Category 9) are proposed for evaluation as individual, complete areas in 2021. Each of these areas is limited by either train activity or fencing. Evaluating these areas will involve strict safety considerations.

6.3 Target Analyte Lists and Sampling Density Overview

Four possible general sources of impacts were identified for the Midland Facility. These include aerial dispersion, imported soils, leachate breakout, and other sources (e.g., point source release, historic area operations). These sources of impacts were used to establish the target analyte lists (TALs) for the property types listed in Table 6-3 and Figure 6-3 and are described in more detail below:

- Aerial dispersion includes areas potentially impacted by the historical aerial release.
- Imported soils are soils brought on-site as final cover for excavations or where site soils were relocated. Soils were imported from regional agricultural areas and may not have been tested when acquired.
- Leachate breakout determined from RGIS detections,
- Other sources (e.g. point source release and historic area operations)

Table 6-4 summarizes the possible sources of impacts, the determination and TALs for each source, and the applicable exposure category for each TAL.

The aerial dispersion TAL includes dioxins and furans and arsenic. All areas classified as Categories 1 and 2, are sampled for this TAL. Areas classified as Categories 5 and 6 warrant limited confirmation sampling based on exposure and use; therefore, at least 20% of the area within these categories is sampled for the aerial dispersion TAL. All areas classified as Category 5 were eventually sampled for the aerial dispersion TAL due to unexpected dioxin and furan detections observed throughout the 2016-2018 sampling efforts. Although usage and exposure are low, all areas classified at Category 8 were analyzed for dioxins and furans. In addition, those DUs adjacent to Ash Pond AOC were analyzed for arsenic. In addition, the aerial TAL will be used to evaluate Category 9.

The TAL for imported soils originally included metals, herbicides, and pesticides. Confirmation sampling for this TAL is proposed for areas covered by imported soils and sampling density was based on category. All areas classified as Category 3 are sampled for this TAL. Due to limited exposure and use, 50% of area classified as Category 4 is sampled and at least 20% of the area within Categories 5 and 6 are sampled for this TAL. However, based on the findings of the additional sampling conducted in the stormwater basins, dioxins and furans were sampled for in Categories 3 and 4 in 2020.

The leachate breakout TAL was determined based on RGIS detections. The TAL includes detected metals, herbicides, pesticides, SVOCs, VOCs, and dioxins and furans. Limited confirmation sampling for this TAL is proposed for those areas covered by landfill cap. Category 6 areas are sampled at a frequency of at least 20%.

The TAL for other sources was determined based on detections from the 2005-2006 Dow On-Site (DOS) sampling effort and the 2010-2015 Worker Exposure Control Program sampling efforts. The other sources TAL includes detected metals, herbicides, pesticides, SVOCs, VOCs, polychlorinated biphenyls (PCBs), and dioxins and furans. All Category 1 areas are sampled for this TAL. Due to limited exposure and use, Category 6 areas are sampled for this TAL at a frequency of at least 20%, and Category 7 areas are generally not sampled; however, specific areas found on vegetated caps closed with EGLE or EPA Oversight and Limited Access have been sampled at the request of EGLE.

6.4 Sampling Methodology

Due to the anthropogenic deposition of the constituents of concern (COCs) within the sampling areas, a heterogeneous distribution throughout the DC sampling areas is likely. Studies have shown that sampling heterogeneous populations, with individual particles that are likely to have different concentrations of COCs through conventional sampling methods (e.g., discrete or standard composite sampling) inadequately represent the average COC concentration of that population (EPA 2012; Engineer Research and Development Center [ERDC]/Cold Regions Research and Engineering Laboratory [CRREL] 2009; Jenkins et al. 2005). Therefore, an incremental sampling methodology (ISM) is employed throughout the DC sampling areas to provide a more unbiased and reproducible estimate of the mean concentrations of analytes in heterogeneous sample populations.

6.4.1 Incremental Sampling Methodology

ISM is a structured sampling and analytical methodology developed to address the problems associated with collecting representative samples from volumes of particulate material with high compositional and distributional heterogeneity by identifying and minimizing types of sampling and analytical errors. Essentially, ISM is a more robust and ordered type of composite sampling that combines uniform, spatially representative grab samples or “increments” to produce a sample result for an area and depth of soil, or, that is representative of the average concentration of COC of that population sampled. ISM is also more appropriate than conventional discrete sampling for comparison with risk-based screening values and for evaluating concentrations relative to background concentrations.

ISM describes both the field sample collection and laboratory processing methods necessary to obtain samples that contain the COC in the same proportions as the sampled population. Some of the primary differences between ISM and conventional composite or grab sampling are as follows:

- The need to define the spatial boundaries of the DUs;
- A sample mass much larger than required by most analytical methods;
- The number of increments that will be collected in each sample;
- The spacing and distribution of the increments to be collected; and
- The laboratory preparation procedures (ERDC, 2013).

6.4.2 Decision Unit Determination

The evaluation of a zone/sub-zone begins by overlaying a satellite aerial of the area to be evaluated with a 2-acre grid, which represents a non-residential DU. Each of the grids are evaluated for property type and current/historical use. Using this aerial/grid map together with the flowchart presented on Figure 6-3, a rationale is developed for whether sampling is proposed for each grid. If sampling is not proposed, justification for no sampling is documented. For example, areas that are covered by pavement, buildings, or process areas are not proposed for DC sampling. DUs are then delineated throughout the target sampling areas based on site characteristics and historical land use. DUs range from less than 1 acre up to approximately 2 acres. A small percentage of DUs may slightly exceed 2 acres. However, these larger DUs are not further divided due to the site-specific conditions such as the contiguous nature of the land and/or common past and present land use. In Zones 1-3, for each DU, 10-30 increments were collected, dependent on the acreage of the DU:

- DUs less than 0.5-acre contained 10 increment sampling locations;
- DUs greater than 0.5-acre and less than 1 acre contained 20 increment sampling locations; and/or
- DUs greater than 1 acre contained 30 increment sampling locations.

However, based on the replicate analysis completed on several Zone 1 and Zone 2 DUs, the increment count per DU was increased to 20-50 increments based on the acreage of the DU for Zones 3 and Zone 4 in 2019. This analysis and outcome were discussed in more detail in the 2019 CAIP/2020 Work Plan; however, the changes to the increment amount are as follows:

- DUs less than 0.5-acre increased to 20 increment sampling locations;

- DUs greater than 0.5-acre and less than 1 acre increased to 30 increment sampling locations; and/or
- DUs greater than 1 acre increased to 50 increment sampling locations.

Increment locations are generated using a systematic random sampling approach. The increments were laid out by selecting a random starting point and generating evenly spaced increments based on that starting point using a geographic information system (GIS) program for each DU.

6.4.3 Sample Collection

Maps and global positioning system (GPS) units containing the increment locations within each DU are provided to each sampling team for sample collection. Field teams either first mark all increment locations with a flag prior to collection or work as a team to navigate up and down the rows of sample locations collecting the increments and tracking collection via the GPS device (Figure 6-4).

Ideally, each increment serves as an equivalent portion of the overall sample, which represents the DU as a whole. The ability to take uniform increments at a consistent depth, each representative of a portion of the sample and contributing equally to a representative sample of the entire DU, is greatly dependent on the sampling tool and proper sampling methods.

Generally, increments in most DUs, for all analyses except VOCs, are collected using stainless steel push samplers or Enterprise Venture Corporation (EVS) Incremental Sampling tools in order to ensure that each increment was collected at the same depth and volume. Each increment is collected using a 1-inch diameter coring device to a depth of 6 inches bgs. Once an increment is collected in the device, it is extruded into a bucket lined with a 3 millimeter (mm)-thick 24-inch x 30-inch zip-close plastic bag to create a resulting composite sample with a target mass of between 1 to 3 kilograms (kg).

In areas where the stainless-steel push samplers/EVS Incremental Sampling tools cannot advance to the desired depth, such as in heavily compacted gravel areas, an AMS gas-powered core sampler is used. This sampling device consists of a portable gas-powered hammer and hollow stainless-steel drive rods capable of driving a 1.5-inch diameter polyvinyl chloride (PVC) liner equipped with a PVC soil catcher to collect a sample. Each increment is collected by driving the rods to a depth of 6 inches bgs. Once an increment is collected (or multiple increments as the PVC liner is capable of collecting up to four increments prior to its contents needing to be extruded), it is extruded into a bucket to result in a composite sample in the same manner as the stainless steel push samplers/EVS incremental sampling tools

For DUs with non-volatile COCs being sent to different laboratories for analyses field replicates are collected for each laboratory so that the entire sample mass is sent to each laboratory for analysis and errors due to splitting samples would be eliminated. Two increment cores are collected approximately 6-12 inches apart and each core went into a different bucket. A 12-inch x 12-inch custom made PVC grid is used to ensure that replicates are collected in the same manner with respect to the primary increment sample location. At each primary increment collection location, the corner of the marked corner of the PVC grid marker is lined up with the increment collection location identified on the GPS. Then an increment is collected from approximately the center of each cell in the grid as necessary to create field replicates. Increment collection is not biased to avoid vegetation; however, vegetation is not included in the analysis of the soil sample. Vegetation included with the collection of the increment remains with the sample until processing either by the field team prior to delivery to the laboratory for the dioxins/furans analyses or by the laboratory for all other analyses.

As VOCs can be quickly lost from an exposed surface additional measures are employed in order to collect a representative sample for DUs that include VOCs on their TAL (Interstate Technology and Regulatory Council [ITRC] 2012; Hewitt, Jenkins, and Grant 1995). For samples collected for VOC analysis, individual increments are collected as 5-gram (g) plugs at the desired core depth and immediately preserved in methanol. A Terra Core® is used to collect a 5-g aliquot from approximately 3 inches bgs from the side of the augered hole and then is extruded into a 1-liter (L) amber jug containing 150 milliliters (mL) of methanol for field preservation.

Each composite sample is assigned a unique sample ID number, which includes the DU designation. Each DU also has a unique ID that corresponds to its category and TAL.

6.4.4 Field Documentation

Each field team is provided with a detailed daily assignment log of sampling units and samples to be collected within each sampling unit. Each field team is responsible for supplying the required information on the form upon sample collection. The sample form includes time of sample collection, date of sample collection, any unusual field conditions or mechanical issues encountered and initial each sample collection line item to verify the entry. At the end of each field day, the Field Team Leader collected all team logs and conducted a quality control check of all samples delivered from the daily activities.

6.4.5 Equipment Decontamination

Solid materials samplers and soil processing equipment, including stainless steel sieves and bowls, are decontaminated according to the following procedures:

A. Scrub the equipment to remove visible contamination, using appropriate brush(es), approved water, and non-phosphate laboratory detergent.

B. Rinse with tap water.

C. Rinse with solvent (acetone).

D. Rinse with deionized water.

E. Allow equipment to air dry or wipe dry with paper towels prior to reuse.

All cleaned sampling equipment is stored in a clean environment and covered in aluminum foil or clean plastic sheeting for protection between uses. All decontamination solutions are properly disposed of according to Dow site policies.

6.4.6 Sample Processing and Laboratory Analysis

Collected samples are brought back to a clean designated workspace for further processing or to be packaged directly for shipment to the laboratory. Soils collected for dioxin/furan analyses are sieved through a 2 mm (US Standard #10 mesh) sieve prior to delivery to the Dow Environmental Analytical Chemistry (EAC) lab. During sieving, any vegetation in the composite sample is broken in smaller pieces to release any trapped soil particles and is subsequently extracted from the soil sample; therefore, vegetation is not part of the sieved subsample extracted for analysis. Once the soils for dioxin/furan analysis are sieved, all samples are packed for immediate delivery to the Dow EAC laboratory. Sieved samples are double bagged into Ziploc bags and are labeled in accordance with sample labeling procedures. For soils collected for all other analysis, excluding VOCs, the soils are doubly rebagged in Ziploc bags and labeled in accordance with sample labeling procedures. Soil samples collected for VOC analysis are field preserved as described in Section 6.4.3.

Samples are then placed in coolers with chain-of-custody forms and are immediately shipped or hand-delivered using standard chain-of-custody procedures. Environmental soil samples are analyzed for the TALs for each category listed in Table 6-4. Table 6-5 shows which laboratories and which analyses are used for each analyte or analyte group.

Upon receipt, laboratories then air dry each composite sample, disaggregate the entire volume using rotary hammers, and sieve the resultant matrix. Once the samples are dried and sieved, a statistical subsampling procedure is performed to sub-aliquot sample volume for use in the analyses. Moisture samples for field preserved VOC samples are removed from the ISM samples prior to any drying.

Soil samples collected for VOC analysis are field preserved as described in Section 6.4.3 and are prepped for analysis upon receipt by the lab in accordance with U.S. EPA Method 5035.

6.5 Statistical Evaluation and Screening of Data

Basic summary statistics are prepared for the soil results from DUs located in the same geographic zone/sub-zone and/or sampling event. These tables include common statistical parameters such as mean, standard deviation, minimum and maximum detected values, and minimum and maximum reporting limits (RLs) of non-detects (NDs). The number of samples and detection rates are also included to provide information regarding sample size and detection frequency. Additionally, these summary statistic tables present the results of the screening comparison to relevant criteria.

A screening-level evaluation of the data is performed by comparing each data point to non-residential DC criteria (DCC) for soil. EGLE Part 201 December 30, 2013 non-residential DCC for soil are selected whenever available (EGLE, 2013). EPA Regional Screening Levels (RSLs) for industrial soil are selected whenever EGLE screening criteria are not available (document release date: May 2016) (EPA, 2016).

EGLE State-wide default background values are used as an initial screen for metals, when available. EGLE also developed and provided a regional background and modified urban background for some metals during the Midland Area Soil project, which are used as a secondary screen.

For the evaluation of analytes that exist in several isomer forms, the isomer-specific concentrations are summed before being compared to the appropriate screening criteria. These classes of analytes include chlordanes, endosulfans, methylphenols (cresols), polynuclear aromatic hydrocarbons (PAHs), PCBs, and xylenes and are summarized in Table 6-6.

6.6 Zone 5 Tittabawassee River Floodplain Area Conceptual Site Model and Assessment Methodologies

6.6.1 Tittabawassee River Flood Plain Conceptual Site Model

The portion of the Tittabawassee River floodplain that is generally flooded at least once every eight years (the “8-year floodplain”) is used to define the area of floodplain to be sampled. The primary constituents of interest (PCOIs) in the floodplain are dioxins and furans. Detailed reports of the floodplain studies and findings can be found in the Tittabawassee River Floodplain Response Proposal, dated May 30, 2014 (Dow 2014) and the 2006-2008 Site Characterization Study (ATS 2009).

6.6.2 Tittabawassee River Flood Plain Sampling Methodology

The 8-year floodplain located between the eastern and western portions of the Midland facility was split into DUs no larger than 20 acres. The DUs extended from the 8-year floodplain boundary to the low river water line in cases where the parcel is immediately adjacent to the river, or to the property boundary closest to the river. Typically, if a property is split into multiple DUs the split will be perpendicular to the river.

The increment collection locations within each DU are generated using a systematic random approach. In the systematic random pattern, a random starting point is generated, and then subsequent increment locations are established on an even spacing within the remainder of the DU. The number of increments will vary based on the size and anticipated variability across the parcel, but is expected to generally consist of the following:

- Other land use DUs 10 acres or smaller: 60 increments
- Other land use DUs larger than 10 acres: 90 increments

The following subsections outline the processes used for sampling the floodplain. The sampling methodology for the floodplain has three major components: the field implementation, the sample processing, and the laboratory analysis. A brief summary of how this data will be evaluated is also provided.

6.6.2.1 Field Implementation

The increment collection locations are created in a Geographic Information System (GIS) in advance of the sampling activity. The planned sampling locations for a DU are loaded into handheld global positioning system (GPS) units for use by field teams to identify sampling locations. In heavily wooded areas where tree cover precludes the use of a GPS unit, alternative techniques may be employed to ensure that the increment can be collected close to the planned location. In the field, each increment collection location will be clearly identified by a member of the field team with a survey flag prior to the sample collection. After a soil core has been collected at a location, the survey flag will be removed and documented to help verify all planned increments have been collected. At each DU, actual conditions may differ from those understood during sample plan generation. The field team will make best efforts to sample at the planned locations, but will use the following guidelines in the field to adjust increment locations on an as-needed basis:

- Increment locations will be selected no closer than twelve inches (12”) from existing roads.
- If an incremental sample is identified at a location of a tree (including tree piles), it will be moved to the closest possible location where a sample can be obtained.
- If a biological hazard exists at the location of the incremental sample, the sample location will be adjusted to the closest possible location where it can be safely obtained
- Soil samples will not be collected from areas typically covered with standing water such as a pond.

In addition, the initial grid of sampling points laid out in GIS may be altered as necessary to ensure adequate coverage of the geomorphic units that form the DU. This alteration may simply mean moving the entire grid by a set amount, or where adequate coverage (i.e. a proportional number of samples) still cannot be obtained across the geomorphic units within a DU, specific sample locations may be moved. Sample layouts will be reviewed with the Agencies prior to sampling.

Soil cores (increments) will be collected using stainless steel push samplers that facilitate consistent collection to the same depth and volume. Each increment will be collected from 0.5- to 1-inch diameter cores to a depth of 6 inches below ground surface (excluding any surficial vegetation layers, which will be cleared prior to core collection). The individual increments will be combined into a single composite sample in the field. Consistent with ITRC guidance, no decontamination is proposed between increment coring, however a decontaminated coring devise will be used for each DU.

6.6.2.2 Sample Processing

After field collection, increment composite samples will be brought back to a clean designated workspace for processing, as described below, prior to delivery to the laboratory. Processing will generally follow methodology and best management practices as outlined in the ITRC incremental composite sampling guidance. Samples will be allowed to air dry, after which, they will go through a sieving process. Any remaining vegetation in the sample (generally assumed to be grass and roots) typically does not pass through the sieve and therefore is not part of the subsample extracted for analysis.

Following initial sieving, each composite sample will be homogenized. This homogenization process will be conducted using 1-5 gallon dedicated sealable cans and a motorized roller machine. The can will be left on the roller machine for a minimum of one hour to allow sufficient mixing/homogenization.

Following homogenization, a relatively thin layer of sample will be spread out horizontally in a square or rectangular layer. Scoops of sample will be made at regular intervals (similar to the incremental sample location design for each site) until the desired extraction size of 250 grams is obtained. Replicate composites will be made by taking scoops of sample at regular intervals directly adjacent to the first scoop. Remaining volume after building the composite may be retained as necessary.

6.6.2.3 Laboratory Methodology

Once the samples are processed, all samples will be packed for delivery to the Dow laboratory. Processed samples will be placed in jars with appropriate labelling and delivered to the laboratory for login and processing. A method has been developed by Dow analytical chemists by adaptation of existing USEPA Method 8280 for rapid determination of polychlorinated dibenzo-p-dioxins (PCDDS) and dibenzofurans (PCDFs) in soil by high resolution gas chromatography/high or low resolution mass spectrometry (HRGC/HRMS or RGC/LRMS). This method was developed to decrease the time necessary for each laboratory analysis. The Standard Operating Procedure (SOP) for Method 8280 was submitted to EGLE on July 5, 2006 as part of the QAPP for the Geomorph Investigation (ATS 2006), which was approved by EGLE (following consultation with USEPA) later that year. The rapid method is also outlined in the 2010 Site QAPP (ATS 2010). The rapid method extracts and analyzes the entire 250-gram sample. The rapid method is anticipated to be used for the majority of sample analyses; however, Dow reserves the right to use the standard method on a property by property basis and will consult with the Agencies when the standard method is used.

6.6.2.4 Data Evaluation

Basic summary statistics have been prepared for the soil results from these Zone 5 DUs similar to those completed for Zones 1 through 4. These tables include common statistical parameters such as mean, standard deviation, minimum and maximum detected values, and minimum and maximum reporting limits (RLs) of non-detects (NDs). The number of samples and detection rates are also included to provide information regarding sample size and detection frequency. Additionally, these summary statistic tables present the results of the screening comparison to relevant criteria.

A screening-level evaluation of the data is performed by comparing each data point to non-residential DC criteria (DCC) for soil. EGLE Part 201 December 30, 2013 non-residential DCC for soil are selected whenever available (EGLE, 2013). EPA Regional Screening Levels (RSLs) for industrial soil are selected whenever EGLE screening criteria are not available (document release date: May 2016) (EPA, 2016).

6.7 Fall 2019 Direct Contact Sampling Activities

Multiple DUs were sampled in Fall 2019 to close data gaps. Table 6-7 provides a summary of these DUs and the purpose behind sampling each of these DUs. Appendix H provides the direct contact data packages and Appendix I provides the decision unit maps for the Fall 2019 sampling effort. The Fall 2019 sampling effort included the following:

- Barrier design clarification sampling completed to further delineate impacts observed during initial sampling event or confirmation sampling event;
- Additional dioxins and furans TEQ triplicate sampling for DUs with dioxins and furans TEQ results between 550 ppt and 1000 ppt; and
- Arsenic triplicate sampling for all DUs with arsenic results that exceeded the projected 95% lower confidence level based on dioxin and furan results.

6.7.1 Barrier Design Clarification Sampling

Several DUs in Zone 1 and Zone 3 were resampled in the fall of 2019 to further delineate impacts observed during the initial sampling event or confirmation sampling event, as was the case with Zone 1 DU 5A-2 (Figure 6-5) and Zone 3 DUs 5C2 (Figure 6-6, 5KK (Figures 6-7 & 6-8), and 1Q and 1O1 (Figure 6-9). This sampling was also completed to help design short-term barriers or long-term barriers for these areas.

Zone 1 DU 5A-2 was previously sampled with another DU (5A-1) and needed to be redrawn to correctly reflect the feature intended for sampling (i.e., a stormwater basin); additionally, previous results for this DU placed it within the range of the 95% lower confidence level. Zone 3 DU 5C2 was sub-divided into five DUs: 5C2T, 5C2S, 5C2N, and RR1. Zone 3 DU 5KK was split into two DUs (5KKN and 5KKS) due to the non-contiguous nature of the two basins that make up to the DU. Zone 3 DUs 1Q and 1O1 were broken down due to the identification of a stormwater basin (1QSW and 1QB) and to determine where, if any, line existed within 1O1 between non-elevated and elevated dioxins and furans TEQ results.

All of these DUs above with dioxin and furan TEQ results greater than the non-residential DCC had previously had short-term barriers placed around them after receipt and analysis of the initial sampling results The Category 5 DUs listed were also analyzed for the Category 1 non-dioxin TAL to determine that no non-dioxin/furan compounds exceeded their respective non-residential DCC. All these DUs were sampled in triplicate for dioxins and furans for analysis via the FAST Method. Table 6-8 summarizes the dioxins and furans TEQ results for these DUs. Table 6-9 and 6-10 summarize the results the metals and non-dioxin/furan compounds for those DUs analyzed for the Category 1 TAL.

The breakdown of DU 5C2 showed that only one portion of the original DU (5C2T) had dioxins and furans TEQ results greater than the non-residential DCC; therefore, only a portion of the original DU (5C2T) was addressed with a long-term barrier. The dioxins and furans TEQ results for 1QB, 1QSW, 1O1A, 1O1B, and 1O1C are all above the non-residential DCC indicating the area covered by these DUs needs to be addressed via a short term and/or long-term barrier. Both Zone 3 5KK DUs also had dioxin and furan TEQ results greater than the non-residential DCC.

6.7.2 Dioxins and Furans TEQ Replicate RSD Confirmation Sampling

The 95% lower confidence level determined from the average RSD among Zones 1 and 2 indicates that further sampling is warranted on DUs with dioxins and furans TEQ results greater than 550 ppt to confidently determine if the DU contains dioxins and furans at values less than the non-residential DCC. This fieldwork was completed in the fall of 2019 for Zones 1 through 3 for DUs not previously addressed via replicate sampling.

Figure 6-10 shows the DUs that underwent this sampling effort and the calculated 95% UCLs determined from the replicate sampling. Table 6-11 shows the original FAST result and the mean, standard deviation, RSD, and 95% UCL for each DU determined from the Fall 2019 FAST results. Out of the fifteen DUs included in this sampling effort, only four of them had 95% UCLs greater than the non-residential DCC: Zone 1 DU 1C3 and Zone 3 DUs 1J2, 2L and 5T1. Either short-term barriers and/or long-term barriers will be put in place as described further below and per the schedule presented in Section 15.0.

6.7.3 Arsenic Replicate Sampling

Arsenic is the only other analyte that has observed exceedances of non-residential DCC in sampling completed in Zones 1 through 3, specifically in Zones 2 and 3. Although replicate sampling of arsenic throughout each zone has not been completed, the average RSD developed for the dioxins and furans TEQ results from Zone 1 and 2 was used to conservatively estimate a 95% lower confidence level for arsenic. As a result, all DUs that exceeded this 95% lower confidence level for arsenic were sampled in triplicate using the new increment counts established in Section 6.4.2 to confidently determine that the arsenic concentrations of these DUs were either greater than or less than the non-residential DCC for arsenic. These DUs are shown on Figure 6-11 and Table 6-12.

The screening comparison for the arsenic results for each replicate as well as the 95% UCL for each of these DUs sampled in the Fall of 2019 are shown in Table 6-12. Zone 2 DU 1B4 and Zone 3 DUs 5EE and 5HH1 have 95% arsenic UCLs that exceed the non-residential DCC. The arsenic 95% UCL for Zone 2 DU 2E (28 mg/kg) is below the non-residential DCC. For the three DUs that exceed the arsenic non-residential DCC, a short-term barrier or long-term barrier will be put in place as described further below and found in Table 6-28.

6.8 2020 Sampling Results and Conclusions

Sixty-two different DUs were sampled during the Summer 2020 sampling season. Table 6-14 summarizes the scope from the Summer 2020 sampling effort:

- Zone 5, which is the Tittabawassee River Floodplain located adjacent to the facility, was sampled and assessed per the methodologies outlined in Section 6.5 (Figure 6-12);

- CSM confirmation sampling took place among Category 3, 4 and 6 DUs (Figures 6-13, 6-14, and 6-15) to confirm the updated CSM established from re-assessing Category 5 DUs in 2019. Ten percent of the Category 6 DUs were sampled in triplicate for dioxins and furans analysis and Category 3 and 4 DUs previously sampled in 2016-2018 were resampled for dioxins and furans analysis;

- Confirmation sampling for dioxins and furans took place in applicable Zone 4 DUs and among select Category 5 stormwater basins to confirm the 2019 dioxins and furans results observed at these DUs in order to assess whether or not dioxins and furans are truly present at concentrations above or below the non-residential DCC (Figure 6-16);

- Sampling of Zone 4 DU Z4-1-27 (Figure 6-17) as it was blocked by construction in 2019; and

- Zone 2 DU Z2-1-46 was sampled for the first time in 2019 but underwent confirmation sampling in 2020.

- Baseline sampling at areas with completed long term barriers.

Appendix H provides the direct contact data packages and Appendix I provides the decision unit maps for the Fall 2019 sampling effort. The following subsections describe these sampling efforts and the results and conclusions determined from those results.

6.8.1 Zone 5 Direct Contact to Soil Pathway

Zone 5 is solely located within the portion of the Tittabawassee River floodplain that borders the facility (Figure 6-12). The Tittabawassee River floodplain to be sampled was defined as an area that generally floods at least once every eight years (the “8-year floodplain”). The primary constituents of interest the floodplain are dioxins and furans; however, arsenic is also a constituent of interest in the floodplain areas adjacent to the Ash Pond area. Detailed reports of the floodplain studies and findings can be found in the Tittabawassee River Floodplain Response Proposal, dated May 30, 2014 (Dow 2014) and the 2006-2008 Site Characterization Study (ATS 2009).

For the purpose of dioxin and furan sampling, the 8-year floodplain was split into DUs no larger than 20 acres. The DUs extended from the 8-year floodplain boundary to the low river water line in cases where the parcel is immediately adjacent to the river, or to the property boundary closest to the river. Typically, if a property is split into multiple DUs the split was made perpendicular to the river. The DUs are shown in Figure 6-18. All DUs in Zone 5 were categorized as Category 8; however, the DUs adjacent to the Ash Pond area were further subdivided and sampled for arsenic in line with the Midland Facility DU determination and sample collection procedures outlined in Section 6.3 (Figure 6-19).

Tables 6-15 and 6-16 summarize the dioxins and furans results and the arsenic results for these DUs, respectively. All dioxins and furans results were below the non-residential DCC in the four DUs sampled in Zone 5 for dioxins and furans. Additionally, all arsenic results were less than the non-residential DCC in the three DUs sampled in Zone 5. For all Zone 5 DUs, no further action is proposed at this time.

6.8.2 Category 3 and 4 CSM Confirmation

Based on unexpected exceedances observed in some stormwater basins (Category 5 DUs) sampled throughout the direct contact pathway assessment, Category 3 and 4 DUs were resampled for dioxins and furans analysis to ensure the assumptions made for the Midland Facility CSM were correct. Category 3 and 4 DUs were not sampled for dioxins and furans previously as these areas consisted of imported soil that was imported either since 2000 (Category 3) or the soils were brought in from more than 10 miles away or from City of Midland soils (Category 4). Twenty-nine Category 3 DUs and 13 Category 4 DUs were sampled during the Summer 2020 sampling effort. These Category 3 and 4 DUs are shown on Figures 6-13 and 6-14, respectively.

Table 6-17 presents the summary statistics for dioxins and furans for these Category 3 and 4 DUs and Table 6-18 presents the dioxins and furans TEQ results by DU.

All dioxins and furans TEQ results for the 29 Category 3 DUs sampled in 2020 were less than the non-residential DCC of 990 ppt. Furthermore, all the results for the 29 Category 3 DUs sampled in 2020 were less than the 95% lower confidence limit for dioxins and furans established in 2019 (550 ppt); therefore, no further action is proposed at this time for the Category 3 DUs.

All but two of the 13 Category 4 DUs sampled in 2020 had dioxins and furans TEQ results that were less than the non-residential DCC of 990 ppt. The two DUs with exceedances were Zone 1 4B-1 at 1,300 ppt and Zone 3 4B at 1,100 ppt. Additionally, those 11 Category 4 DUs with dioxins and furans TEQ results less than the non-residential DCC also had results were less than the 95% lower confidence limit for dioxins and furans established in 2019 (550 ppt). No further action is proposed at this time for these 11 Category 4 DUs. For the two DUs that exceeded the non-residential DCC, the path forward regarding short term and long-term barriers will be discussed in more detail below.

6.8.3 Category 6 Dioxins and Furans Confirmation Sampling

Similar to Categories 3 and 4, confirmation sampling was completed for Category 6 DUs that were not sampled in triplicate. This was done to confirm that the Category 6 areas have results less than the non-residential DCC and that the conceptual model for these areas has proven to be accurate. These DUs

(Figure 6-15) were resampled in triplicate to fully assess the presence of dioxins and furans in soil with regards to the direct contact pathway at the Midland facility.

Four Category 6 DUs located in Zone 1 were included in this evaluation (the previous dioxins and furans TEQ results is listed in parentheses): 6A-1-1 (285 ppt), 6B (261 ppt), 6C (377 ppt) and 6E-2 (249 ppt). Table 6-19 presents the summary statistics for dioxins and furans for these Category 6 DUs and Table 6-20 presents the dioxins and furans TEQ results by DU. Note that the values reported in Table 6-20 are the UCLs determined from the 1613b triplicate sampling results. The means, standard deviations, and RSDs for each of the triplicate sets are also listed.

All dioxins and furans TEQ UCL results for the Category 6 DUs sampled in triplicate in 2020 were less than the non-residential DCC for dioxins and furans TEQ (990 ppt); additionally, the RSDs for these triplicate sets are low (6 to 12%) indicating good reproducibility and precision of the 1613b results among the triplicate samples for a given DU. As all results from these DUs are less than the non-residential DCC, no further action is proposed as this time.

6.8.4 Zone 4 and Stormwater Basin Confirmation Decision Units

As completed previously for Zones 1 through 4, in the year following the initial sampling event for a given zone, several DUs are resampled in triplicate to confirm that the FAST results reported are an accurate representation of the dioxin and furan TEQ results for a given DU. Several DUs in Zone 4 were sampled multiple times as part of the replicate sampling evaluation completed in 2019; therefore, the Zone 4 DUs chosen for confirmation sampling in 2020 were those DUs with results greater than the 95% lower confidence limit established in 2019 (550 ppt) and those DUs with results slightly above the non-residential DCC for dioxins and furans TEQ (990 ppt). Eight of the DUs in Zone 4 underwent triplicate confirmation sampling and analysis via 1613b to determine if the 2019 results were accurate for each DU. The only DU that did not undergo replicate sampling was Z4-1-27 as it was not sampled in 2019 due to construction blocking the area; additionally, the sample from Z4-1-27 was analyzed for the Category 1 TAL.

Table 6-21 presents the summary statistics for dioxins and furans for the Zone 4 DUs and Table 6-22 presents the dioxins and furans TEQ results by DU. Note that the values reported in Table 6-22 are the UCLs determined from the 1613b triplicate sampling results, with the exception of Z4-1-27 as previously noted. The means, standard deviations, and RSDs for each of the triplicate sets are also listed. Out of these nine DUs, five had dioxin and furan TEQ UCL results greater than the non-residential DCC (Z4-1-3, Z4-1-4, Z4-1-11, Z4-2-76 and Z4-2-77). Details about the short and/or long-term barriers planned for these areas will be discussed in greater detail further below. For the other five DUs, no further action is proposed at this time.

Table 6-23 presents the summary statistics for dioxins and furans for the three stormwater basin DUs and Table 6-24 present the dioxins and furans TEQ results by DU. Note that the values reported in Table 6-23 are the UCLs determined by the 1613b triplicate sampling results. The results for these three DUs indicate that two had dioxin and furan TEQ UCL results greater than the non-residential DCC (SW-5H and SW-5W). Details about the short and/or long-term barriers planned for these areas will be discussed in greater detail in Section 6.15. For the other DU (SW-5J), no further action is proposed at this time.

Tables 6-25 and 6-26 summarize the non-dioxin results for DU Z4-1-27. All the non-dioxin analytes results were less than their non-residential DCC; therefore, no further action is planned for DU Z4-1-27.

6.8.5 Follow-up Sampling at Z2-1-46

DU Z2-1-46 was sampled for the first time in 2019 but underwent confirmation sampling in 2020. Table 6-27 summarizes the dioxins and furans TEQ UCL for Z2-1-46. The dioxins and furans TEQ UCL exceeded the non-residential DCC (990 ppt) and the path forward regarding short term and long-term barriers will be discussed in more detail below.

6.8.6 Baseline Sampling in Remedy Areas

Sampling was conducted in remedy areas in order to establish a new dioxins and furans TEQ baseline. The areas with remedy in place with soil sampled during this effort include DUs 5KKN, 5KKS, 1G, 2C, and 5C2T. Table 6-13 presents the results of this baseline sampling. All new baseline concentrations for these remedy areas are well below the non-residential DCC (990 ppt).

6.9 Direct Contact Short-Term Barriers and Long-Term Barriers

Through the course of sampling Zones 1 through 5 and the development of UCLs for DUs sampled in triplicate for dioxins and furans, several DUs have been identified with dioxins and furans TEQ results greater than the non-residential DCC and a few have been identified with arsenic concentrations greater than the respective non-residential DCC. Several areas in Zones 1 through 3 have a long-term barrier in place or have short term barriers to prevent access to the area with elevated dioxins and furans TEQ results.

The approach to short-term barriers and long-term barriers taken to address non-residential DCC exceedances is summarized below:

- If the dioxins and furans TEQ result or TEQ UCL is less than 990 ppt and all other analytes also have results less than their non-residential DCC, no further action is warranted and HE EI is met for these DUs.

- If the dioxins and furans TEQ result or the TEQ UCL for a DU is greater than 990 ppt and/or there are other analytes that exceed their non-residential DCC, fencing and signage with hazard communication and additional PPE usage for workers who need to enter the area will be implemented and/or a long-term barrier may be put in place to achieve HE EI met. A long-term barrier may entail a geotextile covered by gravel or seeded topsoil or asphalt used as a final cover.

Table 6-28 summarizes the short-term barriers installed at the applicable DUs in Zone 1 through Zone 3 and the interim actions that will be completed based on the Fall 2019 and 2020 direct contact sampling activities. Short term fencing activities will be implemented throughout 2021 and a summary of status is presented in Table 6-28.

6.9.1 Zone 1 Short-Term Barriers and Long-Term Barriers

The following sections summarize the long-term barriers that have been implemented in the Pallet Yard Area and will be implemented in the additional Category 1 DUs near the Pallet Yard Area and DUs 2D and 4C in greater detail.

6.9.1.1 Pallet Yard Area (DUs 1A-2 through 1A-8)

Work in the pallet yard area commenced in early November 2018 and was completed by early January 2019. The construction-focused soil management plan and dust-track out control plan submitted and approved in September 2018 was implemented for this construction work.

<u>Work Completed in 2020</u>

A set of as-built drawings was provided to EGLE in 2020, which identified the final dimensions of corrective actions, marker layer layout, and thickness and makeup of the final cover layer within each DU.

6.9.1.2 Additional Category 1 DUs Near Pallet Yard Area

The dioxins and furans TEQ results from DUs 1A-9 through 1A-12 indicate the need for an interim measure or long-term barrier to be put in place to address the non-residential DCC exceedances observed at these DUs. The status of these areas is also summarized on Table 6-28.

Planning for the long-term barrier was initiated in 2018 for DU 1A-10 and is ongoing. The plan will likely include the removal of the top six inches of existing soil, followed by the placement of a non-woven geotextile visible marker layer to be covered by six inches of clean gravel. The intention of the soil removal is to ensure appropriate sloping and stormwater drainage in these areas after installation of this long-term barrier. Additionally, Zone 1 DU 1A-11 will also be included in this effort as the distinction between these two DUs arbitrary and not due to a physical feature, a change in use, and/or a different historical use. The long-term barrier is anticipated to be put in place at DU 1A-10 and 1A-11 in 2021.

6.9.1.3 Zone 1 DUs 2D and 4C

Due to the slope and lack of use of 4C, the interim measure proposed included a barrier and signage to limit exposure to these DUs. The same interim measure was proposed for 2D; however, upon closer examination of DU 2D, a long-term barrier was constructed which included the removal of the top six inches of existing soil, followed by the placement of a non-woven geotextile visible marker layer and covered by six inches of clean top soil prior to revegetation. The intention of the soil removal was to ensure appropriate sloping and stormwater drainage in the area after installation of the cover. A construction drawing for 2D was provided to EGLE in October 2019 and approved in December 2019.

<u>Work Completed in 2020</u>

Construction activities were completed in the 2020 construction season. The construction-focused soil management plan and dust-track out control plan submitted and approved in August 2020 was implemented during the work completed at DU 2D. A set of as-built drawings for 2D are provided in Appendix J and identify the final dimensions of the corrective actions, marker layer layout, thickness, and makeup of the final cover layers within the DU.

6.9.2 Zone 2 Short-Term Barriers and Long-Term Barriers

The 2017 sampling effort of Zone 2 indicated two main areas that required either an interim measure or long-term barrier to be put in place:

- Category 1 DUs near 499 Building (Eastern Zone 2 IM Area)
- Category 2 DUs in the western portion of Zone 2 between G Street, H Street, 9th Street, and 10th Street (Western Zone 2 IM Area)

6.9.2.1 Eastern Zone 2 Long-Term Barrier (499 Area)

Depth-discrete sampling completed in the 499 Area, which was briefly described in Section 6.6 and more thoroughly described in the *2017 Corrective Action Implementation Summary Report and 2018 Work Plan*, further confirmed the need for a long-term barrier in the 499 Area DUs. The status of this area is also summarized on Table 6-28.

<u>Work Completed in 2017</u>

Barricades were placed around one of the DUs (1S3). Contact with the existing soil at DUs 1S1, 1S2, 1S3, and 1S5 through 1S8 was mitigated by placing six inches of new stone and/or gravel cover over the existing soil. For DUs 1S1, 1S2, 1S3, 1S5, 1S6 and 1S8, a stone mix aggregate, which included a significant fine fraction, was utilized and the cover was compacted to approximately four inches to protect the cover to allow for traffic and vehicle use. For DU 1S7, a stone aggregate was used to prevent contact with the existing soil; however, it was not compacted as little to no vehicle traffic or parking is anticipated in that area. These actions were also completed in August of 2017.

Work Completed in 2018

Construction drawings for this area, as well as for the nearby Railroad DU 1B1, were supplied to EGLE on December 21, 2018. EGLE accepted these plans in the first quarter of 2019.

Work Completed in 2019

A long-term barrier consisting of a non-woven geotextile visible marker layer covered by six inches of clean gravel was put in place in 2019. The clean compacted gravel placed in 2017 at the DUs noted above, along with six inches of the underlying pre-existing gravel, was removed in order to maintain the grade from prior to the addition of gravel in 2017. At DUs 1T1 through 1T3, where no gravel was placed in 2017, only six inches of pre-existing gravel was removed prior to the laying of the marker layer and clean compacted gravel. The Railroad DU 1B1 (with a dioxins and furans TEQ result of 52,100 ppt) was also addressed at the same time as the IMs for the eastern Zone 2 IM Area and was handled in the same manner as DUs 1T1 through 1T3. The construction-focused soil management plan and dust-track out control plan submitted and approved in September 2018 was implemented during this work. The construction work for these areas was completed in October 2019.

Work to Be Completed in 2021

A small area in the western portion of 1S4 (see Figure 6-20) was covered with a parking lot for the occupants in 499 Building in lieu of the gravel cover being used for the rest of the DU. Additionally, the remainder of 1S4 has not been addressed as an upcoming water main installation project will disturb the area in the very near future. This remaining portion of DU 1S4 is presently fenced off with signage until the water main installation is complete and the proposed barrier can be put in place. The remainder of DU 1S4 will be handled as 1T1 through 1T3 were addressed as no gravel was placed on the DU in 2017 and the construction-focused soil management plan and dust-track out control plan submitted and approved in August 2020 will be implemented during this work.

Construction activity will be completed for the remaining work in accordance with the milestone schedule provided in Section 15.0 pending completion of the water main installation project. A set of as-built drawings will be provided to EGLE upon completion, which will identify the final dimensions of the corrective actions, marker layer layout, thickness, and makeup of the final cover layers within each DU.

6.9.2.2 Western Zone 2 Long-Term Barrier

A small number of DUs in the western portions of Zone 2 (2A-2D, 2H and 2G) were identified with elevated dioxins and furans TEQ results, as well as one DU (2A) that included both a dioxins and furans TEQ result and a concentration of arsenic above the non-residential DCC. The status of these areas is also summarized on Table 6-28.

Work Completed in 2018

In late October 2018, results and hazard information was provided to the workers in nearby areas. In cases where access to these areas was necessary, the proper use and disposal of PPE to mitigate exposure via ingestion for workers who must enter and work in these areas was also discussed.

Work Completed in 2019

Construction drawings for a long-term barrier for these areas were provided to EGLE on August 15^{th}, 2019 and were reviewed and accepted by EGLE in September 2019. Work commenced on these areas in October 2019 and was completed in November 2019. These areas were first proof rolled, but if the proof roll was deemed not acceptable an additional 6” of soil was removed. The areas were then covered with approximately 2.5” of asphalt leveling course and then covered with 1.5” of asphalt top course. The construction-focused soil management plan and dust-track out control plan submitted and approved in September 2018 was used during the implementation of this work. Any soils removed were taken to Salzburg Landfill in lieu of Dow 6-Pond.

Work Completed in 2020

A set of as-built drawings were provided to EGLE in 2020, which identified the final dimensions of the corrective actions, marker layer layout, thickness, and makeup of the final cover layers within each DU.

6.9.3 Zone 3 Short-term barriers and Long-Term Barriers

Zone 3 was sampled in 2018 and several Zone 3 DUs were sampled in triplicate in 2019. Analysis of samples from DUs 1G, 1Q, 1U1, 1U2, and 5KK for dioxins and furans TEQ yielded results ranging from 4,510 – 14,100 ppt. Additionally, DUs 5EE and 5HH1 yielded arsenic concentrations greater than the non-residential DCC. The UCL evaluation indicates DUs 1DD, 1J1, 1P2, 1T1, 1Z, 2C2, 5C2, 5F2, 5HH1, and 5MM also have dioxins and furans TEQ results greater than the non-residential DCC. Seven additional DUs will have IMs implemented in 2021: 1O1, 1D2, 1H, 1T2, 2C1, and 2C3. The status of these DUs is summarized on Table 6-28.

Work Completed in 2018

Access was restricted to DUs 1G, 1Q, and 5KK by placing fencing and signage. In cases where continued access to the areas is necessary, such as 1U1 and 1U2, the proper use and disposal of PPE to mitigate exposure via ingestion for workers who must enter and work in the area was also discussed. These actions were completed in October 2018.

Construction drawings were assembled to show the planned removal of the top six inches of gravel/soil at DUs 1U1 and 1U2 and were supplied to EGLE in December 21, 2018 and the drawings were accepted by EGLE in the first quarter of 2019.

Work Completed in 2019

The installation of the long-term barrier at DUs 1U1 and 1U2 started in late July 2019 and consisted of the removal of six inches of gravel/soil followed by the laying of a non-woven geotextile visible marker layer to be covered by six inches of clean gravel cover. The construction-focused soil management plan and dust-track out control plan submitted and approved in September 2018 was implemented during this work. The construction of the long-term barrier was completed in late August 2019. A set of as-built drawings were provided to EGLE in 2020.

DU 1G was partially paved over in 2019 as a part of a construction project of a new warehouse on site. However, the remaining unpaved portion of the DU remains barricaded with fencing and signage.

Additional sampling was completed at several Zone 3 DUs in the fall of 2019 to help in the potential design of a long-term barrier. The following summarizes the Zone 3 DUs sampled in the fall of 2019:

- DUs 1Q and 1O1 were subdivided (Figure 6-9) to better assess the delineation of elevated dioxins and furans impacts observed in the 2018 results of 1Q (dioxins and furans TEQ of 14,100 ppt). As noted previously, DU 1Q has been fenced since October 2018. DU 1O1 was divided into three DUs, 1O1A, 1O1B, and 1O1C and DU 1Q was broken up into two DUs to properly assess the area per the Direct Contact CSM for the Midland Facility. Each of these DUs were sampled in triplicate in for dioxins and furans. The dioxins and furans TEQ results for 1QB, 1QSW, 1O1A, 1O1B, and 1O1C are all above the non-residential DCC.

- DU 5KK, which was fenced off with signage in October 2018, was also sub divided into two separate DUs, 5KK_N and 5KK_S, as both were stormwater basin features that are physically separated by 49 Building (Figures 6-7 and 6-8). This DU was split to confirm whether only one of these features or both features needed a long-term barrier. Each of these new DUs were sampled in triplicate for dioxins and furans. Both Zone 3 5KK DUs also had dioxin and furan TEQ results greater than the non-residential DCC.

- DU 5C2 was sampled in triplicate for dioxins and furans analysis during the summer 2019 sampling event. When the Midland FAST result for the duplicate sample was received, fencing and signage was immediately installed as an interim measure. The DU was subdivided into smaller decision units (Figure 6-6) and sampled in the fall of 2019 to determine if a particular portion of the DU contributed to the exceedance. These subdivisions were sampled in triplicate for the Category 1 TAL. The breakdown of DU 5C2 showed that only one portion of the original DU (5C2T) had dioxins and furans TEQ results greater than the non-residential DCC; therefore, only a portion of the original DU (5C2T) was planned to be addressed via a short-term and long-term barrier.

- DUs 5EE and 5HH1 were sampled in triplicate to determine whether the arsenic exceedances observed in 2018 were truly above the non-residential DCC through the replicate analysis. Both DUs 5EE and 5HH1 have 95% arsenic UCLs that exceed the non-residential DCC.

Work Completed in 2020

Construction drawings were prepared for remedy at Zone 3 DUs 1G, 1O1A, 1O1B, 1O1C, 1QB, 1QSW, 5C2T, 5KKN and 5KKS and submitted for approval with an updated 2020 Soil Management and Dust and Track Out Control Plan in May 2020. EGLE subsequently approved the design drawings and plan in late August and work on these areas commenced by September.

For the stormwater swale portion of 1G; 5C2T; 5KKN; and 5KKS, the long-term barrier consisted of 6” of clean compacted topsoil which was placed over a geotextile marker layer and revegetation. The remaining unpaved portion of DU 1G that is not a stormwater swale has clean compacted gravel placed over a geotextile layer after 6” of soil is removed. A set of as-built drawings for this work is included in Appendix J.

A set of as-built drawings was previously provided to EGLE in February 2020 for the work completed at DUs 1U1 and 1U2 which identified the final dimensions of the corrective actions, marker layer layout, thickness, and makeup of the final cover layers within each DU.

6.9.4 Zone 4 and Stormwater Basin CSM Short-term barriers

Most of the results from Zone 4 were less than the non-residential DCC. After triplicate confirmation sampling, the following DUs had dioxins and furans TEQ UCL results greater than the non-residential DCC: Z4-1-3 (3,336 ppt), Z4-1-4 (3,965 ppt), Z4-1-11 (3,901 ppt), Z4-2-76 (2,669 ppt), and Z4-2-77 (2,223 ppt). Two DUs identified in the Category 5 Stormwater Basin CSM evaluation (Figure 6-16) exceeded the non-residential DCC: SW-5H (1,468 ppt) and SW-5W (1,374 ppt). The status of these areas is summarized on Table 6-28.

6.10 Year 6 Direct Contact Goals

The new direct contact primary evaluation will be focused on the previously deferred Category 9 - Rail Yard and Electrical Substation areas of the facility. These areas will be evaluated as individual DUs in 2021 and sampling will be proposed where deemed feasible, safe, and necessary. Each of these areas is limited by either train activity or fencing. Evaluating these areas will involve strict safety considerations.

Remedy is anticipated to be implemented at DUs 1O1/1Q, 1A-10 and 1A-11, and the 5HH and 5EE areas. Design drawings for 1A-10 and 1A-11, and the 5HH and 5EE will be prepared and submitted to the agency for approval prior to initiation of any construction activities. Design plans for 1O1/1Q were approved by EGLE in August 2020. Short term fencing activities will be implemented throughout 2021.

Work in 2021 is anticipated to be completed in accordance with the milestone schedule presented in Section 15.0. Unless otherwise necessary, requested, or noted plans, updates, or findings will be provided during periodic progress meetings, which are scheduled to occur on an approximately monthly basis. Annual updates detailing the work completed and projected for the next year will be presented in the annual CAIP.

7.0 On-Site Outdoor Air Pathway

This section presents an evaluation of the soil volatilization to ambient air and particulate soil inhalation pathways using the data collected to support the DC pathway evaluation.

Midland Plant Zones 1-5

The Midland Plant represents approximately 693 acres that were evaluated by soil sampling in over 596 total DUs from 2016 through 2020. The following land use categories were sampled in The Midland Plant:

- Category 1, Laydown Areas – 175 DUs for Aerial Dispersion and Other Sources target analyte lists (TALs);
- Category 2, Historic Grass Areas – 139 DUs for Aerial Dispersion TAL;
- Category 3, Greenbelt 2000-Present – 51 DUs for Imported Soils, Aerial Dispersion TALs;
- Category 4, Relocated Soil covered with Imported Topsoil – 14 DUs for Imported Soils TAL;
- Category 5, Stormwater Basins – 139 DUs for Imported Soils, Aerial Dispersion via Run-off TALs; and
- Category 6, Vegetated Cap Closed by Dow – 43 DUs for Aerial Dispersion, Leachate Breakout, and Imported Soil TALs.
- Category 8, Tittabawassee River – 4 DUs for Aerial Dispersion TAL
- Campus Area – 31 DUs for Aerial Dispersion TAL

7.1 Soil Volatilization to Ambient Air

The soil volatilization to ambient air exposure pathway applies to all land uses where hazardous substance vapors may emit from soils to ambient air. The outdoor air at the facility is monitored by the Ambient Air Monitoring Program (Attachment 16 of the License). Dow will continue to monitor and review ambient air as part of future corrective action efforts (Appendix G of Attachment 19 of the License).

Construction workers can potentially encounter vapors when working with subsurface soils or in a trench scenario; however, exposure is not reasonably expected to be significant since the exposure routes are managed by air monitoring, elimination of pathways, engineering controls and PPE specified in the Worker Exposure Control Plan, Appendix C of Attachment 19 of the License.

To evaluate this exposure pathway, results from the DC sampling for each zone were compared to the December 30, 2013 Part 201 Non-Residential Infinite Source Volatile Soil Inhalation Criteria (VSIC) modified to reflect a source area of 2,000 acres which is a conservative estimate of the overall size of the Midland Plant facility. The VSIC presented in the criteria tables are derived for a one-half acre source area. For source areas that are larger or smaller than on-half acre a modifier is multiplied to the criteria in the table to determine the source area size adjusted VSIC. EGLE provides appropriate modifiers for source area up to 1,000 acres in the EGLE RRD Operational Memo 1 – Technical Support Document Attachment 7 (EGLE, 2007). The modifier data provided in this operation memo was used to fit an extrapolation regression equation and estimate a modifier of 0.31 for a source area of 2,000 acres (see Table 7-1). The results of the screening comparison are discussed by zone below.

Summary statistics and screening comparisons of results to the Part 201 non-residential infinite source VSIC modified for a source area of 2,000 acres are presented on the following tables:

- Table 7-2 presents the Category 1 results; and
- Table 7-3 presents the Categories 2, 4, 5, 6, and 7 results.

Based on a comparison to the MDEQ 2013 non-residential infinite source VSIC modified for a source area of 2,000 acres (see Table 7-1), all results were less than criteria; therefore, no further evaluation is proposed at this time for the soil volatilization to ambient air exposure pathway.

7.2 Particulate Soil Inhalation

The particulate soil inhalation exposure pathway addresses the emission and dispersion of contaminated soil particles into the ambient air (inhalation of fugitive dust particles). Exhaust constituents from process vents, power generation, and thermal incineration processes may have deposited onto plant soils. During dry periods, these soils may have been disturbed by equipment or vehicles and blown by the wind, resulting in fugitive dust emissions.

Fugitive dust control has been in progress at the Midland Plant since 1986. Dow is currently required by the 2015 Operating License and its Renewable Operating Permit (Section 1, IX.5) to provide and regularly update an operating program to control fugitive dust sources or emissions. The current fugitive dust control program requires semi-annual review and updates. In addition, fugitive dust emissions from the facility are monitored for dioxin emissions on an ongoing basis along the plant perimeter pursuant to the “Soil Box Data Evaluation Plan,” approved by MDEQ on September 25, 2015. Monitoring began in 2002 and continues to show the fugitive dust control program for the facility is effective.

In order to limit the generation of fugitive dust and particulates, Dow has placed surface cover on surface soil in certain areas of the facility. The covers include clean top soil and vegetation, gravel, and/or asphalt. Existing covers are managed and maintained. Based on current conditions, this pathway is likely to be adequately controlled.

To evaluate this exposure pathway, results from the DC sampling for each zone were compared to the December 30, 2013 Part 201 Non-Residential Infinite Source Volatile Soil Inhalation Criteria (VSIC) modified to reflect a source area of 2,000 acres which is a conservative estimate of the overall size of the Midland Plant facility. The VSIC presented in the criteria tables are derived for a one-half acre source area. For source areas that are larger or smaller than on-half acre a modifier is multiplied to the criteria in the table to determine the source area size adjusted VSIC. EGLE provides appropriate modifiers for source area up to 1,000 acres in the EGLE RRD Operational Memo 1 – Technical Support Document Attachment 7 (EGLE, 2007). The modifier data provided in this operation memo was used to fit an extrapolation regression equation and estimate a modifier of 0.31 for a source area of 2,000 acres (see Table 7-1). The non-dioxin summary statistics and screening comparison are presented on the following tables:

- Table 7-4 presents the Category 1 results; and
- Table 7-5 presents the Zone 4 Categories 2, 4, 5, 6, and 7 results

The 2,3,7,8-TCDD TEQ summary statistics and screening comparisons are presented on the following tables:

- Table 7-6 presents the Category 1 results; and
- Table 7-7 presents the Zone 4 Categories 2, 4, 5, 6, and 8 results

As shown in the tables listed above, all non-dioxin results are below the non-residential particulate soil inhalation criteria modified for a source area of 2,000 acres. All but five 2,3,7,8-TCDD TEQ results are below the modified non-residential particulate soil inhalation criteria and remedy is planned or has been completed for each of the five DUs with results above criteria (see Table 7-8). Therefore, no further evaluation is proposed at this time in to address the particulate soil inhalation exposure pathway.

Table 7-8. Remedy Status on DUs with 2,3,7,8-TCDD TEQ Results Above Modified Non-Residential Particulate Soil Inhalation Criteria

Zone/Category	DU	TEQ Result (ppt)	Remedy Status
Zone 1 Category 1	1A3	31,100	Results and hazards were communicated to nearby personnel. Additional PPE use and proper disposal practices of PPE were also implemented in the area. The initial plan for the barrier was to remove roughly 6" of existing gravel/soil and then to cover the area with a geotextile fabric and 6" of clean gravel. The gravel removal was intended to maintain present grade/drainage after the long-term barrier was constructed. Dow submitted construction drawings and a soil management/dust track-out plan in May 2018. However, asbestos was identified on the ground surface during a site walk after the May 2018 submittal. Shortly after the asbestos identification, soil samples for asbestos analysis was also completed. After the identification of asbestos on and in the soil, the plan for the long-term barrier plan was adjusted to leave the existing soil in place, so the asbestos was not disturbed, and to cover the area with geotextile and 6" of clean gravel. Dow submitted revised construction drawings and resubmitted the soil management/dust track out plan to EGLE in September 2018, EGLE approved of revised drawings and plan. Construction on the long-term barrier was completed in November 2018. The long-term barrier consists of a geotextile covered with 6" of gravel over existing ground surface. No soil was removed prior to placement of barrier due to the identification of asbestos in the area. As-built drawings will be provided to EGLE in 2020.
Zone 2 Category 1	1S1	180,000	Construction drawings were provided to EGLE on December 21, 2018 and EGLE provided acceptance in the first quarter of 2019. The 4-6" of gravel placed in 2017 at 1S1, 1S2, 1S3, 1S5, 1S6, 1S7, and 1S8 was removed along with 6" of preexisting gravel. Six inches existing gravel at DUs 1T1 through 1T3 were removed. The gravel removal was followed by placement of a geotextile and 6" of clean gravel. The intent of the gravel removal prior to placement of barrier is to maintain existing grade and drainage. The soil management plan and dust track-out supplied to and approved by EGLE in September 2018 was implemented when work was completed in 2019. As-built drawings will be provided to EGLE in 2020.
	1S2	29,400	Gravel cover installed as part of 1S1
Zone 2 Category 1 Railroad	1B1	52,100	Construction drawings were provided to EGLE on December 21, 2018 and EGLE provided acceptance in the first quarter of 2019. Six inches existing gravel at 1B1 were removed. The gravel removal was followed by placement of a geotextile marker layer and 6" of clean gravel. The intent of the gravel removal prior to placement of barrier is to maintain existing grade and drainage. The soil management plan and dust track-out supplied to and approved by EGLE in September 2018 was implemented when work was completed in 2019. As-built drawings will be provided to EGLE in 2020.

Zone 3 Category 1	Z3-1QB	30,300	Short term fencing installed; DU is scheduled for remedy. Construction drawings and 2020 Soil management and Dust and Track-Out Plan was submitted on May 19, 2020 and EGLE provided approval on August 21, 2020.

7.3 Conclusions and Recommendations

A comparison to MDEQ 2013 Part 201 non-residential Infinite Source VSIC and Particulate Soil Inhalation criteria modified for a source area of 2,000 acres demonstrated that no further evaluation is warranted at this time. Dow will maintain current ambient air and fugitive dust monitoring programs.

8.0 Sludge Dewatering Facility

The SDF is a closed land-based disposal located on the corner of Saginaw Road and Salzburg Road in Midland County. It was used in the 1970's and 1980's for dewatering and disposal of wastewater treatment sludge generated at Dow's Midland Plant site. The unit is currently maintained under the Post-Closure Plan (modified 2015) and routine sampling is currently conducted in accordance with Condition II.K. and IX.A.1. of the Operating License.

8.1 Overview of Site Characterization and Interim Measures

As detailed in the Environmental Monitoring Program Sampling and Analysis Plan (SAP) for the Operating License, samples and field parameters are obtained from the SDF Groundwater Detection monitoring wells on a quarterly basis. Samples and field parameters are obtained from Perimeter Wells every four years, or in response to Hydraulic Monitoring Performance Criteria not being met. SWLs are collected from SDF wells on a quarterly basis.

The *2015 Operation and Maintenance Inspection Report for the Sludge Dewatering Facility (SDF)* (Inspection Report) conducted by the MDEQ noted an outward gradient identified at Cell 1. This report also noted that water levels in the internal piezometer (6143) within Cell 1 and external well 3775 appeared to be tracking (Figure 8-1). As an immediate action in response to the noted outward gradient in Cell 1, Perimeter Monitoring Well 3916 was added to 2016 quarterly sampling events and will continue as such until determined otherwise.

In further response to the conditions of concern noted in the DEQ Inspection Report, Dow also submitted a *Response to 2015 Operation and Maintenance Inspection Report*, dated November 19, 2015. As described in this document, the water levels measured at 3916 have been measured below that of internal piezometer 6143 consistently in recent years. A decrease in groundwater elevation in well 3916 was observed in 2012, around the time of road construction on Salzburg Road, which included changes to the ditch along the south of Salzburg Road. Evaluation of the SWL data has continued to indicate an inward gradient at all other SDF wells. The additional chemical analyses conducted for Perimeter Well 3916 has also provided no indication of a release from SDF despite the noted apparent outward gradient.

The *Response to 2015 Operation and Maintenance Inspection Report* also detailed analyses of hydraulic groundwater data and describes that additional investigation would be taken to resolve any potential issues. The additional investigation was then described in the *2016 Corrective Action Implementation Work Plan* (2016 Work Plan) for the Midland Plant Facility. The 2016 Work Plan described planned slug and pump tests that were anticipated and that the preliminary findings of the slug test would be used to modify and complete the design of the planned investigation.

As a result of the analysis of the slug test data, the pump test conceptual design presented in the 2016 Work Plan was modified and Geoprobe Direct Image Hydraulic Profiling Tool (HPT) work was added to the investigation to better address the existing conditions and provide the data necessary to make further conclusions. In May 2016, Dow submitted an Activity Plan to DEQ detailing single well pump tests, HPT work, and the installation of an additional groundwater monitoring well that were to be completed through the investigation to better characterize the waste material and the surrounding hydrogeologic environment. Dow requested DEQ approval of the Activity Plan specifically due to the need to disturb the final cover to complete the HPT borings at the closed facility. On July 8, 2016, the DEQ granted conditional approval of the Activity Plan.

Dow then initiated a drilling and hydraulic profiling tool (HPT) investigation at Cell 1 and Cell 7 on July 12, 2016. HPT borings were conducted along the north and west perimeter of Cell 1 (SDF-1 through SDF-7; and SDF-15 through 19). An additional two locations were pushed within the central area of Cell 1 (SDF-8 and SDF-9), including one adjacent to the existing internal piezometer (6143). Another three locations were advanced outside Cell 1 along the northeastern perimeter (SDF-11, SDF-12, and SDF-13) and one other near the center of Cell 7 (SDF-10) (Figure 8-2). Two-single well constant rate-pump tests were completed at Cell 1 and Cell 7 in September 2016. Evaluation of the pump test results was completed in 2017. The pump tests were conducted at existing internal piezometers located inside both cells.

Based on the data evaluations performed in 2017, priority actions were planned for SDF during 2018 including CSM development and the installation of an approximately 100-ft long section of permeable backfill and perforated collection tile that would be tied into the existing manhole within Cell 1. The demonstration-scale system was intended to be monitored for drawdown and then be used to design a full-scale implementation for Cell 1 to reduce the head inside the cell to an elevation below that of the external piezometers.

The CSM of the SDF including Cell 1 was completed in 2018 (Figure 8-2). Site characteristics were entered into a 3D-groundwater flow modeling program (MODFLOW) and capture zone and radius of influence (ROI) simulations performed to demonstrate the effectiveness of the proposed pilot system (Figure 8-3). Because the demonstration scale dewatering system within Cell 1 would necessarily disturb the final cover at the closed SDF in Cell 1, Dow submitted a request to the MDEQ to review a liner repair plan to facilitate installation of the demonstration scale dewatering system for Cell 1 at the SDF on December 19, 2017. DEQ staff provided comments on February 28, 2018, and the plans were discussed during a meeting in Lansing on March 1, 2018. Additional information was then prepared and submitted in a correspondence dated July 13, 2018.

The pilot tile installation and liner repair were completed in late October 2018 with an additional eight monitoring wells installed to assist in the evaluation of the pilot system in early 2019. Evaluation of the SDF groundwater monitoring network at the SDF Cell 1 was performed to study the groundwater flow direction, well construction, and current and proposed monitoring well placement relative to groundwater flow direction with the current pilot system. Water elevation monitoring of the new wells was initiated on January 11, 2019 using In Situ® Level Troll 700 pressure transducers. Water level monitoring of the pilot system was completed July 1, 2019. The completed pilot study evaluation included water levels collected from transducers installed in the new wells, and manual (quarterly) recorded fluid levels at existing perimeter monitoring wells 3775, 3916 and internal Cell 1 piezometer 6143. Transducer data confirmed a transient seasonal flow system with overall downward trending fluid levels until early March's seasonal rebound (Figure 8-4).

Overall, the pilot system demonstration-scaled system showed the drain was effective and did produce the desired result; however, may be more susceptible to seasonal groundwater variation than anticipated. As such, final steady state groundwater modeling studies utilizing fully penetrating barrier walls (slurry walls) and a new drain system were modeled to assess potential increased drawdown and capture in Cell 1 (Figure 8-5). Therefore, the solution to improve groundwater migration and gradient control at the SDF Cell 1 was determined to be a fully penetrating slurry wall along the North and West perimeter of Cell 1 and additional installation of a new drain tile collection system encapsulating Cell 1.

8.2 Work in 2020

Work in 2020 focused on the preparation of design and logistical plans for the slurry wall/drain tile based on the conceptual design for Cell 1 and the design of appropriate means to adequately monitor the effectiveness of the design.

8.2.1 Tile and Slurry Wall Design

The scope of work for SDF Cell 1 drainage restoration includes conducting an approximately 775 foot excavation beginning approximately 100' west of the existing manhole in the Southeast corner of SDF Cell 1 and continuing around the perimeter of Cell 1 and ending at the manhole as well as the completion of approximately 390 feet of slurry wall around the North and West perimeter of the cell. The purpose of this project is to restore the existing leachate collection system to its original intended functionality.

A new leachate collection tile and permeable cutoff wall (french drain) will be installed by excavating an approximately 30-inch wide trench and installing filter stone (drainage media) and an 8-inch perforated HDPE collection pipe (tile). The upper portion of the trench will be backfilled with 24 inches of compacted clay. The compacted clay will be isolated from the drainage media by a geosynthetic clay liner (GCL). Finish grade will be six inches of crushed limestone, separated from the compacted clay by a non-woven geotextile separator or six inches of topsoil with seed. Relevant design detail drawings are included as Appendix K.

An organoclay mix will be used to construct the slurry wall around the northwest corner of the Sludge Dewatering Facility Cell 1 as shown on the Design Drawings in Appendix K. Work shall include performing pre-construction soil sampling and laboratory analysis for pre-mix testing, providing all labor, equipment, expertise, and materials necessary to prepare the work area, perform the installation of the trench, and restore the area to the proposed final grade as necessary. All work shall be performed in accordance with the design specifications.

The design for the project includes an 8-inch diameter pipe, slope as specified on the Design Drawings. The backfill plan and the perforation design provide sufficient capacity to manage all inflows for the project. Since the design process accounted for worst case scenarios, there is a significant factor of safety established in the design parameters. A Hydrogeological Evaluation and Design Report (Appendix L) provides the detailed soils evaluation and engineering assumptions and calculations performed to establish the tile sizing and elevations.

Additionally, six new monitoring wells will be installed around the perimeter of the cell to evaluate water levels in and around the cell. One group of three monitoring wells will be installed along both the northern and western perimeter of the cell as indicated on Sheet B2-002 in Appendix K. One well in each of these well groups will be installed within the cell, between the new tile system and the slurry wall, and outside the slurry wall.

8.2.2 Cell 1 Workplan Submittal

The Cell 1 Restoration Workplan was completed in 2020 and will be submitted to the agency for review and approval in early 2021. The workplan includes design drawings and specifications; a Hydrological Evaluation and Design Report, which includes boring information and design calculations; and a conceptual schedule for completion.

Dow has also requested a minor modification to the Operating License to update the Post-Closure care conditions and SDF Post-Closure plan attachments once the work has been completed.

8.2.3 System Evaluation

Two groups of three monitoring wells will be installed along both the northern and western perimeter of the cell as indicated on Sheet B2-002 in Appendix K. Static water levels (SWLs) are proposed to be collected from the newly installed monitoring wells on a weekly basis for a least 3 months after construction completion. After which time, a new monitoring frequency will be determined based on the data gathered. Data gathered from these new monitoring wells will serve a dual purpose: 1) evaluation of the effectiveness of the drainage system changes as well as 2) additional information regarding the noted data irregularities at compliance wells 3916 and 3775.

SWLs will be collected at the compliance wells 3916, 3775, and Cell 1 internal piezometer 6143 in conjunction with the SWLs from the newly installed drainage system wells. This will allow for a further investigation and assessment of the groundwater elevation changes observed in well 3916 and assessment of the appropriateness of the groundwater monitoring location. Additionally, the noted tracking between the internal piezometer and well 3775 will be assessed.

Preliminary modeling of the groundwater elevation at both 3916 and 3775 have demonstrated a statistically significant decreasing trend at 3916, while no such trend at 3775 (Figures 8-13 and 8-14). Upon further investigation of the data collected at 3916 it was determined that the installation of a supplementary monitoring wells and data collection is necessary to gather additional information and establish an whether an alternative groundwater sampling location needs to be cited moving to adequately monitor the cell.

8.3 Path Forward

Work in 2021 will focus on the preparation for and installation of the slurry wall/drain tile restoration work for Cell 1, the incorporation of the changes at the cell into the Operating License, and the evaluation of the effectiveness of the corrective actions including an assessment of the impacts of the changes on the observed water levels in and out of the cell.

A conceptual schedule for construction activities was proposed in the Cell 1 Restoration Workplan submitted to the agency for review and approval in January 2021. This plan describes that the proposed construction schedule is conceptual and is contingent upon numerous factors including EGLE approval of this workplan at least 60-days prior to the proposed start; availability of specialty contractors necessary to perform the work; weather and other unforeseen or uncontrollable issues. The conceptual schedule below assumes a start date of the first week of June 2021.

Once the construction effort is complete additional tasks planned for 2021 include:

- Completion and submittal of As-Built drawings to EGLE
- Completion of modification to the Operating License with updates to the Post-Closure care conditions and SDF Post-Closure plan attachments as necessary
- Collection of SWL data from the newly installed monitoring wells as well as compliance wells 3916 and 3775 and internal piezometer 6143
- Evaluation of the SWL data to determine: on-going monitoring frequency, effectiveness of corrective actions at Cell 1, impacts on interpretation of compliance well data, and appropriateness of the location of 3916

Work in 2021 is based on an assumed start date for construction activities at Cell 1 to begin in the first week of June and is anticipated to be completed in accordance with the milestone schedule presented in Section 15.0. Unless otherwise necessary or requested, plans or findings will be provided during periodic progress meetings, which are scheduled to occur on an approximately monthly basis. Annual updates detailing the work completed and projected for the next year will be presented in the annual CAIP.

9.0 Poseyville Landfill

Poseyville Landfill (PLF) is within the contiguous property boundary of Dow, located west of the Dow industrial complex and southwest of the City of Midland in Midland Township (Figure 9-1). The landfill is bordered on the east by the Dow complex, and by Dow property to the north. The landfill was operated as a municipal landfill by the City of Midland, beginning in 1940. Dow purchased the landfill and began operations in 1955. Landfill operations were discontinued on January 5, 1981.

A draft compliance and final closure schedule for PLF, was submitted to Michigan Department of Natural Resources (MDNR) by Dow on August 18, 1981. The proposed schedule for closure included details regarding the installation of additional monitoring wells to be sampled and analyzed for specific parameters. Dow also committed to defining the hydrogeological conditions in the northeast corner of the site including the flow direction, aquifer thickness, and water quality. In addition, Dow committed to further defining the flow direction in the upper aquifer in the southeast corner of the site, which included a groundwater contour map for the eastern portion of the landfill.

9.1 Overview of Site Characterization and Interim Measures

Dow was issued a hazardous and solid waste amendment (HSWA) permit on October 12, 1988. Since that time, Dow has submitted required closure packages and Corrective Action Monitoring Plans for the solid waste management units (SWMUs). Dow was required to submit a RCRA Facility Investigation (RFI) Phase I Environmental Monitoring Report (Phase I) for the PLF SWMU within 365 days of the effective date of the permit. This report, submitted October 12, 1989, detailed past monitoring requirements, an apparent leakage in the northeast corner of the facility, and corrective action measures completed.

In 1996, Dow submitted the final two sections of the PLF RFI Phase II Release Assessment (Phase II). The report focused on chemical and hydraulic monitoring data of the isolated plume on the northeast corner of the landfill, and analysis of the chemical data from groundwater within the plume to evaluate the possibility of a continuing release from the landfill. The data was evaluated in order to provide a comprehensive hydraulic picture of the effectiveness of the purge wells employed to contain and remediate the groundwater in the plume.

Routine sampling at PLF is currently conducted in accordance with the Operating License SAP. Hydraulic information, as well as groundwater and leachate samples are collected and analyzed. Samples are regularly collected for Leak Detection Chemical Monitoring, Corrective Action Chemical Monitoring, and Corrective Action Hydraulic Monitoring. Four purge wells in the northeast corner of the landfill (2690A, 2917, 2960, and 2961), that were installed to mitigate the plume in the northeast corner, are part of the Corrective Action Chemical Monitoring program and are sampled quarterly for benzene, chlorobenzene, chloroform, and ethylbenzene.

The four purge wells are screened at the base of the Eastern Till Sand Body, which lies beneath the northeast corner of the PLF and extends beyond the landfill boundaries (Figure 9-2). A slurry wall constructed in 2019, keyed into clay till beneath the Till Sand,) is present to isolate the portion of the Till Sand present beneath the landfill. The well pumps are controlled by water level probes in the well casings in order to maintain a consistent drawdown profile into the well. The volume of water pumped from each of the four purge wells is recorded.

Hydraulic monitoring is conducted for the Eastern Till Sand outside of the landfill perimeter slurry wall using an array of piezometers as shown in Figure 9-1. The hydraulic monitoring is utilized to observe groundwater drawdown into the four purge wells and ensure that existing contaminants do not migrate away from the landfill perimeter.

9.2 Northeast Corner

In 2016, Dow contracted with EarthCon Consultants, Inc. (EarthCon) to perform groundwater plume analytical services to further assess the groundwater plume in the northeast corner of the PLF. EarthCon initially performed the plume analytics to help provide a better understanding of the overall behavior of the plume dynamics by conducting a stability analysis looking at the center of the mass over time, the aerial extent of the plume, and the overall spatial difference of the plume from 1995 to August 2016.

EarthCon found that in the earlier period of the analysis, the dissolved plume in the northeast corner was centered near well 2917 and extended to the east near purge well 2961 and west near purge well 2960. Sustained pumping from peripheral purge wells 2960 and 2961 appears to have resulted in cleanup of the dissolved plume in the eastern and western portions by about 2010 and until the end of the period of their initial period of analysis (Figure 9-3). Also, during this period, the dissolved plume exhibited patterns of continued attenuation in the eastern portions of the plume area, including the vicinity of 2917.

The 2016 evaluation also demonstrated that:

1. The release of constituents was likely not a one-time release. It appeared from the analyses that there may be an on-going sourcing of constituents into the study area. However, with the recent pumping regime at the site and the recent site data, it also appeared that the plume was at or near a point of hydrodynamic equilibrium (e.g., the rate of pumping is such that the plume was stable).

2. The data analyses suggested that there was an apparent dynamic between purge wells 2690A and 2917, whereby the plume behaves differently depending on the ratio of flow rates between these two wells. For example, based on observation of site data from 1995 through 2016, plume attenuation rates were better when the flow rate from 2960A far exceeded the flow rate from 2917 and were sub-optimal when flow rates from 2917 exceeded those from 2690A.

3. Purge wells 2960 and 2691 have exhibited generally ND or below maximum contaminant level (MCL) concentrations. Their continued pumping appears to expand (or retard the collapse of) the present dissolved plume.

Based on this evaluation and other analyses conducted in 2016, additional actions were planned for 2017 including the development of a Pilot Purge Well Optimization Study. Since purge wells 2960 and 2961 exhibited generally ND or below MCL concentrations, and their continued pumping could be serving to slow the collapse of the present dissolved plume, the pilot optimization study was developed to include an initial intended trial period of one to two years, depending on observable trends, during which wells 2960 and 2961 would be shut down and pump rates of the remaining two purge wells would be optimized. As the 2016 evaluations also suggested the continued release of COCs in the northeast corner of the landfill, additional investigation of the potential continued sourcing of the plume area was also planned.

As reported in the 2017/2018 CAIP, a total of 27 borings were advanced within and around the northeast corner of the PLF during the 2017 membrane hydraulic profiling tool (MiHPT) investigation. The MiHPT investigation was also supplemented through the collection of groundwater samples at existing piezometers, monitoring wells, and purge wells as well as grab water samples collected at MiHPT locations to assist in the interpretation of results and confirm specific analyte concentrations. Based upon the MiHPT boring responses and the confirmatory water quality data, the apparent breach in the slurry wall was identified between MiHPT boring locations PLF-14 and PLF-16, centered approximately on MiHPT boring PLF-15 (Figure 9-4). Impacts were observed to extend to the north of the slurry wall.

9.2.1 Purge Well Optimization Pilot

In March 2017, details of the Purge Well Optimization pilot study were shared with EGLE at the regular monthly coordination meeting. The implementation of the optimization study began November 13, 2017 by shutting off the pumps at 2960 and 2961. Purge wells 2690A and 2917 were inspected and refurbished in late 2017 so that flow rates for these two wells could be easily modified as needed throughout the pilot.

It was expected that throughout the study the 2690A/2917 flow ratio would be modified over time depending on plume behavior and resulting trends. The initial intent was that the rate of 2917 be kept well below 2690A so as not to "pull" the plume from 2690A toward 2917. Optimal conditions in the past were observed when 2917 pumped much less than 2690A, approximately one fourth to one fifth of the 2690A flow rate; and were sub-optimal when flow rates from 2917 exceeded those from 2960A. The purge wells were monitored and sampled in accordance with the SAP throughout the pilot.

Although the purge wells were refurbished in late 2017 to achieve the desired flow rates, attempts to modify the pump settings to achieve the desired rates throughout early 2018 were unsuccessful. Additionally, in Q1 2018, 2917 was pumping at a rate higher than 2690A. Due to the low pump rates and a reverse in the primary and secondary pump rates, the plume began to spread to the east and southeast.

During the Q1 2018 sampling event monitoring wells 5923, 5924, and 2549 were added to the optimization pilot monitoring well network in order to have a more robust network for monitoring plume migration. The rest of the monitoring network consists of the PLF Corrective Action Chemical Monitoring well network listed in Table 2-N of the SAP for the Midland Plant.

By Q2 2018, the 2917 rate dropped below that of 2690A; however, it was still pumping at approximately 90% of the rate of 2690A. In the Q3 2018, the pump at 2917 failed and needed to be replaced. This quarter the pump rate of 2690A was significantly higher than that of 2917.

Due to the inadequate pump performance, the wells were re-inspected in June 2018. A downhole camera was utilized to inspect the screen and integrity of casing. The inspection found that both screens and casings appeared to be in good condition and the columns were clear; however, both wells showed considerable precipitation and/or microbial growth which appeared to be effectively clogging the both screens. As such, redevelopment was planned for both locations.

Wells 2690A and 2917 were redeveloped in late October through early November 2018. In the months following the redevelopment, pump rates increased substantially with the rate at 2690A increasing by 5.3 gallons per minute (gpm) and 2917 increasing approximately 0.9 gpm from pre-development setting (Table 9-1).

Tables 9-2 and 9-3 present the purge and flow rates for purge wells 2690A and 2917 for 2019 and the statistical trends of three primary plume characteristics (area, concentration, and mass) observed in 2019. The statistical trends presented in Table 9-3 and discussed below are all in relation to the March 2018 (Q1 2018) sampling event, which occurred near the beginning of the optimization pilot.

Figures 9-5 through 9-7 show the plume analysis for the three primary COCs for the plume (benzene, chlorobenzene, and ethylbenzene, respectively) as well as the average pumping rates for the purge wells 2690A and 2917 observed during the first three quarters. Figure 9-8 shows groundwater elevation and flow maps Q1-Q3.

During Q1 2019, the wells were left to run at nearly the same (unadjusted) rates as the post-development rates observed in Q4 2018 to determine what impacts these rates had on the plume since Q4 2018 sampling event occurred too close to the redevelopment to observe any appreciable changes in the plume. The groundwater elevations and flow directions shown in Figure 9-8 indicate 2690A heavily influenced groundwater flow in the plume area post-redevelopment in Q1 2019. The plume analysis completed using Q1 2019 analytical data showed no change/statistical trend in plume concentration or mass for benzene, chlorobenzene, and ethylbenzene. The plume area with respect to chlorobenzene and ethylbenzene also observed no trend/change but saw a very minor decreasing trend with respect to benzene. The conclusion of the analyses was that the pumping rates at the purge wells were likely too high (particularly at purge well 2690A) and water was beginning to be pulled from the area near the compromised slurry wall. In response to this assessment the pumping rates were decreased in early Q2 2019 to roughly 5 gpm at 2690A and approximately 1 gpm at 2917 to mitigate these effects.

The plume analyses of Q2 2019 data showed a smaller plume area for benzene, chlorobenzene, and ethylbenzene, but statistically no trend was observed with regard to plume concentration for this same event. The plume mass with respect to benzene and ethylbenzene showed no trend/change, but a slight decreasing trend was observed for chlorobenzene. As a result, the pump rates implemented in Q2 2019 were maintained for Q3 2019 in order to observe more appreciable changes in the plume concentration and mass and a continuation of the decreasing trend for plume area. However, the groundwater elevation contouring and flow figure for May shown in Figure 9-8 shows the flow arrows along the eastern side of the pilot area starting to rotate to the east as opposed to going in the westerly direction observed in Q1 2019.

Pump and flow meter issues at 2690A during the first three weeks in Q3 2019 compromised the ability to accurately record pump and flow rates during that time. A downhole camera was again utilized during this three-week period to inspect the screen and integrity of casing of each well to confirm well conditions were not contributing to any of the ongoing issues with the meters. The inspection found the screens and casings in good condition and the water columns were clear and neither well showed any appreciable precipitation and/or microbial growth. The Q3 2019 plume analyses showed a decreasing trend in plume area for benzene, but no trend/change was observed with regards to a change in plume area for chlorobenzene and ethylbenzene in Q3 2019. The average concentration of the plume with respect to benzene and chlorobenzene showed no trend, but the average plume concentration of ethylbenzene showed an increasing trend. Additionally, the plume mass with respect to benzene saw a slight decreasing trend, but no trend was observed with respect to chlorobenzene and ethylbenzene. The groundwater elevation contouring and flow figure for May shown in Figure 9-8 shows the same eastward rotation of flow along the eastern side of the pilot area.

As discussed in Section 9.3, a slurry wall was constructed in September – October 2019 along the northeast corner of PLF. As part of the slurry wall construction effort, the wells were turned off the morning of September 23, 2019 and remained off until the morning of October 18, 2019. The plume analyses for Q3 were conducted shortly before the completion of the slurry wall. It was determined that the pump rates of the purge wells should be maximized once the slurry wall construction was complete. The purge wells were turned back on the afternoon of October 18, 2019 and rates were maximized throughout the quarter.

9.2.1.1 2020 Status of Purge Well Optimization Pilot

Tables 9-4 and 9-5 present the purge and flow rates for purge wells 2690A and 2917 for Q4 2019 through Q3 2020 and the statistical trends of three primary plume characteristics (area, concentration, and mass) observed in Q4 2019 through Q3 2020, respectively. The statistical trends presented in Table 9-5 and discussed below are in relation to the March 2018 (Q1 2018) sampling event, which occurred near the beginning of the optimization pilot. Figures 9-9 through 9-11 show the plume analysis for the three primary COCs for the plume (benzene, chlorobenzene, and ethylbenzene, respectively) as well as the average pumping rates for the purge wells 2690A and 2917 observed during the applicable quarter. Figure 9-12 shows groundwater elevation and flow maps for Q4 2019-Q3 2020.

During Q4 2019, the purge rates of the wells were slowly maximized after the slurry wall construction was completed in early Q4 2019. However, the sampling event in Q4 2019 was completed shortly after the slurry wall construction; therefore, results from Q4 2019 do not show a marked impact from the construction effort. The groundwater elevations and flow directions shown in Figure 9-12 indicate the purge wells, particularly 2917, heavily influenced groundwater flow and direction. The plume analysis completed using Q4 2019 analytical data showed no change/statistical trend in plume concentration or mass for benzene, chlorobenzene, and ethylbenzene. The conclusion of the analyses was to continue maximizing the pumping rates since any sourcing from the slurry wall breach was now shut down due to the construction completed in late Q3 2019/early Q4 2019.

The plume analyses of the Q1 2020 data showed a slightly larger plume area for benzene and chlorobenzene, and a slightly smaller plume area for ethylbenzene. Statistically no trend was observed with regard to plume concentration and plume mass for this same event for benzene and ethylbenzene, but a very slight increasing trend was observed for chlorobenzene. As a result, the pump rates implemented in Q4 2019 were maintained for Q2 2020 in order to observe more appreciable changes in the plume concentration and mass and a continuation of the decreasing trend for plume area. The groundwater elevation contouring and flow figure for Q1 2020 shown in Figure 9-12 again shows the purge wells heavily influence groundwater flow in the area, with 2690A having a slightly greater impact when compared to the Q4 2019 data set.

During mid to late February, the purge wells were shut off for a brief period (February 14 -19, 2020) to facilitate the elevation of electrical equipment for LS#201 for protection from future flood events.

The Q2 2020 sampling event occurred before the May 2020 flood/dam failure event in April through early May 2020. Plume area, concentration, and mass increased for both ethylbenzene and chlorobenzene. Only plume concentration increased for benzene whereas the mass and area of benzene decreased. The statistical evaluation for Q2 2020 and Q3 2020 were assessed together.. The groundwater elevation contouring and flow figure for March (Figure 9-12) again showed the purge wells heavily influence groundwater flow in the area, with the trend of elevations and flow being pulled toward 2690A continuing into Q2 2020.

On May 18, 2020, purge wells 2690A and 2917 were turned off as a flood precaution due to a major rain event. On May 19 - 20, 2020, the dams at Wixom Lake and Sanford Lake failed causing a catastrophic flooding event. Purge Well 2690A remained off until May 26th, 2020 and 2917 was not turned back on until June 19, 2020 due to damage from the flood.

The Q3 2020 sampling event occurred in early to mid-July. Plume area for benzene and ethylbenzene showed no trend, but chlorobenzene showed an increasing trend. Benzene showed no trend for plume area concentration and mass, but ethylbenzene and chlorobenzene saw an increase in these two plume indicators. The groundwater elevation contouring and flow figure (Figure 9-12) consistently showed the purge wells heavily influence groundwater flow in the area, with the trend of elevations and flow being pulled toward 2690A continuing into Q2 2020.

When evaluating the Q2 2020 data on a well-by-well basis, a new upward trend in concentrations was observed in 6174 post the Q3-Q4 2019 slurry wall construction. This increasing trend can be observed in Figure 9-13. Additionally, via the plume analytics completed by EarthCon, it was noted that concentrations in 2549 do not appear to be decreasing post slurry wall construction. Figure 9-14 shows the concentrations of 2549 over the course of the pilot study. Once these potential trends were identified, immediate actions were implemented:

- The pump in purge well 2961 was turned back on as a precaution to ensure that if concentrations began to increase in an eastward direction toward Poseyville Road, the impacts would be captured by 2961;
- Visual inspections to identify any potential issues at the landfill; and
- Further investigation into site characteristics and potential explanations for the observed conditions.

Data and trend analyses information as well as the immediate response and further planned action was shared with EGLE at the next subsequent CA status update meeting held in August 2020.

Upon further assessment, it was determined that the purge rate of 2917 should be maximized in relation to 2690A as 2917 is located closer to 2549 and therefore could remove more plume mass in the area around 2549. Prior to making the purge rate adjustments, a supplemental Q3 2020 sampling event was completed in late September to obtain an additional snapshot of data. However, after the sampling event, issues with the controller box for 2690A prevented the adjustment to the flow rates in the early part of Q4 2020; therefore, Q4 2020 data when collected will not be impacted by the change in purge rates. A subsequent update on the conditions and actions implemented was provided to EGLE during the December 2020 CA status update meeting.

9.3 Leachate Collection System and Slurry Wall Upgrades

During 2018, the approved upgrades began for the south side of the tile from Lift Station #203 to MH203L (Figure 9-15). Work started in October 2018 and by December 2018, 2,300 ft of tile and manholes along the southern perimeter of the landfill were upgraded. By the end of the year, approximately 1,200 ft of the length was completed with GCL and backfilled.

During completion of the work on the southern tile, cuts were made into the banks of the landfill to install the tile system. In one bank cut area, water was observed in the upper sections of the open cuts. It was determined that an additional upper tile segment of approximately 1,000 ft should be installed in this area to support enhanced removal and management of the landfill (Figure 9-16). The remainder of the south tile replacement, approximately 1,100 ft, was completed with GCL and backfilled in early 2019.

A Hydraulic Report and Design package was then prepared for the north tile replacement and slurry wall construction and submitted to EGLE on June 3, 2019. This report and design package was also included as Appendix L in the 2019/2020 CAIP. The design package was also presented and discussed with EGLE during the June CA monthly status update meeting.

Construction on the north tile and slurry wall construction was initiated in July. Approximately 475 ft of slurry wall was completed by October 2019. The planned 3,600 ft of tile, plus an additional 250 ft of upper tile, were replaced on the northern perimeter of the landfill by the end of the year.

A similar situation to the one encountered during the southern tile installation the previous year also occurred during the installation of the northern tile. In an area where cuts were made to install the tile system, water was observed in the upper sections of the cuts. To enhance drainage in this area, an additional 250 ft of upper tile was installed on the northern perimeter during the construction effort (Figure 9-17).

One additional area was also observed to have accumulated water on the southern perimeter of the landfill during construction. Design of an additional upper tile system began upon observation of this additional area (Figure 9-18).

9.3.1 Upgrades in 2020

In early 2020 to August 2020, the addition of an upper section of tile to address water discovered along the southern perimeter of the landfill was completed. Approximately 1,500 ft of tile was installed including 3 additional manholes (MH# 203 AU, MH# 203 BU, & MH# 203 CU). This section of tile was tied into MH# 203 A. The trench was covered with GCL & completely backfilled.

In late February/early March, the electrical equipment controlling LS# 201 (including shutoffs, transformers, communication and control panels) were elevated 4-6 feet to prevent outages during future spring floods. Concrete foundations were poured and access platforms were fabricated and installed. Access platform installation was completed in early August 2020.

Starting in August 2020, clay was imported to the landfill and placed along the north slope of the landfill for restoration of the north leachate collection tile installation as well as the soil relocation areas. Clay placement was completed by mid-August 2020. Upon completion, site restoration began including topsoil placement, grading, re-seeding of the site, and restoration/repair of the sites access roads. This work was completed by mid-late October.

9.4 May 2020 Flood Event

Extensive rainfall and subsequent dam failures on Wixom and Sanford Lakes occurred on Tuesday, May 19, 2020 and Wednesday, May 20, 2020. As a result of these failures, flooding occurred in many areas downstream along Tittabawassee River, including the Poseyville Landfill area.

After flood waters had receded allowing safe access, Dow Chemical Remediation staff arrived on site on Saturday, May 23, 2020 to do an inspection of Poseyville Landfill. Upon inspection, it was found that water flowing out from between the concrete barrel section and the metal lid that is bolted on the top of LS-203 was comingling with flood water. This comingled water was flowing from LS-203, down the southeast landfill access driveway and towards the storm sewer located along Poseyville Road. Response actions were initiated.

9.4.1 Interim Response Actions

Response actions were initiated on Saturday, May 23rd to prevent further migration of the comingled water. An excavation contractor was brought on site to excavate a ditch and berm to contain the comingled flood water to the Poseyville Landfill property. A berm of sand was built around multiple storm sewer catch basins along Poseyville Road in the immediate and nearby area to minimize the potential of comingled water from entering the storm sewers.

As the efforts of initial containment were completed, an environmental emergency response contractor was mobilized to the site with vacuum extraction trucks to attempt to lower the water level in the leachate collection system, as well as to remove water from the sump dug into the ditch and bermed area.

The Dow Chemical Midland Remediation team mobilized a diesel-powered water pump to operate the main forwarding Lift Station (LS-201) located at the northeast corner of the landfill. The intent of pumping LS-201 was to bring down the water elevation in the entire perimeter system as multiple lift stations (including LS-203) are interconnected by gravity drain lines.

A grab sample of the comingled flood water and lift station water was collected as it flowed from LS-203 prior to the flow being stopped. The sample was analyzed for volatile organic compounds (VOC), semi-volatile organic compounds (SVOC), dioxins, furans and metals. The groundwater analysis results were compared to the following Michigan Part 201 residential criteria:

- Drinking Water;
- Groundwater Venting to Surface Water Interface (GSI);
- Water Solubility; and
- Flammability and Explosivity.

Table 9-6 summarizes the comparison of analytical results of the LS-203 water sample to Part 201 criteria. A table of all the groundwater sample analytical results is included as Table 9-7, with the exception of the dioxin and furan results summary which is shown on Table 9-8.

An on-site assessment resulted in identifying the area impacted by water along the overland flow path identified. This was further verified by the hydraulic head of water on top of the lift station that would not allow water to flow until the level of surrounding flood waters receded to a level below the lid. Remediation efforts consisted of removing 1 foot of existing soil in the impacted area identified and disposing it in Dow's Salzburg Landfill. The extent of the impacted area is included as Figure 9-19.

9.4.2 Remedial Measures

Excavation of the impacted area began on Wednesday May 27, 2020, and impacted soils were excavated to a depth of one foot below ground surface. Excavation activities continued into Thursday, May 28, 2020. A total of 1,153 cubic yards of impacted soil was removed from the project area. To verify that the full extent of the impacted soil was removed, soils samples were collected using ISM from the floor of the excavation area prior to backfilling with clean soil.

Verification DUs were determined based on the acreage and on-site features (the access road) that provided a conduit for surface water and if the area was located inside or outside the landfill security fence. The impacted area was divided into four (4) DUs. Approximately 30 random systematic increments were collected within each unit. A map of the decision units and increments is included as Figure 9-20.

Increments of soil were collected from the bottom of the excavated area to 6 inches below the excavated depth within each DU. Samples were analyzed for VOCs and SVOCs which is consistent with past analysis at PLF. The excavated areas were backfilled with clean soil before results of the soil analysis had been received under the assumption that if ISM results showed significant impact, the specific DU would be re-excavated to a deeper depth.

Soil ISM results were compared to the following Michigan Part 201 Residential Criteria:

- Drinking Water Protection;
- Groundwater to Surface Water Interface Protection;
- Infinite Source Volatile Soil Inhalation;
- Particulate Soil Inhalation Criteria
- Direct Contact; and
- Soil Saturation Concentration Screening Level (C-Sat).

When compared to the criteria listed above, all soil analysis results were below the applicable criteria. Table 9-9 provides the summary of the detections and maximum concentrations. A table of all the soil ISM sample analytical results is included as Table 9-10.

Restoration of the excavated area began by placing 6 inches of clean sand over the entire area. The access road to the landfill was rebuilt with geotextile placed over the sand and topped with 6 inches of 23A gravel. The area outside of the access road was topped with approximately 6 inches of topsoil over the sand. The area was hydroseeded and mulch blankets were placed in areas near catch basins. The final stage of restoration was paving the bike path that was removed in the remediation process. The asphalt replacement was completed on Thursday, June 4, 2020.

The response actions to the May 2020 flood event, including remediation and restoration of the area impacted by the comingling of the flood waters and Poseyville Landfill Leachate, were successful. The soil ISM sample results for each of the decision units were below applicable Michigan Part 201 Criteria, therefore no further actions are proposed at this time.

9.5 2021 Path Forward

Work in 2021 will continue to assess the plume response to the slurry wall construction and optimize the performance of the existing well network. The impact of the slurry wall construction on the plume has not yet been determined due to the impacts from the slurry wall construction, the historical flood event and the subsequent activities conducted to manage the event, in addition to the difficulties with the purge well rate adjustments. Short term potential trends identified at wells 6174 and 2549 in 2020 will be observed closely and managed in 2021.

The expanded optimization pilot monitoring network will continue to be gauged and sampled on a quarterly basis in 2021 to provide additional data on the plume response. Quarterly plume analyses will be completed with the data. The physical condition of the purge wells, their purge rates and flow rates will also be monitored on a monthly basis through 2021.

The purge well optimization work will focus on optimization of pump rates based on water quality data collected from the purge wells and expanded network. The effects of the slurry wall construction will also be evaluated and it is expected that the plume area will retract over time. Dependent upon the response of the plume, Dow may assess potential further management strategies necessary to address the plume.

Throughout 2021 Dow will:

- Continue routine quarterly monitoring in purge wells
- Collect additional samples from wells 2549, 5924, and 5923 in order to support understanding of the plume migration and retraction
- Continue to examine trends in purge wells and sentinel wells
- Take appropriate actions if the plume is not responding as expected
- Adjust flow rates as appropriate to optimize performance

Work in 2021 is anticipated to be completed in accordance with the milestone schedule presented in Section 15.0. Unless otherwise necessary or requested plans, updates, or findings will be provided during periodic progress meetings, which are scheduled to occur on an approximately monthly basis. Annual updates detailing the work completed and projected for the next year will be presented in the annual CAIP.

10.0 Northeast Perimeter

The Northeast Perimeter (NEP) is located along the north and east of the Midland Plant (Figure 10-1). Shallow groundwater in this area has been identified as having the potential for seasonal off-site migration and possible venting to storm sewers located along Washington Street, Bay City and South Saginaw Roads. Historic releases of organic contaminants have been identified by detection in groundwater monitoring wells, including benzene, trichlorofluoromethane (CFC-11), dichlorofluoromethane (CFC-21) and the organic daughter products and inorganic byproducts from natural attenuation of chlorinated ethenes.

10.1 Overview of Site Characterization and Interim Measures

A federal HSWA permit was originally issued to the Midland Plant on October 12, 1988. Included in the conditions of the permit were provisions that Dow was required to contain all contaminated groundwater on-site and properly treat it through the WWTP. In addition, the corrective action plan for the facility at that time included intercepting and treating shallow groundwater flowing underneath the Midland Plant, and continuing to study the hydrogeology as needed to develop a full understanding of groundwater flow relationships and potential environmental impacts of the Midland Plant and contiguous properties.

As part of the on-going study, EDI Engineering and Science completed a hydrogeologic study of the Midland Plant in March of 1989. Groundwater modelling performed as a part of this study identified areas where shallow groundwater could flow off-site from the Midland Plant, including the NEP of the Midland Plant along Saginaw Road and Bay City Road. A groundwater collection system was presumptively proposed for the area in May of 1990. Study of the area continued into 1993 to fill data gaps identified by MDEQ. Groundwater samples collected from the area were found to be free of contamination, so the plans to construct the groundwater collection system were withdrawn.

Development of a groundwater monitoring program for the NEP was outlined in the 2003 Operating License. Dow proposed to conduct additional investigation needed to finalize and implement a routine groundwater monitoring program. A groundwater monitoring program was developed and submitted to MDEQ on July 22, 2005. Based on MDEQ comments to the proposal, an addendum to the Monitoring Program was submitted on October 14, 2005. The groundwater monitoring program for the NEP was added to the RCRA Facility SAP in April 2006 and received MDEQ approval on September 27, 2007.

During implementation of the approved groundwater monitoring program at the NEP, vinyl chloride (VC) was detected in two monitoring wells (MW-6175 and MW-6178). Additional groundwater investigations were developed and implemented to determine the extent of the groundwater impacts. Summary reports for both the 6175 and 6178 Area studies were submitted to the MDEQ on September 14, 2007. Corrective Action Plans were submitted for these two areas (Area 6175 and Area 6178) on January 18, 2008.

Results of the 2007 study of the 6178 Area indicate that the VC is a daughter product of higher chlorinated ethenes that are being naturally dechlorinated. At the downgradient boundary of the plume, the concentrations of the COIs were below the generic GSI criterion. Results of the 6175 Area study also indicate that the VC is a daughter product of higher chlorinated ethenes that are being naturally dechlorinated; however, observations indicated that the dechlorination process in the 6175 Area may not progress to ethenes and ethanes prior to entering the backfill of an existing storm sewer (Figure 10-2). This storm sewer eventually discharges to the Tittabawassee River, so corrective action was proposed; however, additional data from the 2017 Membrane Interface Hydraulic Profiling Tool (MiHPT) investigation shows that corrective action is likely not needed at this time (see Section 10.2.2).

In both areas, the initial source was hypothesized to be a relatively small, historic release of higher chlorinated ethenes that have naturally dechlorinated in the groundwater and diffused into the lower clay soils. Monitoring wells from both areas were added to the existing bi-annual NEP groundwater monitoring program in the area. The purpose of the monitoring programs is to demonstrate on-going natural attenuation and ensure that concentrations of COIs are not increasing over time.

Dow also completed an investigation in 2008 near monitoring wells 3540A and 4358 (CFC Area) in the NEP due to detectable concentrations of CFC-11 and CFC-21. A GSI criterion has not formally been developed for CFC-11 or -21

Further investigation was proposed in the *Work Plan for CFC-11 and -21 Evaluation Near Wells 3450-A and 4358* submitted September 30, 2010 and the *Work Plan Addendum for the Northeast Perimeter Groundwater Monitoring Program* submitted for MDEQ review and approval on December 21, 2011.

Dow has continued to assess results from the on-going NEP groundwater monitoring program since its implementation. To assist with the assessment of the historical data, in 2016 Dow contracted with EarthCon to perform additional groundwater plume analytical services to help characterize the conditions in the NEP. These analytical results together with the monitoring data further defined additional investigation for the NEP to address detected groundwater concentrations above generic MDEQ GSI and the detected concentrations of CFC-11 and CFC-21.

The 2016/2017 CAIP described the planned work activities for 2017, including the primary objectives of the work planned for NEP. The planned activities included additional drilling work using a MiHPT and follow-up laboratory analyses to assess each area as defined at the time (Figure 10-3). The initial plan included the potential completion of MiHPT at regular intervals along investigative tracks, dependent upon the MiHPT and analytical results. Additionally, MiHPT borings were planned to be advanced at locations to the north of the facility to delineate the extent of the plume areas. The final MiHPT locations are found on Figure 10-4.

Each MiHPT boring included the use of multiple detectors (e.g. PID, flame ionization detector [FID], electron capture detector (ECD), HPT, halogen-specific detector (XSD), stratigraphy, etc.). Further, groundwater samples were planned to be collected from selected MiHPT borings in order to determine the relative distribution of target constituents based upon the MiHPT technology responses. A mobile laboratory was on-site to provide analytical services.

The target constituents for the 6175 and 6178 Areas included VC, cis-1,2-DCE, trans-1,2-DCE, 1,1-DCE, TCE, and PCE. The target constituents for the CFC Area were CFC-11 and CFC-21. Since the plume areas were anticipated to overlap or intersect, each groundwater sample was analyzed for all analytes of concern.

The methodology and results of the 2017 investigative work was detailed in the 2017/2018 CAIP. The findings defined the limits of impacts of site COIs for each of the investigative areas: 6175 Area; 6178 Area; and CFC Area. The impacts in each of the NEP investigative areas were delineated through the implementation of MiHPT borings and focused groundwater sampling.

The MiHPT investigative program identified a dense non-aqueous phase liquid (DNAPL) source area south of the 6175 Area in the vicinity of Building 433 to the northwest and Building 1268 to the southeast (Figure 10-5). Based upon the limited TAL, the DNAPL appeared to be predominantly comprised of PCE. Upon review of the available hydrogeologic data for this portion of the NEP, this DNAPL was identified as the likely source area for impacts in the 6175 Area and potentially the 6178 Area. The primary COIs identified for the 6175 Area included PCE, TCE, cis-1,2-DCE and VC while the 6178 Area COIs were limited to cis-1,2-DCE and VC. For DCE detections, cis-1,2-DCE comprises a significant percentage of the total DCE, therefore, it is inferred to represent a reductive dechlorination by-product of a PCE or TCE source.

For the CFC Area, the MiHPT investigative program and associated focused groundwater sampling program successfully delineated the impacts of the target CFCs. Both the sampling and MiHPT results identified the apparent source of the primary CFC-11 impacts in the area between and north of Buildings

719 and 872, with lower level impacts in the area north of Building 564, which may be due to migration from the apparent source area based upon variable groundwater flow conditions in this portion of the NEP (Figure 10-6). The distribution of CFC-11 and its reductive dechlorination by-product CFC-21 are nearly coincident and appear to be bounded by hydrogeologic conditions in this portion of the NEP.

10.2 Conceptual Site Models

Based on the results of the 2017 investigation, refined CSMs were constructed for each of the areas.

10.2.1 6178 Area

For the 6178 Area, the developed CSM (Figure 10-7) depicts the coincidence of the impacts of COIs with an area of depressed elevation in the surface of the stiff clay unit, which serves as the base of the uppermost sand unit monitoring well network. Based upon the orientation of the clay surface, the monitoring network screened intervals, the observed localized groundwater flow conditions, and the proximity of the identified DNAPL source area to the southeast of the 6178 Area, the potential for impacts emanating from the DNAPL area to the 6178 Area exists. Further evidenced by the developed CSM is the likely presence of impacts within the clay unit due to the detections of COIs within monitoring wells screened predominantly below the uppermost sand unit (e.g. within the stiff clay unit).

An area of limited data points exists between Building 433 and the existing monitoring network. Additionally, several of the existing monitoring network well locations (MW-I, MW-J) possess screened intervals above the clay unit while others (MW-A, MW-B, MW-C) have a majority of the screened interval within the clay unit. Further, no monitoring wells are located to the west of monitoring wells MW-J and MW-K, an area suggested to coincide with depression in the surface of the clay unit (e.g. uppermost sand thickening).

10.2.2 6175 Area

The developed CSM (Figure 10-8) for the 6175 Area also depicts the influence of hydrogeologic conditions on the distribution of COI impacts. The identified DNAPL source area was found to be present between elevation 612-616 ft, 3 to 5 ft below the uppermost sand and stiff clay unit contact. Downgradient (northerly) migration of dissolved phase impacts, and potentially DNAPL, appears to be controlled by several factors, including the slope of the clay unit, the thickening of the uppermost sand unit, and the resulting northerly groundwater flow pattern between the source area and the 6175 Area. Based upon these observations, the DNAPL area likely constitutes a continuing source area for the impacts to the 6175 Area.

With respect to COI fate, the MiHPT investigation identified a localized area near monitoring well MW-3 in which current VC concentrations in excess of the GSI criteria (15 μg/L) likely extends beyond the northern property line of the Facility. However, based upon further downgradient groundwater sampling, the migration appears to attenuate to ND levels 200-300 ft prior to the storm sewer located to the north of this area; however, further delineation of the northernmost extent of the COIs may be warranted. Additional sampling of the storm sewer completed after the 2017 MIHPT investigation also showed that COIs for this area were not present in the sewer (Table 10-1). Additional recommendations include optimization of the monitoring well network as several monitoring wells (MW-2, MW-5, MW-7, MW-8, and MW-9) possess screened intervals above the clay unit.

10.2.3 CFC Area

The CSM prepared for the CFC Area (Figure 10-9) was developed based upon the results of the MiHPT investigation and limited to CFC-11 and CFC-21 COIs. The CFC impacts were also determined to be largely controlled by the hydrogeologic conditions in this portion of the Facility. Specifically, the migration of CFCs is northeast, consistent with the observed groundwater flow direction before forming two distinct dissolved phase lobes to the northwest and east-southeast in the vicinity of monitoring well MW-3540A where the uppermost sand unit thins due to an apparent ridge-like feature in the stiff clay unit in this portion of the Facility. This assessment can be confirmed as monitoring well MW-4359, installed within the ridge-like feature, is periodically noted to be dry.

The results of the MiHPT investigation successfully delineated the CFC impacts and noted that impacts were observed within both the uppermost sand unit as well as the stiff clay unit, suggestive of a surface source. Therefore, identified data gaps for the CFC Area are limited to optimization of the CFC Area monitoring network and the collection of pre-design sampling data in order to facilitate remedial technology screening and selection, if warranted.

10.3 High-Resolution Conceptual Site Model Development

During 2019, preliminary remedial technology screenings were performed for the 6175 and 6178 Areas and alternative technologies were explored for the CFC area. A preliminary workplan for the data gap analysis was developed; however, during the development of the workplan it was determined that due to the complex nature of the site geology and stratigraphy, refinement of the CSMs would be prudent prior to another field mobilization. As such, a high-resolution CSM (HRCSM) applying Environmental Sequence Stratigraphic (ESS) analysis was planned to provide further information on the plume areas prior to finalizing the workplan for the next phase of the field effort.

The refinement of the CSMs consisted of reviewing and interpreting previously-acquired site subsurface lithology data as well as MiHPT data within the context of the depositional environment. The development of the HRCSM is intended to be used to better understand the subsurface conditions that control the fate and transport of chlorofluorocarbons (CFCs) and chlorinated volatile organic compounds (CVOCs) in groundwater at NEP. Ultimately, the comprehensive CSM will help aid the understanding of the nature and extent of CVOC- and CFC-related impacts, identify data gaps, and potentially aid in the implementation of an effective remedial strategy for NEP, if warranted.

The findings from the ESS analysis are summarized in the following subsections.

10.3.1 Regional Geology and Sedimentology

Episodic glaciation was the major process responsible for creating the Great Lakes basins; however, bedrock (and its inherent type and distribution), regional structure and paleo-drainage patterns have all influenced the present-day configuration. The Midland facility is located in the Eastern Lowlands Physiographic Region of Michigan's Lower Peninsula, representing a flat topography of lacustrine origin (the Saginaw Lowlands) along coastal areas in the southeastern part of the state, extending north from the Saginaw Bay area, along Lake Huron to the tip of the Lower Peninsula. The Saginaw Lowlands encompassing the Site refer to an area that was variously inundated by many lake stages associated with Glacial Lake Saginaw, broadly defined. Much of this landscape is low relief and the soils within it often have high water tables (Schaetzl et al., 2013).

10.3.1.1 Glacio-Lacustrine History

Six major ice sheets advanced across the Michigan region likely beginning as early as 2.4 million years ago (Ma). As shown in Figure 10-10, much of Lower Michigan region was last glaciated during the late-Wisconsinian by the Saginaw Lobe of the Laurentide Ice Sheet (Kehew et al., 2012; Fisher et al., 2015;). As the Saginaw lobe ice margin was receding between approximately 17 and 15 thousand years before present (ka·YBP), a broad, sandy delta known as the Chippewa Delta (Figure 10-11) developed into various stages of Glacial Lake Saginaw. The delta heads near the city of Mt. Pleasant, where the Chippewa River enters the Saginaw Lowlands, and ends at the city of Midland encompassing the Site, near the confluence of the Chippewa and Tittabawassee Rivers. Evidence of the complex history of fluctuating lake levels in the Saginaw Lowlands is preserved as relict shorelines and wave-cut bluffs. Many of these features are spatially discontinuous; whereas others are faint or equivocal, likely because they were either not strongly formed and/or were not well preserved because of their sandy composition.

In most places, including the Site location, the Chippewa delta has a diffuse, gradual distal boundary rather than a sharp delta front. Because of its weak topographic expression, the margin of the delta can be correlated to the extent/boundaries of sandy deposits on the otherwise loamy lake plain (Hutchinson, 1979; McLeese and Tardy, 1985; Schaetzl et al., 2013). It is believed that the gradual slope of the delta margin around the Site area was formed in part by fluctuating lake levels, which effectively reworked the sands and splayed them out in the swashzones of the various lakes.

10.3.1.2 General Lithology

Soil types are typically derived from glacial and post-glacial fluvial processes and generally are composed of coarse-grained material deposited in ancient beach and near-shore environments and clay-rich lacustrine deposits (MDNR, 1988). The background soils (i.e., those soils whose characteristics are typical of the landscape outside of the delta) are loam textured; many are associated with tills of the Saginaw Lobe (Lusch et al., 2009). In lower parts of the Lowlands, fine-textured sediments, mostly silty clays and silty clay loams, are common; these presumably have glacio-lacustrine origins. Broad tracts of the Lowlands are also sandy (Veatch, 1953; Schaetzl et al., 2013), and in many of these areas, fields of sand dunes are commonplace (Arbogast et al., 1997). Deeper sections in the subsurface reveal locally continuous glacial deposits composed of an admixture of clay, silt and coarse sand in various proportions, interspersed with gravels, pebbles and cobbles.

10.3.2 Data and Methodology

A total of 5 ESS cross sections (at least 1 for each N-S oriented site/plume, and one E-W cross section tying the sites together) were developed. Sections A-A', B-B', C-C' and D-D' are oriented north to south along the regional strike of the Chippewa Delta. Section E-E' represents a section oriented from east to west, along the depositional dip of the Chippewa Delta. These cross sections are intended to better define the shape and extent of contamination at each plume site within the NEP Area of the Dow Midland Plant, namely the 6178 Area, 6175 Area, and the CFC Area.

AECOM compiled and examined the quality of all data provided for conducting the ESS analysis, which included GIS data, facility maps, boring logs, MiHPT raw data, survey data, water levels, etc. Research is also performed to understand and interpolate the stratigraphic relationship of the transmissive and non-transmissive sediments between the boreholes examined. This involves journal research on the regional Quaternary glacial geology of Michigan, as well as measuring the dimensions of present-day geomorphological features (channels, delta mouthbars, etc.) of the Site area using Google Earth imagery (Figure 10-13).

Electrical conductivity (EC) logs from the MiHPT data were primarily used for understanding lithology and vertical facies trends at each borehole location. Where conductivity (K) data were available, they were converted to logs and utilized in combination with the EC logs to further refine the stratigraphic heterogeneity (Figure 10-12). EC/K logs data from a total of 37 boreholes were utilized to develop the five cross-section transects (Figure 10-14) in order to determine the interconnectivity of high-transmissivity flow paths for potential contamination migration.

The depositional environments identified at each borehole using MiHPT data (calibrated with borehole core information) were propagated through the adjacent wells based on the correlation lengths determined through the research. Finally, two fence diagrams were created between the five sections in order to illustrate their 3-dimensional stratigraphic relationship

10.3.3 Stratigraphic Correlation

Four distinct depositional facies were recognized from the investigation of the borehole data. They are, 1) channel bar deposits (dunes), 2) delta mouthbars and crevasse splay deposits, 3) overbank fines, and 4) glacial till deposits.

10.3.3.1 Channel Bar Deposits

The channel point bars (Figure 10-15) are usually yellowish-brown to grayish-brown, unconsolidated to well consolidated, poorly sorted, well- to sub-rounded gravels and cobbles in a fine-grained matrix. In vertical profiles, these point bar sediments generally fine-upward from coarse cobbles and gravels at the base to fine sands, silts, and muds at the top. The investigation of bar width-length ratios show that the quaternary point bars encountered in the boreholes would have an average width of 555 ft. and an average length of 1,456 ft. This yields an average width-length ratio of 0.40. Point bar deposits are generally highly transmissive. Also, applying the width vs. thickness cross-plot of point bar deposits (after Blumer et al., 2013) to the derived width-data, the individual point bars are found to be about 6.6 ft thick on average. However, the actual data in the boreholes locally show a thickness above 10 ft. This indicates probable amalgamation of several stacked channel bars over time. These channel bar deposits are interpreted to be highly transmissive and locally well connected.

10.3.3.2 Delta Mouthbars and Crevasse Splays

Delta mouthbars and crevasse splays are coarsening up sandy units (Figure 10-15) that attain a thickness of more than 10 ft (when stacked), consisting of fine and very fine sand with occasional coarse sand, gravels and pebbles. These deposits are more continuous than the channel bar units which truncate them. The sand-size grains of the delta mouthbar deposits at the Site mean that they are generally lower in transmissivity than the channel bars. However, groundwater and contamination will be able to travel a longer distance through the mouthbars, as compared to the channel bars, because of their higher degree of stratigraphic continuity over a longer distance. Crevasse-splay sediments are similar coarsening up features that attain a thickness of less than a foot to a few feet. Laterally they appear as thin, discontinuous stringers of silty sand that may not often extend between two boreholes.

10.3.3.3 Overbank Fines

Overbank fines (floodplain sediments) (Figure 10-15) tend to appear in the subsurface as dark grey to brown, unconsolidated to weakly consolidated, well sorted, silt and clay deposits. Locally, these organic sediments show a high organic content as well as plant roots. In some instances, this unit shows shell fragments, indicating the fluvial floodplain originally developed from infilling of preglacial lakes. The overall muddy lithology of the overbank indicates a generally low background transmissivity for the facies.

10.3.3.4 Glacial Till Deposits

The glacial till deposits (Figure 10-15) at the Site underlie the fluvio-deltaic deposits, consisting primarily of clay and silty materials, interspersed with gravels, pebbles and cobbles. These units have the appearance of slurry, with large grains and pebbles floating in a muddy matrix, which is representative of their origin of deposition by subaerial debris flow related to glacial retreat. Dimensional measurements of these deposits from Quaternary geology maps indicate that they are 2 to 5 miles wide in the east-west direction and 10 to 25 miles long in the north-south direction. Although these units contain a substantial amount of coarse grains and pebbles, the predominantly muddy matrix renders it an impermeable, basal confining unit in terms of groundwater and contaminant flow at the Site.

10.3.4 Stratigraphic Relationship in Cross Sections

Each of the five cross sections and their variations (Figures 10-16 through 10-30) show a series of erosionally-based, well-connected, high-permeability channel bar sands and gravels that are predominantly accreting towards the south. The fence diagrams (Figures 10-31 and 10-32) shows the lateral interconnectivity of these high transmissivity channel bar units. Two tiers of channel belt deposits composed of the channel bars were interpreted via this assessment. The upper channel belt is represented by stacked channel bars from a depth of about 5 ft bgs to about 10 to 15 ft bgs. The lower channel belt is represented by stacked channel bars from a depth of about 10 to 15 ft bgs to about 20 to 25 ft bgs. The stacking pattern of the channel bars show a number of bifurcations of the channel belts, particularly in the lower tier as exemplified by section B-B' in Figures 10-19, 10-20, and 10-21, as wells as the fence diagrams (Figures 10-31 and 10-32)**.** The channel bars of the lower tier typically erosionally truncate the sandy mouthbar deposits of the Chippewa Delta, which show variable permeability. On both tiers, the channel deposits are surrounded by low-permeability sediments (floodplain deposits). The cross-sections show that the delta mouthbars are preferentially oriented along the dip direction of the Chippewa Delta.

The correlations show that the glacial till deposits serve as a basal confining unit for shallow contamination for all practical purposes. The cross sections appear to demonstrate that channel bar and mouthbar connectivity and stacking patterns are the predominant stratigraphic factors affecting contaminant migration for the Site.

10.3.5 Hydrogeology

The overlying regional hydrology is primarily comprised of the Tittabawassee River, located south of the Site. The river drains approximately 2,600 square miles of land in the Saginaw River watershed (MDNR, 1988) and flows south to southeast for approximately 80 miles to its confluence with the Saginaw River, located approximately 22 miles southeast of Midland.

Other pertinent secondary surface water features include small permanent and intermittent streams flowing into tributaries of the Tittabawassee River, small natural and constructed ponds and ditches used to store and convey storm water from developed properties.

The regional topography indicates that surficial drainage patterns in the area are generally toward the Tittabawassee River. However, natural drainage patterns in developed portions of the area have likely been altered and might direct surface water away from the Tittabawassee River, towards drainage basins and other storm water collection units.

10.3.5.1 Regional Setting

Surficial deposits are comprised of topsoil and/or fill material. Underlying these surficial materials are Pleistocene glacial drift deposits. The glacial drift deposits include glaciofluvial and glacial lacustrine deposits. The shallow aquifer is primarily contained within the permeable glaciofluvial deposits. In some areas, individual inland parabolic shaped aeolian dune deposits are also recognized and may be in connection with, or provide a conduit to, the glaciofluvial deposits. The base of the glacial drift deposits is defined by a till layer that acts as a semi-confining to confining layer for the underlying Saginaw aquifer. The Saginaw Aquifer is the deeper regional sandstone aquifer system found within the Pennsylvanian aged bedrock Saginaw Formation. However, the hydrogeology of the NEP area is primarily driven by the shallow aquifer system.

10.3.5.2 Local Setting

For purposes of this discussion, the local setting is defined as within Midland Township and north of the Tittabawassee River. Typically, in this region, the shallow aquifer is found within ten to fifteen ft of the ground surface. The shallow aquifer is the most likely to have received anthropogenic impacts. This aquifer's natural discharge location is the Tittabawassee River.

Because the groundwater is so shallow, an approximation of the groundwater contours and flow direction can be determined by plotting surface water elevations on a contour map. A drawback is that areas with a lack of observable surface water features require significant interpretation of the groundwater contours. Several main assumptions include:

- Distribution of surface water locations has broad coverage;
- All marked water features are perennial; and
- All water features are in contact with the shallow aquifer (i.e. not a lined pond).

The 1962 1:24,000 USGS Midland North and Midland South topographic maps were used to identify historic surface water features and their respective surface elevation. An older map was chosen to minimize the interference of modern anthropogenic development on the analysis. Once the features were identified and labelled, contours were drawn. At this scale the contours, with 10-foot intervals, are an approximate assessment of the groundwater surface and generalized flow directions can be interpreted. There is an apparent groundwater divide (Figure 10-33) located to the northeast of the town and oriented in a NW to SE direction. Groundwater on the SW side of the divide will generally flow towards the Tittabawassee River.

10.3.5.3 Site-Specific Setting

In order to develop groundwater contour/potentiometric surface maps, the available data was graphed to determine which dates had the greatest number and variety of groundwater elevation data. Specifically, two separate dates (October 2018 & May 2019) were selected as each had seventeen wells that were gauged. The gauged wells were fairly well-distributed across the site so as to provide good control for the development of groundwater contours. Groundwater elevation measurements ranged between a high of 630 ft above mean sea level (amsl) to a low of 621 ft amsl. The May 2019 potentiometric surface is illustrated in Figure 10-34 while Figure 10-35 illustrates the October 2018 potentiometric surface.

There is an apparent groundwater divide that coincides with the grassy area located to the north of the 6178 and 6175 plume areas between Washington Street and 18th Street and north of “D” Street. In this region the channel bar deposits are thicker and more continuous west of the divide while east of the divide the channel bar deposits are thinner and located several feet deeper. Groundwater on the eastern side of the divide flows towards the east and northeast. On the western side of the divide groundwater flows within the channel bar deposits in a west-northwest direction. Even though the groundwater contours represent the upper aquifer, there is good flow alignment with the lower channel deposits, which will be discussed in more detail below. In the south-southwestern part of the NEP area there is a groundwater high though the extent of this feature is not well defined due to lack of gauging locations. This groundwater high is generally centered along the region with the thickest amalgamation of stacked channel bar deposits. These deposits thin towards the east.

The variation in screen depths provided an opportunity to evaluate the vertical gradient within the shallow aquifer. Generally, groundwater from the deeper part of the shallow aquifer is migrating upwards resulting in a slight upward gradient across the site; therefore, for dissolved constituents, it is not likely that they will be actively transported to deeper parts of the aquifer but rather upward through the stratigraphic network. If DNAPL is present, it would still migrate downward until it encountered an impermeable zone (the glacial till) that would slow or stop its downward migration.

10.3.6 Implications for Plume Morphology and Potential Contaminant Migration Pathways

In order to analyze the state of COIs in soil and groundwater at NEP, analytical results from the permanent monitoring well network (installed in 2005 and sampled one or more times from 2005 through 2020) and the 2017 MiHPT investigation (location names beginning with “NEP-“) were used. The 2017 MiHPT investigation included 67 borings across the NEP area, with grab groundwater samples collected at 41 of those locations. Additionally, select permanent monitoring wells were sampled during this investigation. The 2017 groundwater sampling data set was of particular importance for this study as it covers a wide geographic area in NEP, and the MiHPT locations filled in some apparent data gaps in the permanent monitoring well network.

Boring logs from historic site borings extending back as far as the 1950s were reviewed to bolster the understanding of site stratigraphy. Additionally, a cluster of temporary wells installed in 2006 in the 6178 area (GP-16, GP-17, GP-18, GP-19, GP-20, GP-21, GP-22, GP-23, GP-24, GP-25) were reviewed since they fall within a spatial area that is not covered by the permanent monitoring well or MiHPT data sets.

The permanent monitoring well network associated with the 6178 Area has typically included monitoring wells A through K and monitoring well 6178. The permanent monitoring well network associated with the 6175 Area has typically included MW-1 through MW-10 and monitoring well 6175. The permanent monitoring well network associated with the CFC Area has typically included the shallow monitoring wells 3540A, 3654, 4358, 4359, 4364, and 6176 and the deep monitoring wells 3539A and 3540B. Monitoring wells 4355, 5385, 6177, and 9317 are also part of the overall NEP monitoring well network.

Key geochemical parameters (such as dissolved oxygen [DO], oxidation reduction potential [ORP], pH, ferrous iron, nitrate, chlorides, sulfate, and total organic carbon [TOC]) as well as the concentrations of reductive dechlorination end products (ethene, ethane, and carbon dioxide) were also evaluated from the data set originating from the monitoring networks at the 6178 and 6175 plume areas. This was completed to determine whether the geochemical state of these plumes is shifting in a manner that is favorable for continued reductive dechlorination. A similar assessment for the CFC plume area was completed as well; however, this assessment was limited to only DO, ORP, and pH due to a limited data set.

Additionally, a molar mass and chlorine number assessment was completed on the CVOC and daughter product chemistry in select wells to further support the assessment for the 6175 and 6178 plume areas. Changes in molar concentrations of CVOCs (PCE, TCE, cis-1,2-DCE, VC, and ethene) over time at select wells in the 6175 and 6718 Areas were evaluated to provide additional insight into ongoing reductive dechlorination in the area. Annual average concentrations of the CVOCs were converted from ug/L to uM using molecular weights. The molar concentrations were then used to calculate chlorine numbers at each of the monitoring wells in the 6175 and 6178 Areas. Chlorine numbers are calculated by dividing the number of chlorine atoms attached to each CVOC divided by the sum of the total molar concentration of those CVOCs. The formula is shown below:

$$Chlorine\ No. = \frac{\left((4*PCE\ Molar\ C) + (3*TCE\ Molar\ C) + (2*DCE\ Molar\ C) + (1*VC\ Molar\ C) + (0*Ethene\ Molar\ C)\right)}{Total\ Molar\ Concetration}$$

10.3.6.1 6178 Area

Groundwater analytical results from the 6178 Area (Figure 10-36) show varying levels of CVOC daughter products, namely VC and cis-1,2-DCE in several of the area’s monitoring wells. Of the 11 permanent monitoring wells assessed in this area, seven have increasing concentrations of cis-1,2-DCE (MW-A, MW-F, MW-G, MW-I, MW-J, MW-K and 6178). Those seven wells were reported with higher detected levels of cis-1,2-DCE in their most recent sampling rounds as compared to their initial baseline sampling round. Reported VC concentrations have mostly decreased within the 6178 Area overall; however, groundwater samples collected from MW-H and MW-G reported higher concentration levels of VC in more recent sampling rounds as compared to their initial baseline sampling rounds.

Key geochemical parameters (such as DO, ORP, pH, ferrous iron, nitrate, chlorides, and sulfate) as well as the concentrations of reductive dechlorination end products (ethene, ethane, and carbon dioxide) show that reductive chlorination is occurring in the 6178 plume area. Low DO, ORP, and neutral pHs are favorable for anaerobic/reducing conditions and can be observed in Figure 10-37. The observation of detectable levels of ethane, ethene, and carbon dioxide indicate that the reductive chlorination process has managed to reach its endpoint (Figure 10-38). Additionally, relatively low levels of nitrates, ferrous iron, and sulfates in conjunction with elevated and increasing chloride concentrations also indicate ongoing reductive chlorination (Figures 10-39 and 10-40). TOC concentrations have typically been near or less than 5 mg/L (Figure 10-41), with the exception of the TOC fluctuations observed in 6178. A higher TOC concentration would be more desirable in order for the reducing microbes to have enough organic substrate to continue the reductive chlorination process.

The chlorine numbers for monitoring wells in the 6178 Area have been slightly increasing since 2014; therefore, the chlorine number evaluations presented in Figure 10-42 indicate that the reductive chlorination process in the 6178 Area has potentially reached a stall point at cis-1,2-DCE and VC.

As part of the conclusions of the 2017 MiHPT investigation, the source of these CVOC breakdown products in groundwater was hypothesized to be the same DNAPL area observed at MiHPT boring locations NEP-69 and NEP-151 as well as the high PCE concentration observed at NEP-157. Figure 10-43 shows a stratigraphic connection in the lower channel belt deposits from the reported DNAPL area to the 6178 Area. Furthermore, the fine-grained stratigraphic sediments directly to the north of the observed DNAPL area serves as an impediment to the flow of COIs and groundwater in the lower channel belt complex. Groundwater, and any dissolved phase constituents, will follow the flow path of least resistance. The October 2018 groundwater contours identify flow paths from the observed DNAPL area that bifurcate to the northeast and the northwest. The groundwater gradient trending to the northwest in conjunction with the stratigraphic controls in this area confirm a potential pathway for CVOCs to reach the 6178 Area.

This stratigraphic pathway is represented by the lower channel belt deposits depicted in Figure 10-42 between NEP-159 and NEP-160 at approximately 615 to 619 ft amsl. It is evident in the cross section that the temporary wells used in 2017 to sample this area do not penetrate far enough to reach the lower channel belt complex, which is hypothetically where higher concentrations of dissolved CVOCs originating from the observed DNAPL area would be present. In addition to this apparent vertical sampling data gap, a horizontal data gap exists between the southern end of Section C-C’ and the 6178 Area (Figure 10-43) in terms of stratigraphy and groundwater sampling. There are 10 historic soil borings from 2006 in the 6178 Area; however, these borings were also not installed deep enough to capture the full stratigraphic architecture of the lower channel belt complex in this area. Grab groundwater samples from these 10 borings all resulted in non-detect (ND) values for CVOCs, with the exception of one sample which detected PCE at 3 ug/L. This apparent lack of substantial CVOCs in the upper channel belt complex is further evidence for the migration pathway of COIs from the observed DNAPL area found in the lower channel belt complex. Advancing additional borings to adequate depths (615 amsl) in the 2006 study area, as well as in the vicinity of NEP-159 and NEP-160, could help confirm the lower channel belt stratigraphy and chemistry hypothesis outlined above.

The maximum dissolved phase concentration of PCE detected in groundwater at NEP-157 in 2017 was observed in the interval from 13 to 18 ft bgs (622-616 ft amsl), which partially sits above the mapped lower channel belt sand unit shown in the facies figure (Figure 10-43). Therefore, dissolved phase constituents detected in this location are not constrained by the mapped geologic architecture and will likely migrate along the observed groundwater gradient to the northeast toward the 6175 Area. Alternates to Figures 10-20, 10-21, 10-23, and 10-24 are included in Appendix M for reference.

Additionally, analytical chemistry data is limited in the parking lot area located to the north of 433A. Analytical data and groundwater level data could be helpful in confirming that a lack of impacts observed at depths equivalent to the lower channel belts, as well as incongruent lithology, would support that the lower channel belts are not present in this area as shown in Figure 10-43; and a lack of impacts observed at depths equivalent to the upper channel belts would support the groundwater divide depicted Figures 10-34 and 10-35.

The 2017 MiHPT conclusions noted that off-site migration of CVOCs from the 6178 plume at unacceptable levels is unlikely. The stratigraphic architecture mapped (Figure 10-43) along with the observed groundwater gradient in the 6178 Area support this conclusion, as dissolved phase constituents will continue to be pulled to the west-northwest of the 6178 Area. The 2017 CAIP/2018 WP involved a fate and transport modelling effort which identified the groundwater concentration detections which would be necessary for the off-site migration of VC and cis-1,2,-DCE at unacceptable levels. As evidenced by more recent sampling results from the corrective action monitoring program, concentrations of VC and cis-1,2-DCE detected in groundwater continue to be far below the concentrations of concern for potential off-site migration.

10.3.6.2 6175 Area

Groundwater analytical results from the 6175 Area (Figure 10-44) show varying levels of CVOC daughter products, namely VC and cis-1,2-DCE in several of the area's monitoring wells. Generally, the concentrations of CVOC daughter products have shifted from cis-1,2-DCE being the dominant daughter product in the area. This shift in predominant daughter products indicates that ongoing degradation via reductive dechlorination of CVOCs is occurring in this area.

Key geochemical parameters (such as DO, ORP, pH, ferrous iron, nitrate, chlorides, and sulfate), as well as the concentrations of reductive dechlorination end products (ethene, ethane, and carbon dioxide), also show that reductive chlorination is occurring in the 6175 plume area. Low DO, ORP, and neutral pHs are favorable for anaerobic/reducing conditions and can be observed in Figure 10-45. The observation of detectable levels of ethane, ethene, and carbon dioxide indicate that the reductive chlorination process has managed to reach its endpoint (Figure 10-46). Additionally, relatively low levels of nitrates, ferrous iron, and sulfates in conjunction with elevated and increasing chloride concentrations also indicate ongoing reductive chlorination (Figures 10-47 and 10-48). TOC concentrations have typically been above 10 mg/L (Figure 10-49). A higher TOC concentration would be more desirable in order for the reducing microbes to have enough organic substrate to continue the reductive chlorination process; however, these TOC values are higher than those observed in the 6178 plume area. A continuous decrease has been observed in the chlorine number for monitoring wells in the 6175 Area (Figure 10-50). The decreasing chlorine number paired with the detection of ethene in a number of monitoring wells supports complete and continued reductive dechlorination; therefore, any CVOC impacts on the storm sewer line located to the north of this plume area are unlikely.

As noted in the 2017 MIHPT investigation, the likely source of the CVOCs and associated breakdown products in the 6175 Area is the observed presence of DNAPL in the subsurface. Two areas of DNAPL and/or elevated PCE concentrations were identified, 1) at temporary wells NEP-69 and NEP-151, and 2) the area near NEP-157. The 2017 investigation concluded that the observed DNAPL at NEP-69 and NEP-151 is likely PCE.

A general northerly/northeasterly groundwater flow direction is noted emanating from the DNAPL area towards the 6175 Area. Notably, as DNAPL has a tendency to move 'downhill' along underlying confining surfaces, Figures 10-31 and 10-32 show a stratigraphic dip of the channel sand units generally from north to south in the study area; therefore, any impacts emanating from the DNAPL area toward the 6175 well network would only be in the dissolved phase as the DNAPL would follow the stratigraphic dip to the south.

Based on the reported screen elevations of the temporary wells and the stratigraphy represented in Figure 10-43, the observed DNAPL at NEP-69 and NEP-151 was present in the lower channel belt unit (defined as the sandy channel bars deposited from approximately 615 to 619 ft amsl), which is mapped laterally in Figure 10-43. There is a potential flow path for dissolved phase constituents consistent with the observed groundwater head gradient in this lower channel belt immediately to the east of cross section B-B'. The stratigraphic impediment to groundwater and contaminant flow shown in areas outside of the orange polygon in Figure 10-43 can also be visualized in Figures 10-20, 10-21, and 10-22 between NEP-42 and NEP-70, and in Figures 10-28, 10-29, and 10-30 between NEP-29 and NEP-31. This subsurface "barrier" to groundwater and contaminant migration to the lower channel belt is further made apparent in the fence diagrams (Figures 10-31 and 10-32).

The maximum dissolved phase concentration of PCE detected in groundwater at NEP-157 in 2017 was observed in the interval from 13 to 18 ft bgs (622-616 ft amsl), which partially sits above the mapped lower channel belt sand unit shown in the facies figure (Figure 10-43). Therefore, dissolved phase constituents detected in this location are not constrained by the mapped geologic architecture and will likely migrate along the observed groundwater gradient to the northeast toward the 6175 Area. Additionally, analytical chemistry data is limited in the parking lot area located to the north of 433A and could be helpful in confirming this hypothesis. Alternates to Figures 10-20, 10-21, 10-23, and 10-24 are included in Appendix M for reference.

As observed in Figure 10-43, dissolved phase contamination in the 6175 Area will be influenced by a north-easterly groundwater flow gradient. There are detections of VC in the lower and upper channel belt sands (approximately 622 to 628 ft amsl), which may provide a pathway for further easterly flow (Figures 10-28, 10-29, and 10-30). However, 2017 sampling results did not detect VC to the east of 6175 Area, indicating that constituents are naturally attenuating at this point.

10.3.6.3 CFC Area

Groundwater sampling results from 2011-2020 (Figure 10-51) show persistent high levels of CFC-11 at monitoring well 3540A, which is screened in a shallow zone of the aquifer, from 1 to 8 ft bgs. Results from 2017 also indicate that CFCs are present at high levels in the lower channel belt complex (approximately 10 to 15 ft bgs in this area) at NEP-24, NEP-25, and NEP 36 and in the upper channel belt complex at NEP-51, NEP-53, and NEP-54. The lower channel lobe does not appear to reach monitoring well 4358 to the north.

There is evidence of ongoing reductive defluorination/dechlorination; however, this process seems limited when compared to the 6175 and 6178 areas. The area appears to only be in mildly anaerobic/reducing conditions based on low-flow field parameters collected during sampling (low DO, ORP near 0, neutral pH, see Figure 10-52); however, there is a lack of analytical data related to other natural attenuation parameters (i.e., nitrates, ferrous iron, chlorides, sulfate, dissolved gases and TOC). Obtaining a better understanding of the plume chemistry with respect to reductive defluorination/dechlorination would inform the current geochemical status of the plume.

The CFC plume appears to have manifested within both the upper and lower channel belts, which allows the observed groundwater flow pathways (to the north and east) to play the chief role in dictating migration, but the plume appears to form two distinct dissolved phase lobes to the northwest and east-southeast in the vicinity of monitoring well MW-3540A. Along the eastern edge of the site there is a potential for CFC migration in the upper channel belt which could result in off-site migration of the plume; however, 2017 XSD and chemistry data (from wells/MiHPT points MW-6176, NEP-27, NEP-38, NEP-67, NEP-77, NEP-149, and NEP-150) shows that this is not the case. Additionally, a ridge-like feature in the glacial till appears to thin out the lower channel belt and therefore limits the migration of impacts observed in the lower channel belt complex. This assessment of the ridge-like feature can be confirmed by MW-4359, which is installed within this feature and is routinely dry.

10.3.7 Conclusions

The conclusions of the HRCSM development are broken down by geological, hydrogeological, and plume morphology/fate and transport migration findings.

10.3.7.1 Geology

- Channel bar deposits are the primary transmissive units at the site. Therefore, understanding the stacking pattern and heterogeneity of these bars is critical in understanding contamination flow paths. Bifurcation of the channel belt in the lower tier would have significant impact in controlling the migration paths from the potential sources.

- Delta mouthbar and crevasse splay deposits show variable transmissivity dependent upon the grain size, with the coarse-grained crevasse splays and delta mouthbar showing the highest transmissivity following the channel bars.

- Flood-plain deposits in the inter-channel areas represent local confining units and the glacial till deposits underlying the lower tier of the channel-belt deposits at NEP serves as a more regional basal confining unit.

10.3.7.2 Hydrogeology

- A groundwater divide is generally located between the 6175 Plume Area and the 6178 Plume Area.

- A groundwater high is situated just south and west of the interpreted on-site source zone area (SW of NEP-73, NEP-152, NEP-68 and NEP-160).

- Groundwater flow with impacted chemistry in the 6175 and 6178 Plume Areas appears to be influenced by the deeper channel belt stratigraphy.

- Groundwater flow in the 6175 Plume Area is predominantly north to northeasterly whereas flow in the 6178 Plume Area is predominantly west to northwesterly.

- Groundwater flow in the CFC Plume Area is predominantly to the north and east.

10.3.7.3 Plume Morphology, Fate and Transport Migration, and Chemistry

- The potential dissolved-phase contaminant migration pathway from the reported DNAPL source area to the 6178 Plume Area is a data gap. Previous investigations including 1) the 2006 borings GP-16, GP-17, GP-18, GP-19, GP-20, GP-21, GP-22, GP-23, GP-24, and GP-25 and 2) the MiHPT borings in the area of NEP-159 to NEP-160 sampled the shallow portions of the aquifer, and therefore, did not fill this data gap. However, off-site migration of COIs from the 6178 Area continues to be unlikely, as concluded in 2017 CAIP/2018 WP.

- There is limited analytical chemistry data from the 433A parking lot area. Gathering data from this area can help support the stratigraphic and groundwater flow findings presented via the ESS assessment.

- There is an incomplete picture of the groundwater chemistry as it relates to reductive dechlorination in the 6175 and 6178 Plume Areas and reductive defluorination/dechlorination in the CFC plume area but the data assessed shows:

  - The groundwater chemistry in the 6175 Area indicates reductive dechlorination is reaching its end stage;

  - The groundwater chemistry in the 6178 Area indicates that reductive dechlorination is occurring, but to a lesser extent than the 6175 Area;

  - An increase in the chlorine number in the 6178 Plume Area indicates a cis-1,2-DCE and/or VC stall is likely occurring; however, groundwater flow from this area is moving away from the fenceline (west-northwestward); and

  - The groundwater chemistry in the CFC area appears to only be mildly anaerobic/reducing.

10.4 2021 Path Forward

Work in 2021 will focus on achieving the following objectives for the NEP:

- Revision of the field work plan for the collection of additional data necessary to fill CSM data gaps;
- Implementation of the field workplan to collect additional data necessary;
- Evaluate 2021 data collected and update the HRCSM; and
- Begin modifying the well network optimization plan based on the updated the HRCSM.

Work in 2021 is anticipated to be completed in accordance with the milestone schedule presented in Section 15.0. Unless otherwise necessary or requested plans or findings will be provided during periodic progress meetings, which are scheduled to occur on an approximately monthly basis. Annual updates detailing the work completed and projected for the next year will be presented in the annual CAIP.

11.0 Chemical Disposal Well 3

Closed Chemical Disposal Well #3 is located east of Poseyville Road within the Midland Plant (Figure 11-1). The well was formerly used for injection of wastewater. It was closed in 1985 and a groundwater collection tile and pumping station was installed in the immediate area prior to 1990 to capture groundwater and prevent off-site flow. Hydraulic monitoring of the system through the use of piezometers began in 2004.

The potential for off-site groundwater flow at the western boundary of the facility was identified and reported to the MDEQ in the Compliance Schedule Task H-11 West Side Shallow Groundwater Investigation Summary Report dated August 7, 2009. Off-site flow was determined to have the potential to vent to storm sewers that were present at that time which drained southwards, eventually discharging to the Tittabawassee River downstream of the Dow Dam. Interim measures continued in 2011 to address the issues identified at the site, as described below.

11.1 Overview of Site Characteristics and Interim Measures

Work completed in association with the H-11 project included a characterization of groundwater quality in the area by collecting a groundwater sample from facility shallow monitoring well MW-6172 (Figure 11-1) and analyzing it for the presence of constituents listed in 40 Code of Federal Regulations (CFR) Appendix IX. Chlorobenzene was detected at a concentration exceeding generic GSI criteria. Supplemental soil and groundwater characterization were then completed in 2011 and early 2012. Results were used to evaluate the exposure pathways at the relevant properties affected by this contamination. An IRA Work Plan was submitted on March 16, 2012 to address venting to surface water and dermal contact to groundwater and the work described in the Plan was completed in the summer and fall of 2012.

The 2012 IRA included a source removal activity and approximately 5,280 cubic yards of existing contaminated soil was removed and disposed of at Salzburg Landfill. Due to the presence of three existing active utilities that remain in place (8-inch Consumer's Gas Main, 12-inch High Pressure Maverick Natural Resources, LLC High Pressure Gas Main, City of Midland 10-inch Water Main), contaminated soils remained in place after completion of the IRA (Figure 11-2). Four cross-ties linking the sewers on each side of the road potentially acted as preferential flow paths. Three cross-ties were subsequently physically removed, and the fourth (4^{th}) cross-tie, a 60-inch culvert, was plugged with flow fill. A 30-ft clay plug was also installed on the eastern boundary of the culvert to minimize flow along the backfill.

Supplemental soil and groundwater characterization were completed in 2016 and 2018 to evaluate the exposure pathways at the relevant properties affected by the contaminated soils left in place. The objective of this work was to determine if impacted groundwater exceeding the MDEQ GSI criteria is flowing offsite with the potential of impacting GSI receptors in the area.

In late March to early April of 2018 groundwater samples were collected from shallow wells 2925, 8815, 8816, 8817, 8818, 8819, 8820, 2926A, 2927A and analyzed for a suite of analytes including metals, pesticides, PCBs, herbicides, VOCs, and SVOCs. In August of 2018, the collection of SWLs levels began and continued into December 2018. Monitoring well top of casings (TOCs) were also resurveyed to 0.01-inch. The shallow groundwater flow direction was determined to be to the west, in concurrence with the 2016 data collected.

A topographic survey was also completed. The potential for groundwater to vent to the ditch on the west side of Poseyville Road was confirmed when comparing groundwater elevations at shallow monitoring wells 8817 and 8818 to the elevation of the bottom of the west ditch. Groundwater elevations in shallow monitoring wells 8817 and 8818 are at the approximate elevation of the bottom of the ditch. Surface water in the ditch ranges from several feet during flood events to a few inches during normal conditions. A storm water sewer also trends north-south along the west side of Poseyville Road approximately 170 feet west of the CD-3 site. Groundwater is not expected to vent to the shallow swale to the east of Poseyville Road based on the survey data.

In early March of 2018, slug tests were performed at each shallow piezometer 8815, 8816, 8817, and 8818 to determine the hydraulic conductivity of the shallow formation. Four slug tests were performed at each piezometer consisting of two falling head and two rising head tests varying the slug displacement between each test. Slug test data was analyzed with the Bouwer and Rice method for unconfined formations as well as the Cooper method for confined formations as outlined in *The Design, Performance, and Analysis of Slug Tests* by James J. Butler. Conductivity values range from 0.005 cm/sec at 8816 to 1.77×10^{-6} cm/sec at MW-8815. Measured hydraulic conductivities are typical for the lithology observed in the soil borings for shallow monitoring wells 8815, 8816, 8817 and 8818.

The 2016 and 2018 shallow groundwater sampling results were compared to the Michigan Part 201 GSI Criteria. Monitoring wells 2925, 2926A, 2927A, 8816, 8817 and 8819 had chemistry that exceeded various GSI criteria in 2016. Monitoring wells 2926A and 8819 had chemistry that exceeded various GSI criteria in 2018.

Shallow monitoring wells 8817 and 8818 are the current GSI compliance points and were installed to intercept any offsite groundwater flow from the east side of Poseyville Road before reaching the ditch and storm sewer. For the 2016 sampling event, MW-8817 was over the GSI criterion for Cyanide at 0.110 mg/l. The GSI criterion for cyanide is 0.0052 mg/l. Cyanide was analyzed using the waste and leachate-based method of SW9012A with a reporting limit of 0.010 mg/l.

Compliance with the Michigan GSI criterion for cyanide requires use of method OIA-1677 or comparable for determination of amenable cyanide with a reporting limit of 0.005 mg/L. There were no cyanide detections for the 2018 sampling event using method SW9012A and a reporting limit of 0.010 mg/L. It should be noted that MW-8817 and MW-8818 were purged dry during the 2018 sampling event and samples collected after the wells recharged the following day.

11.1.1 Short-Term Shallow Groundwater Monitoring Program

The 2016/2018 data assessment provided sufficient information to establish a site-specific TAL and determine that further sampling should be conducted to better evaluate the site (Table 11-1). The proposed short term monitoring program was presented and discussed in the May 2019 monthly Dow/EGLE Corrective Action Status meeting. The short-term monitoring program was proposed to include eight sampling events over a 16-month period.

The monitoring program developed includes bimonthly sampling at six shallow wells (8817, 8818, 8819, 8820, 2926A and new location to be installed west of 2926A) for the site-specific TAL, static water level measurements at seven shallow groundwater well locations (8815, 8816, 8817, 8818, 8819, 8820 and 2926A), and pH and hardness sample collection from the north-south trending ditch west of Poseyville Road for calculation of GSI criteria (Figure 11-3). Prior to sampling all wells are developed using surge and pump techniques to remove any residual turbidity from past flooding events.

The results for two groundwater sampling events (August 2019 and October 2019) were available as of December 2019 and reported in the 2019/2020 CAIP. There was only one exceedance of the copper criterion at 8818 during the August 2019 event. There were no other exceedances of the GSI Criteria at GSI compliance monitoring wells 8817 and 8818 for either of these events. The reporting limit for amenable cyanide was reported as 0.010 mg/l for the August and October groundwater sampling. As the GSI criterion for cyanide is 0.005 mg/l future sampling events were arranged to be analyzed to reporting limit of 0.005 mg/l. Groundwater flow direction for the August and October sampling events was also to the west for both sampling events.

11.2 Work in 2020

Short term bi-monthly monitoring which began in 2019 continued through 2020. During each bimonthly monitoring event, groundwater elevations were collected and groundwater flow direction maps were generated. The groundwater flow direction was primarily to the southwest-west-northwest for all monitoring events. Groundwater elevations are included as Table 11-2. The groundwater flow direction maps are included as figures 11-4 through 11-10.

Results for the December 2019 sampling event and five of the six 2020 groundwater sampling events were available as of December 2020. There were exceedances of the GSI criterion for copper during the June 2020 sampling event and cyanide during the October 2020 sampling event at monitoring wells 8817 and 8818. Prior to the June 2020 sampling event, there was only one exceedance of the copper criterion at 8818 during the August 2019 sampling event and no prior exceedances of the cyanide GSI criterion at 8816 and 8817 during the short term bi-monthly sampling events.

The October 2020 sampling event laboratory report indicated that the cyanide matrix spike/matrix spike duplicate/sample duplicate for the preparation batch and analytical batch associated with MW-8817 and MW-8818 were outside control limits and sample matrix interference or non-homogeneity was suspected so additional analysis of the Level IV data report was conducted. The analysis concluded that the matrix spike pair was not performed on a site sample so it has no determinable impact on the field sample results. This may indicate a precision issue but the cyanide duplicate performed was within control limits at 2% RPD, therefore there is no reason to invalidate the result. The results of the 2020 groundwater sampling events are included as Table 11-3.

To address the potential for offsite flow near monitoring well 2926A, an additional well was planned to be installed on the west side of Poseyville Rd. directly west of 2926A as a part of the short-term monitoring program. The well was intended to be installed prior to beginning of the bimonthly groundwater sampling but due to the need to obtain property use license agreements to install the monitoring well on City of Midland Property, the installation has been delayed.

11.3 Path Forward

The proposed well to the west of 2926A will be installed in 2021. Placement of the new well to intercept potential offsite flow from the 2926A area well requires coordination between Dow and the City of Midland to obtain a license agreement which is currently on-going.

If cyanide concentrations at 8816 and 8817 exceed the cyanide GSI criterion in the December 2020 results, a confirmation sampling event will be performed at 8816 and 8817 for cyanide will be performed and a Level IV analytical report will be reviewed by an analytical chemist to validate the results.

The short-term bi-monthly monitoring program is scheduled to conclude in December of 2020. However, due to the delayed installation of the proposed well west of 2926A, the well will be sampled for amenable cyanide and metals once completed. Once this data is received and reviewed, the results of this sampling event and next steps will be discussed with the EGLE at the following regularly scheduled coordination meeting.

Work in 2021 is anticipated to be completed in accordance with the milestone schedule presented in Section 15.0. Unless otherwise necessary or requested, plans or findings will be provided during periodic progress meetings, which are scheduled to occur on an approximately monthly basis. Annual updates detailing the work completed and projected for the next year will be presented in the annual CAIP.

12.0 7th Street Purge Wells Area (Fuel Oil Tank Farm)

The former fuel tank farm AOC, known as 7th Street Purge Wells AOC, is located in an upland area on the west bank of the Tittabawassee River, approximately 520 ft upstream of the Dow Dam (Figure 12-1). Historically, two above-ground fuel oil storage tanks were located in the area. The tanks provided fuel oil to a backup boiler located in Building 879. Historic release(s) from the operation of this above-ground storage tank system and associated piping have impacted the soil and groundwater. The area has been extensively backfilled with ash, sand, gravel, bricks, crushed concrete, asphalt, coal, and various other man-made materials. The shallow perched groundwater exhibits an easterly hydraulic gradient towards the Tittabawassee River. Thin silts and clays underlie the fill material. The silts and clays form a thin aquitard over the large sand inclusion in the till that is in hydraulic communication with the Tittabawassee River channel. Work has been focused on managing both the shallow perched groundwater as well as the deeper groundwater hydraulic zones.

12.1 Overview of Site Characterization and Interim Measures

The 7th Street Purge Well Area is currently an industrial area including paved and gravel roadways, a service water pump house, and above ground utility truss supporting utilities which cross the Tittabawassee River via either of two bridges spanning the River at the eastern extent of the study area (Figure 12-2). Groundwater pumping wells (purge wells) are operated in the area as stipulated by RCRA License operating conditions. Along the eastern margin of the study area, the Tittabawassee River flows from north to south at levels generally around 597 ft NAVD 29. A service water intake basin was constructed along the west portion of the Tittabawassee River within the study area, partially separated from the main flow channel by a steel sheet pile wall.

Groundwater in the study area is generally present in two strata, the surface sands (generally miscellaneous fills from 0-18 ft in the study area, generally referred to as the shallow perched groundwater) and the deep sand area. Previous study (URS Corporation, 2007) of the shallow groundwater concluded that the shallow perched groundwater is flowing easterly toward the Tittabawassee River at an approximate hydraulic gradient of 0.03 feet per foot (ft/ft). The perched groundwater flow is restricted and/or retarded along the bank by the presence of silts and clays present adjacent to the river. Although the sediments in this immediate area have a relatively low hydraulic conductivity, a hydraulic connection to the Tittabawassee River is present. Previous studies (McDowell and Associates, 1986 and Radian International, 2000) of the deep sand area have concluded that a hydraulic connection between the groundwater in the deeper sand till and the Tittabawassee River exists.

12.1.1 Shallow Zone Interim Measures

An IRA Work Plan was submitted December 13, 2005, and a Completion Summary Report provided September 28, 2007. The IRA investigation included the installation of a number of groundwater monitoring wells in the shallow zone (Figure 12-3). Groundwater sampling identified chromium, lead, and various volatile organic hydrocarbons including naphthalene. The highest groundwater concentrations of the COCs were detected in MW-4 and MW-7. The groundwater concentrations in MW-4 and MW-7 occasionally exceeded the GSI criteria.

Measureable free product was identified in monitoring wells MW-9, MW-10, MW-11, and MW-13. An intermittent heavy sheen of free product has been noted in MW-7. The free product is dark brown to black in color and highly viscous (e.g., not mobile). Analytical data confirms the oil is viscous and lighter than water. A map indicating the estimated extent of the area impacted by free product is attached as Figure 12-4.

The silt and clay aquitard undulates across the site, is generally at a higher elevation along the riverbank and is restricting or retarding the movement of groundwater towards the river. The aquitard is present at the highest level along the riverbank near MW-17 and MW-18 and lowest along the riverbank near MW-1 and MW-6.

During routine monitoring, seven compounds were detected at concentrations above their GSI Cleanup criterion, following the April 2, 2013 sampling of corrective action wells MW-15S, MW-14S, MW-18, and MW-17. The MDEQ was verbally notified on June 10, 2013, and the wells were re-sampled on June 13 and 17, 2013. Detected concentrations of 1,2,4-trimethylbenzene, ethylbenzene, and naphthalene were confirmed to be at concentrations exceeding their GSI Cleanup Criterion. 1,2,4-Trimethylbenzene was identified in one sample at concentrations that also exceed the Michigan Rule 57 Final Acute Value. MDEQ was notified of the confirmation on July 8, 2013.

In response to the chemical detections in the corrective action monitoring wells that exceeded generic MDEQ Cleanup Criterion, an IRA Work Plan was submitted August 2, 2013, summarizing the IMs that included targeted removal of 'source' material in the area. The interim response was designed in order to improve the groundwater quality sufficiently enough that generic Cleanup Criterion will not be exceeded. During the fall of 2013, soil was excavated to the top of the aquitard and impacted soil was removed from the area. Approximately 5,000 cubic yards of 'source' material was removed (Figure12-5). The area was backfilled with excess soils re-located from other areas on-site. Immediately following the source removal detections of arsenic, 1,2,4-trimethylbenzene, ethylbenzene, isopropylbenzene, o-xylene, naphthalene, and cyanide were detected above the generic GSI cleanup criteria but were either not confirmed in follow-up sampling or the wells were dry.

12.2 Shallow Zone Current Status

Existing shallow monitoring wells 14S, 15S, 17, and 18 routinely dry or they go dry during sample collection except when seasonally induced higher water levels (snow melt, rain, etc.) exist, which presents a significant challenge to routinely and effectively evaluate the shallow groundwater against Performance Criteria. Historically, groundwater samples collected from MW-18 in second quarter have exceeded the Michigan Part 201 GSI cleanup criteria for VOCs, SVOCs and occasionally metals.

In the second Quarter of 2018, a sample was obtained from MW-18 and 1,2,4-trimethylbenzene, ethylbenzene, o-xylene, naphthalene, and m,p-xylene was detected (with results of 74 micrograms per Liter (µg/L), 220 µg/L, 22 µg/L, 43 µg/L, and 44 µg/L, respectively) above the performance criterion for each of these analytes. Per the requirements of the SAP, MW-18 was then resampled in quadruplicate on August 2, 2018 and the results confirmed the VOC exceedances.

Water was again observed in MW-18 during the Q3 2018 chemical monitoring sampling event completed on August 28, 2018. The results reported that arsenic, and additional organic constituents in the sample collected at MW-18 did not meet Performance Criteria established in Table 2-F of the SAP (Table 12-1).

Table 12-1. Constituents Detected Above Performance Criteria in MW-18 in 3rd Quarter 2018

Analyte	Result (µg/L)	Criteria (µg/L)
1,2,4-Trimethylbenzene	310	17
1,3,5-Trimethylbenzene	51	45
Ethylbenzene	510	18
Isopropylbenzene	83	28
o-Xylene	500	41
2-Methylnapthalene	31	19
Naphthalene	380	11
m,p-xylene	260	41
Arsenic	36.7	10

MDEQ was notified of the Q2 exceedances in a letter sent to MDEQ on September 7, 2018 and of the other GSI exceedances via a phone call on September 24, 2018 followed by a confirmation email sent the same day. Per the requirements of the SAP, MW-18 was resampled in quadruplicate on October 3, 2018 and the results confirmed the exceedances.

In response to the shallow zone criteria exceedances at MW-18, pursuant with Condition IX.B.2.(c)(iii) and (iv) of the Operating License, a work plan was developed to put together a more complete CSM in order to design an effective remedial strategy to address the GSI exceedances found in MW-18. A historical boring logs review was conducted. Historic boring logs in the 7th Street Purge Well Area and in the Tittabawassee River were reviewed to generate cross-sections of the area (Figures 12-6 thru 12-9). The presence of historical river banks under fill are evident in the cross sections demonstrating the groundwater flow is complex in the area and there are potentially many unconnected perched groundwater zones.

A historical aerial photograph and drawing review was also completed to review the location of former bulk tanks, dispensing facilities, power houses and assess potential impacts of existing structures in the area including the bridge design. The original bridge design drawings from the 1920's revealed that the edge of the wing wall extends well below the upper shallow aquifer and that water in MW-18 may be trapped perched groundwater (Figure 12-10).

Groundwater and surface water data in the area were also reviewed. Groundwater elevation data demonstrates that groundwater in MW-18 tracks directly with the Tittabawassee River level, while the other monitoring wells in the area do not (Figure 12-11).

Once all the existing data was reviewed, it was determined that the next step would be to evaluate the extent of the groundwater that exceeds the GSI criteria north of MW-18 and evaluate the groundwater that is flowing towards MW-18. To do this Dow developed a workplan to install two new monitoring wells north of MW-18 along the fence line (MW-9472 and MW-9473) and one additional well to the west of MW-18 (MW-9474) (Figure 12-12). The new wells were completed on July 10 and 11, 2019 with the use sonic drilling due to buried concrete debris in the area. The wells are screened in the base of the fill and a few feet of silty riverbank sediment. The bottom of the wells are set on the brown clay separating the upper perched groundwater from the underlying sand layer that is controlled by RGIS.

During well installation, the field team noticed a water main leak in the area adjacent to MW-17. MW-17 has historically been dry; however, during this event had water flowing out of the ground alongside the casing. The leaking water main linewas repaired during the same time frame as the installation of the wells.

The wells were then developed on July 15, 2019. The new wells only contained a few milliliters of groundwater upon initiation of development and remained dry after pumping. The following week, the sampling team attempted to sample wells. MW-16, MW-17, MW-9472 and MW-9473 were dry. The only well that contained a small amount of groundwater is MW-18.

Subsequently, since the water main leak was repaired MW-18 was dry during each attempt to sample in 2019. This suggests the area of groundwater exceeding the GSI is very limited and potentially only a small area along the bridge wing wall. It is also possible the groundwater in MW-18 may have been influence by the water main leak near MW-17.

12.3 Work in 2020 and Path Forward

Dow has continued to monitor the wells in the area throughout 2020. MW-18 was dry during every attempt to sample during the year.

Now that the data on the wells in the area has been collected for another year, Dow will assess the data set from the area to determine what, if any, modification of the Corrective Action Monitoring Program may be necessary.

Work in 2021 is anticipated to be completed in accordance with the milestone schedule presented in Section 15.0. Unless otherwise necessary requested plans or findings will be provided during periodic progress meetings, which are scheduled to occur on an approximately monthly basis. Annual updates detailing the work completed and projected for the next year will be presented in the annual CAIP.

13.0 Mark Putnam Road AOC

In late October 2018, a new AOC south of Mark Putnam Road and east of South Saginaw Road extending to the south and east an indeterminate distance was confirmed when analytical results were received for a soil sample taken after an odor was detected during the removal of a tree in the area.

The location of the AOC is shown on Figure 13-1. Pursuant to Condition XI.F.1 of the Act 451 Part 111 of the Operating License Dow communicated the identification of this new AOC to the DEQ on November 16, 2018.

13.1 Summary of Work to Date

The Mark Putnam AOC was discovered when prepping the site for installation of a storm sewer to the south of Mark Putnam. Upon discovery of the impacted soil, the installation of the storm sewer was stopped. The sewer installation was redesigned to minimize potential infiltration into the storm sewer and storm sewer bedding backfill.

Installation of the redesigned storm sewer resumed in January 2019. The trench was excavated to depth for the storm sewer and all soil and debris was disposed of in Dow's Salzburg Landfill. A continuous high-density polyethylene (HDPE) sewer pipe was installed starting at the Saginaw Road storm sewer tie in and installed approximately 40 ft to the east of the initial impacted soil discovery location. Prior to installation of the HDPE Sewer Pipe an HDPE Sheet was placed in the trench directly on the undisturbed native soils of the excavation and extended up the side walls. The bedding for the HDPE Pipe was placed on top of the HDPE sheet prior to lowering the HDPE sewer pipe into place. Remaining bedding and backfill material were placed around the HDPE storm sewer. The HDPE liner was folded over the backfill and welded to itself. A bulk head was formed at each end of the HDPE liner by welding and clamping the HDPE sheet to the HDPE sewer pipe at the Saginaw Rd. storm sewer tie in and 40.0 feet east of the location of the initial impacted soils discovery. The remaining open excavation was backfilled with clean soils.

The new AOC is not a release from any known WMU. Dow has not been able to identify any specific process or WMU operation associated with this area. A review of aerial photographs suggests that some type of industrial activity took place in the area of the new AOC at some point after 1952 and before 1983. No additional information is currently available on the specific industrial activity that took place in this area.

Work in 2019 focused on the development of a work plan to investigate the AOC, implementation of the workplan and analysis of the data.

13.1.1 2019 Soil Results Summary

Seven soil borings (SB) were advanced at the Mark Putnam AOC starting March 2019 (see Figure 13-1). SB-9444 was advanced at the location where evidence of impacted soil was first discovered. SB-9445, SB-9446, SB-9447 and SB-9449 were offset approximately 75 feet (ft) from SB-9444 to the east, west, south and north direction, respectively.

Soil results indicate a circular plume centered around SB-9444. All results at SB-9444 are below all criteria at 30 ft bgs and deeper, with the exception of methylene chloride which exceeds the Nonresidential Volatilization to Indoor Air Criteria (VIAC) for a 12- hour work-day exposure (nonresidential structure < 50,000 ft^2 with slab-on-grade, depth to water of 5 ft and a USDA soil type of sand). Exceedances of the EGLE Part 201 Statewide Default Background (Background) Criteria for metals occur consistently at all depths and in all borings.

13.1.2 2019 Groundwater Investigation and Results Summary

Three shallow groundwater monitoring wells were installed in July 2019 at SB-9444, SB-9445 and SB-9447 (see Figure 13-1). Samples were collected in monitoring wells 9444, 9445, 9447 and existing well 3654 and results indicated that groundwater impacts were concentrated in MW-9447 and MW-9445 with exceedances of the Michigan Part 201 Non-Residential Drinking Water (Drinking Water) Criteria and Groundwater Venting to Surface Water Interface (GSI) Criteria. Benzene exceeded the drinking water criteria in MW-9444. All results in MW-3654 were less than criteria.

13.1.3 Incremental Composite Sample Collection

In the fourth quarter of 2019, a 1.4-acre decision unit (DU) was created encompassing the Mark Putnam AOC (Figure 13-2). The decision unit was sampled for Dioxins/Furans, VOCs, SVOCs, herbicides, pesticides, metals and PCBs using incremental sampling methodology. A total of 50 soil Increments were collected from 0 to 6 inches in depth and composited into one sample. The results comparison to Michigan Part 201 Soil Direct Contact criteria is presented in Section 13.2.1.3.

13.2 Work in 2020

In 2020, work at the Mark Putnam AOC included the collection of groundwater elevations and development of groundwater flow direction maps. Additionally, the 2019 soil sample results were compared to soil background values, in accordance with the Soil Background and the Use of the 2005 Michigan Background Soil Survey (MBSS)– Resource Materials approved by EGLE on October 4, 2019. Additionally, the incremental composite sample results were evaluated with a comparison to the Michigan Part 201 Soil Direct Contact criteria.

13.2.1 Groundwater Elevation

Beginning in January of 2020, groundwater elevations were collected from monitoring wells (MW) 9444, 9445, 9447 and 3654 at the Mark Putnam Area of Concern (AOC) and groundwater flow direction maps created. Flow direction for the five groundwater elevation measurement events was to the north with a slightly radial flow pattern centering on MW-9447. Groundwater elevation measurement ceased in March of 2020 due to the COVID-19 Pandemic.

Table 13-1 presents the groundwater elevation measurements collected from January to March 2020. Figures 13-3 through 13-7 depict the groundwater flow direction.

13.2.2 Soil Investigation Results Comparison to Soil Background

A comparison of the 2019 Mark Putnam AOC soil concentrations to soil background values was completed according to the Soil Background and the Use of the 2005 Michigan Background Soil Survey (MBSS)– Resource Materials approved by EGLE on October 4, 2019. Applying the applicable background metals value for the Mark Putnam AOC is the lesser of two values, either the upper value from the ‘Typical Range of Data’ from Table 1 or the ‘2SD’ column for the Saginaw Lobe from Table 4 for Clay. Clay is the predominate soil type at the Mark Putnam AOC from the surface to depth where silt is encountered at approximately 27 ft bgs. After applying the relevant soil background value, all soil detections for metals fall under the respective metals background values. Replacing Michigan Part 201 drinking water protection criteria with the greater MBSS values eliminates all exceedances of the drinking water criteria for the analyzed metals. Therefore, all metals results are below all applicable Michigan Part 201 generic criteria. Table 13-2 presents the results of this comparison.

13.2.3 Incremental Soil Investigation Results Comparison to Soil Direct Contact Pathway

Incremental soil sampling (ISM) of the Mark Putnam AOC surface soils was conducted on October 22, 2019. As shown in Table 13-3, an evaluation of the data shows that soils do not exceed the Michigan Part 201 generic direct contact criteria for VOCs, SVOCs, volatile organic compounds (VOC), semi-volatile organic compounds (SVOC), metals, herbicides, pesticides, polychlorinated PCBs biphenyls, or the Industrial 990 ng TEQ/kg for dioxins (ETEQ ND = 0.5 LOD).

13.3 Path Forward

Work in 2021 will focus on completing the outstanding tasks outlined in the 2019 CAIP recommended path forward that were delayed due to COVID-19.

- Further delineation of the soil contamination between soil boring (SB)SB-9444 and SB-9447 to the south and SB-9449 to the north will be completed to understand the depth of soil impact. The soil analyte list will be reduced to metals, cyanide, VOCs, and SVOCs as there were no detections of herbicides and pesticides in previous soil samples.

- Additional delineation of the groundwater plume is required to understand the north, east and southern extent of the groundwater plume. Installation of a monitoring well along the sewer back fill adjacent to the ditch to the east will confirm the effectiveness of the storm water backfill infiltration mitigation. A deep monitoring well will be installed adjacent to MW-9444 in the moist to wet silt encountered at 27 feet BGS to determine groundwater impact at depth. The groundwater analyte list will also be reduced to metals, cyanide, VOCs and SVOCs as there were no detections of herbicides and pesticides in previous groundwater samples.

- Groundwater elevation measurements resumed in December of 2020 and will continue quarterly through December 2021 to understand any seasonal variations in groundwater flow direction.

- Potential alternatives to address the delineated soil and groundwater impacts will be reviewed based on the results of the additional data collected.

Work in 2021 is anticipated to be completed in accordance with the milestone schedule presented in Section 15.0. Unless otherwise necessary or requested plans, updates, or findings will be provided during periodic progress meetings, which are scheduled to occur on an approximately monthly basis. Annual updates detailing the work completed and projected for the next year will be presented in the annual CAIP.

14.0 Ash Pond AOC

The Former Ash Pond was constructed as a cooling pond in the late 1940/50s to cool water from the on-site coal fired power plant prior to discharge to the Tittabawassee River. The Ash Pond berms were constructed primarily of sand and other fill material. Coal ash from the power plant operations accumulated in the pond. This practice stopped with the closure of the power plant in the 1980s. The area was identified as an AOC in the License, issued in June 2003. Numerous studies have been completed in accordance with the requirements of the License for the Former Ash Pond beginning in 2004. Remedial work was completed in 2016 at the Former Ash Pond was reported in the 2016/2017 CAIP. Approximately 148,000 cubic yards of ash and soil were removed and approximately 124,000 cubic yards of clean soil was replaced on site in the constructed wetland. Site restoration incorporated 1,700 ft of riparian restoration, upland meadows, vernal pools, and submergent, emergent, and forested wetlands.

After approval of the RAP/CR, it is possible that the perimeter fencing may be relocated in the future so that the Former Ash Pond area will be outside of the Midland Plant fence line and outside of the floodplain. The site is adjacent to a river front property that is owned by the City of Midland. The City is currently planning the restoration of this 14-acre property to a natural area with public access. The final restoration design for the Former Ash Pond area will incorporate the goals of the City of Midland and other stakeholders for a comprehensive restoration of the entire area. It is envisioned that a possible future for the property could include one mile of riparian restoration along the river and a nearly 45-acre natural area with public access or other use that is beneficial to the community and the ecosystem, while also improving the aesthetics of a property that is visible from the downtown area and as you enter the City from the south.

14.1 Overview of Site Characterization and Interim Measures

Studies were completed in accordance with the requirements of the License for the Former Ash Pond beginning in 2004 include:

- <u>RCRA Facility Investigation (RFI) Phase-1 Type Investigation/Preliminary Assessment (2004)</u> - A preliminary assessment was completed in 2004 in response to the classification of the Former Ash Pond as an AOC by EGLE, in accordance with the requirements of the 2003 License, Corrective Action Conditions and Schedules of Compliance, Parts XI.C.2 and XII.A.

- <u>Surface Water Protection Monitoring Evaluation (2004)</u> - Five monitoring wells were installed between the Former Ash Pond and the river to evaluate groundwater flow and groundwater quality in 2004. Furthermore, four composite samples of coal ash from the Former Ash Pond area were obtained in October 2004 and analyzed by synthetic precipitation leachate procedure (SPLP) and the toxicity characteristic leachate procedure (TCLP) methods for the following metals: silver, aluminum, arsenic, barium, beryllium, cadmium, cobalt, chromium, copper, iron, manganese, nickel, lead, antimony, selenium, thallium, vanadium, zinc, boron and mercury.

- <u>On-going Groundwater Monitoring</u> - Five monitoring wells installed during the 2004 surface water protection monitoring evaluation (located between the Former Ash Pond and the river) are sampled on a quarterly basis and have been since November 2006, in accordance with the Michigan Operations Act 451 Part 111 Operating License as part of the surface water protection program. The groundwater from these wells is analyzed for a list of primary organic constituents, as well as arsenic and boron.

- <u>Main Plant West Side Shallow Hydrogeologic Study (2009)</u> - The study was conducted under the 2003 License Compliance Schedule H-11. Thirteen monitoring wells were installed in 2009 to the north and west of the Former Ash Pond to evaluate the potential for groundwater to migrate beyond the facility boundary.

- Terrain Conductivity Survey (2013) - In 2013, a terrain conductivity survey was performed using an EM31-MK2 electromagnetic (EM) conductivity device of the areas north and west (along the river) of the Former Ash Pond.

- Terrain Conductivity Survey (2014) – In 2014, a second terrain conductivity survey was conducted inside the berm of the Former Ash Pond.

- Soil and Groundwater Characterization (2015) – Soil and groundwater samples were collected from soil borings and new wells installed within the interior of the Former Ash Pond, the berm around the Former Ash Pond, and in the flats between the Former Ash Pond and the Tittabawassee River.

- Ash Pond Wetland Delineation Report (2015) - A wetland delineation report was completed in October 2015 to delineate wetlands in preparation for anticipated remedial activities including removing coal ash and soil, removing fence and sections of the berm, enhancing wetlands, managing invasive species, and incorporating a trail system. The wetland delineation was completed using procedures set forth in accordance with Part 303, Wetlands Protection, of Act 451 Natural Resources and Environmental Protection Act (NREPA), as amended (1994).

- Ash Pond Remedy Implementation Workplan (2015) – The workplan for the work at the Former Ash Pond including a characterization of the Site, and evaluation of the data against screening criteria, preliminary pathway evaluation, and proposed source removal activities was presented in the annual 2015 Corrective Action Implementation Summary Report and 2016 Workplan (CAIP).

- Ash Pond Remedial Action Report (2016) - A report on the remedial work completed in 2016 at the Former Ash Pond was provided in the 2016/2017 CAIP. While, it had been estimated that approximately 90,000 cubic yards of material would be removed from the site, additional excavation based on verification sampling and removal of visual ash resulted in approximately 148,000 cubic yards of ash and soil being removed in 2016. This material was taken to the City of Midland Landfill, with the exception of 10,000 cubic yards that was taken to Salzburg Landfill.

- Former Ash Pond Conceptual Site Model (CSM) Refinement (2019) — Due to the need to refine the CSM for the site based on the implementation of the remedy and the results of the on-going groundwater monitoring program Dow developed a refined CSM to better inform the data evaluation and the path forward.

14.2 Current Status

Routine groundwater monitoring at the site has continued to be performed as specified in the current SAP at the groundwater detection wells (Figure 14-1). Five monitoring wells located between the Former Ash Pond and the river are sampled on a quarterly basis and have been since November 2006, in accordance with License as part of the surface water protection program. The groundwater from these wells is analyzed for a list of primary organic constituents, as well as arsenic and boron. No VOCs have been detected above the RL. Results indicate that boron concentrations are below GSI in all five monitoring wells. Concentrations of arsenic are below GSI in MW-6166 and MW-6167. Arsenic concentrations have generally exceeded the current generic GSI criteria in MW-6165 and MW-6169 during recent monitoring events. MW-6168 has had no result above criteria until August 2020, where there was a confirmed result over criteria.

Due to the arsenic exceedances, Dow has undertaken additional site characterization activities during since 2018 to refine the CSM to better understand the site and establish an agreed upon regulatory path for closure.

14.2.1 Post Remedy Work

In 2019, Dow focused on completing a revised CSM. Dow shared information and progress with EGLE, provided additional briefings, and worked with EGLE to establish a path forward for site closure including the preparation of Part I of the Remedial Action Plan/Closure Report (RAP/CR).

The principal tasks in the development of the revised CSM included reviewing and interpreting previously acquired site subsurface lithology data within the context of the depositional environment, applying Environmental Sequence Stratigraphic (ESS) analysis and developing a groundwater contour map. A primary objective of the CSM was to use it to help evaluate potential GSI issues related to the former Ash Pond area. More specifically, the objective of the incorporation of ESS in refinement of the CSM is to assess the connectivity of transmissive sediments at the site to better evaluate potential contaminant flow pathways in relation to the nearby Tittabawassee River.

During the May 2019 Dow/EGLE CA Status Meeting, Dow discussed recent work that had been completed for the Former Ash Pond and requested an additional meeting with EGLE to discuss the site in greater detail, present the refined CSM, and ultimately discuss demonstration of GSI compliance at the site. During that subsequent meeting held June 4, 2019 with representatives from Water Resources and Materials Management Division, Dow presented an overview of the site, the refined CSM, and presented potential GSI compliance options that fit the site conditions. Specifically, Dow discussed GSI compliance options such as a mixing zone, site-specific criteria, and de minimis effect demonstration at the meeting that were applicable to site conditions. During the meeting and subsequently, EGLE suggested that the mixing zone request was likely the most viable option to demonstrate GSI compliance.

In an email dated June 19, 2019 EGLE made some additional suggestions regarding potential steps that could be taken to support the mixing zone request and the site closure. Many of these suggestions were then discussed at the subsequent June 2019 Dow/EGLE CA Status Meeting. During the July 2019 Dow/EGLE CA Status Meeting, EGLE requested additional information be submitted so that they could conduct additional site analyses. There was some question regarding the groundwater model and flow regime presented in the refined CSM and EGLE wanted to additional information to be able to better assess the CSM. Dow provided the information that EGLE requested and posted the boring and well logs on-site, information on backfill material and grading, site data and a data screening table on the SharePoint site in August. Dow also prepared a CSM technical memo titled *Ash Pond Conceptual Site Model Development* to provide further information regarding the methodology and data used to prepare the revised CSM and submitted that with the additional information provided to the agency.

In the September 2019 Dow/EGLE CA Status Meeting Dow discussed the plan to move forward with the Former Ash Pond site. Dow discussed the intent to submit the RAP/CR document in three volumes, similar in structure to the Midland Area Soils RAP. For the Former Ash Pond submittal, Part I is the Remedial Investigation Characterization and Assessment (RICA, Part I) for the Former Ash Pond Area. The purpose of this volume is to provide an overview of the site setting, land use, release characterization, and historical investigation activities; identify the potential exposure pathways; and present the methodologies to determine the contaminants of concern for human health and ecological exposure. The Remedy and Screening Criteria Evaluation (RSCE, Part II) presents and summarizes the results of the human health and ecological risk screening evaluations, any constituents of interest (COIs) identified for relevant exposure pathways and details the workplan for remedy. The final Corrective Measures Implementation (CMI, Part III) will describe the remedial actions and how the remedial actions address current and reasonably anticipated future use, meet the requirements of the Act 451, and ensure the protection of the public health, safety, welfare and the environment.

Dow explained that the intent of this structure was to provide additional information to the agency while allowing Dow and EGLE some flexibility in working out some of the finer details of the final portions of the document. Dow also informed the agency of anticipated timelines for the submittal and detailed that the plan was to move forward with the request for the calculation of mixing zone based GSI criteria. EGLE was supportive of this path forward.

In the 2019 October Dow/EGLE CA Status Meeting, the agency indicated that upon review of the supplemental material provided by Dow, there were additional technical questions raised that they would like to discuss in a subsequent technical meeting for the site. The technical meeting was held at Dow to discuss these concerns on October 28, 2019. One of the primary issues discussed during this meeting was the groundwater flow model presented in the CSM. As a consequence, EGLE requested that Dow collect additional site information including a well inventory, resurvey of the existing wells, and collect a synoptic water level event. Dow agreed to collect the information and mobilized resources to collect the additional information. The wells were inventoried, resurveyed, and synoptic water level data was collected in November 2019. Subsequent to this data collection, in mid-December the agency requested that Dow also install surface water staff gauges and include these measurements with the groundwater data collection. Due to the timing of this request, this additional work could not be scheduled until 2020.

14.3 Work in 2020

Work in 2020 continued to support establishing an acceptable path forward for site closure with EGLE and working towards that end.

During 2019, Dow drafted Part I of the Former Ash Pond RAP/CR. This document was submitted to the agency in 1st Quarter 2020. Subsequently work on Part II began in 2020 and was completed in late 2020. It is anticipated that this volume will be submitted in early 2021.

The additional water surface elevation data that EGLE requested in December 2019 was collected in early January 2020. Dow integrated the new information into the CSM and scheduled another technical meeting with EGLE to review the update to the CSM and path forward for the site. The meeting was held March 25, 2020 (Appendix N). While the CSM was updated with the new information gathered in late 2019 and early 2020, the model still provides the same interpretation of the site, which is that there are likely two groundwater zones on site: one shallow contributing to the wetland and one deeper contributing to the Tittabawassee directly. EGLE agreed with this interpretation of the site. Dow reviewed the current plan for additional data collection at the time with EGLE and they concurred that the collection of general chemistry parameters to create Stiff diagrams for the compliance wells and wetland areas would add support for the current CSM.

The team also attempted to reconfirm the path forward for the site at the March 2020 meeting. While the deeper groundwater zone that contributes to the Tittabawassee River may be able to be address with a mixing zone, additional data may be necessary to better understand the shallow pathway and whether it needs to be further addressed as well. Dow noted that they anticipated further data collection for the shallow groundwater pathway to the wetland regardless of its interconnection to the Tittabawassee River. Dow proposed further data evaluation of datasets that could be attributed to each pathway in order to assess what additional data may need to be collected.

The next meeting with EGLE was held September 15, 2020 (Appendix O). During this meeting Dow presented the datasets evaluated, processes, and results of the further pathway specific data evaluation. Dow developed and discussed the specific parameters identified for further investigation in each pathway, proposed sampling locations, and media and methods for sampling. EGLE agreed conceptually with the plan as detailed during the meeting; however, requested submittal of a workplan for further consideration. Dow agreed to provide EGLE with a workplan for the GSI pathway analysis.

14.4 Work in 2021

As detailed in the previous section, Dow completed work on Part II of the Former Ash Pond RAP/CR in late 2020. It is anticipated that this volume will be submitted in early 2021. Dow also completed the GSI Investigation Workplan and intends on submitting this in early 2021 as well. Dow anticipates setting up an additional technical meeting during 2021 with EGLE to further discuss the field plan for the site and address any questions.

Contingent on EGLE approval, Dow plans on executing the additional proposed fieldwork at the site in Summer 2021 to capture any potential worst-case seasonal variability. Once the data is gathered and evaluated, Dow will schedule a project specific meeting with EGLE to discuss the findings and next steps.

Work in 2021 is anticipated to be completed in accordance with the milestone schedule presented in Section 15.0. Unless otherwise necessary or requested, plans or findings will be provided during periodic progress meetings, which are scheduled to occur on an approximately monthly basis. Annual updates detailing the work completed and projected for the next year will be presented in the annual CAIP.

15.0 2021 Conceptual Schedule

The Corrective Action work as a whole is anticipated to proceed according to the updated Corrective Action Implementation Plan High Level Overview, provided as Figure 1-4. Work on this program during 2021 is anticipated to progress consistent with the timelines provided in Table 15-1 below.

EGLE and Dow have tentatively scheduled monthly Corrective Action working meetings to facilitate discussions on the topics outlined in this Work Plan, review relevant data or findings and revisit the schedule on an on-going basis throughout the year. A SharePoint website was launched in 2016 to track progress, provide data and other electronic deliverables to EGLE, as needed for decision-making and to help EGLE fulfill their oversight function. As additional information becomes available, other corrective action goals may be identified in cooperation with EGLE.

The anticipated timelines provided below are guidelines to be used for planning purposes only. They are highly dependent on approvals, weather, technical developments, and other issues which may necessitate changes. Work scheduling and the planning process, described in Appendix G of Attachment 19 to the current Operating License, will be an iterative process that will incorporate changes, as warranted, through adaptive management.

Unless otherwise necessary or requested, plans or findings will be provided to EGLE during periodic progress meetings, which are scheduled to occur on an approximately monthly basis. Presentations and notes from those meetings will be posted to the Microsoft SharePoint® website approximately two weeks after the meeting. Environmental data collected will continue to be provided each quarter through the Environmental Monitoring Report unless otherwise agreed upon or requested.

Table 15-1. 2021 Corrective Action Workplan Anticipated Milestone Schedule

Report Section	Program	Milestones	Anticipated 2019 Timeline
4	1925	Conduct Evaluation of Existing Site Data to Assess CSM	Q2
4	1925	Complete Data Gap Analysis for the Collection of Additional Data	Q3
4	1925	Initiate Development of Water Balance Model	Q3
4	1925	Initiate Evapotranspiration Rate Assessment	Q3
5	VI	Present and provide a Summary of Initial Zone 3 Phase 3 Sub-slab, Indoor Air and Outdoor Air Sampling Results to EGLE	Q1
5	VI	Collect Seasonal Confirmation Samples and IM Samples for Selected Buildings in Z1 – Z4	Q1-Q4
5	VI	Review Add-on Building Categorization and Prioritization for Vapor Intrusion with EGLE	Q2
5	VI	Conduct Add-on Building VI Sampling	Q3 and Q4
6	DC	Submit As-Built Drawings for 2020 Implemented DC IMs	Q1
6	DC	Submit Plans for Long Term Barriers at DC DUs 1A-10 and 1A-11; 5EE and 5HH1	Q2
6	DC	Complete Construction for Long Term Barriers at DC DUs 1A-10 and 1A-11;5EE and 5HH1	Q3
6	DC	Evaluate DUs and Prepare Soil Sampling Plans for Category 9 (Rail Yard and Electrical Substation)	Q2
6	DC	Collect Soil Samples for Category 9 DUs	Q2 and Q3
6	DC	Review Results of Zone 4 Direct Contact Soil Sampling with EGLE	Q4
7	Ambient Air	Complete Ambient Air Pathway Evaluation for Category 9 DUs	Q4
8	SDF	Submit Cell 1 Design Package and License Mod Request	Q1
8	SDF	Initiate Construction Activities at Cell 1	Q3
8	SDF	Complete Construction Activities	Q3
8	SDF	Submit As-Built Plans and Post-Closure Plan Updates	Q3
8	SDF	Collect SWL data	Q3-Q4
8	SDF	Evaluate SWL data	Q4
9	PLF	Collect Additional Samples from wells 2549, 5924, and 5923	Q1-Q4
9	PLF	Complete plume modeling and adjust Pump Rate in Purge Wells 2690A and 2917 as necessary for Pilot Optimization	Q1-Q4
10	NEP	Revise Workplan for Data Gap Fieldwork	Q2

10	NEP	Implement Data Gap Workplan	Q3
10	NEP	Evaluate Field Data and Update HRCSM	Q4
10	NEP	Begin Well Network Optimization Plan	Q4
11	CD3	Complete installation of well west of 2926A and conduct sampling event	Q2
11	CD3	Present Results and Discuss Path Forward	Q3
12	7th Street	Reassess 7th Street Compliance Monitoring Program	Q2
13	Mark Putnam AOC	Groundwater SWL Collection	Q1-Q4
13	Mark Putnam AOC	Further Delineation Fieldwork	Q2-Q3
13	Mark Putnam AOC	Alternative Assessment for Management Approach	Q4
14	Former Ash Pond AOC	Submit Workplan for Data Gap Sampling	Q1
14	Former Ash Pond AOC	Submit Part II of the RAP/CR	Q1
14	Former Ash Pond	Conduct data gap sampling	Q3
ALL	ALL	Submittal of 2021 Corrective Action Summary Report and 2022 Corrective Action Implementation Work Plan	Q1 2022

16.0 References

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