

Volatilization to Indoor Air Pathway (VIAP)

Evaluation of a Dispersed Vapor Source under Part 201

A common challenge for developers and property owners is evaluating the VIAP at facilities with a dispersed vapor source such as contaminated urban soil, historic fill from unknown sources, or non-natural fill (urban fill). EGLE recognizes that when contamination is dispersed (no point source release), there may not be sufficient contaminant mass present to pose an unacceptable risk through the VIAP. This document identifies options to demonstrate contaminants are randomly dispersed and do not represent an unacceptable risk from the VIAP. This document primarily focuses on contamination dispersed in urban fill; however, it is also applicable to the evaluation of contamination dispersed in soil from other naturally occurring or man-made activities.

The evaluation described below is only applicable to the VIAP. It does not take the place of or eliminate the need to conduct additional characterization to appropriately evaluate all other relevant or complete exposure pathways, such as direct contact, particulate soil inhalation, volatile soil inhalation, etc. It also does not remove the need for appropriate land or resource use restrictions when applicable under Part 201, Environmental Remediation, of the Natural Resource and Environmental Protection Act, 1994 PA 451, as amended.

Submittals to EGLE for review and approval should demonstrate the information and requirements described throughout this document. Alternative demonstrations that meet the requirements can be proposed and considered by EGLE on a site-specific basis. It is recommended you contact the Remediation and Redevelopment Division (RRD) prior to developing an alternative or site-specific evaluation not discussed in this document.

Evaluation of the VIAP for Mercury in Soil: Unless there is a known or suspected release of elemental mercury at a site, evaluation of the VIAP for mercury is not required by EGLE regardless of the soil concentrations of total mercury. Mercury is a common contaminant present in soil and urban fill and may exist in the environment as multiple chemical species, many of which are not volatile. Soil gas sampling data for mercury at sites where soil exceeds screening levels or criteria has demonstrated that the mercury is highly unlikely to be present at concentrations that could pose an unacceptable risk to the VIAP. The presence of mercury in soil and urban fill is not considered a release of elemental mercury; however, this does not eliminate the requirement to evaluate total mercury in soil to assess other exposure pathways.

The evaluation of a dispersed source of contaminants as described in this document is only appropriate if it can be shown that the contaminants are randomly distributed and a contiguous contaminant mass or point source release is not present. This can be accomplished with a Phase I Environmental Site Assessment (ASTM E1527 or 40 CFR Part 312) or similar site assessment and subsequent borings and sampling data that effectively demonstrates all the following:

- Urban fill is a recognized environmental condition relevant to the VIAP, and
- The urban fill material that was deposited on the facility was contaminated prior to placement, and
- Contaminants within the fill material are in no way connected with a release on the property that may impact the VIAP.

To utilize this document, it is not necessary for urban fill to be present across the facility in a continuous formation or at consistent depths. It is important to note that by nature, urban fill is heterogeneous and may have been placed on a property at different times. Users of this document should utilize the section or sections below that are most appropriate to the conditions at the facility. A summary of all the evaluation options is included as Attachment 1.

Urban Fill less than 4' Below Ground Surface (bgs)

For facilities with urban fill only present at depths less than 4-feet bgs, there are two possible approaches to evaluate the VIAP using soil data. Both approaches are based on the following conditions being met:

- Urban fill has concentrations of volatile hazardous substances above the applicable unrestricted soil volatilization to indoor air criteria
- Urban fill is not present at depths of 4-feet bgs or greater; and
 - If urban fill is present at 4-feet or greater bgs, soil gas sampling is EGLE's preferred evaluation method. Follow the appropriate section later in this document.
- Urban fill is not present beneath a current building.
 - If urban fill is present beneath a current building, sub slab soil gas sampling is EGLE's preferred evaluation method. Follow the appropriate section later in this document.
 - If urban fill will be present below a planned building, follow the evaluation described below.

When the conditions listed above are met, either of the following approaches may be appropriate to evaluate the VIAP at the site or facility:

1. Incremental Sampling (IS) – IS, which is EGLE's preferred method of evaluation for planned structures, should be conducted in accordance with EGLE's [Incremental Sampling Methodology and Applications](#) resource material (2018). The decision unit (DU) should be representative of the fill being evaluated and may require collection of vertical

increments at multiple depths; however, the entire fill thickness does not necessarily have to be included in the sampling. If new structures are being proposed, the DU should encompass the area of the footprint of the proposed building(s).

The IS results are then compared to the applicable unrestricted soil volatilization to indoor air criteria to determine if a vapor source can be considered dispersed. If the detected concentrations in the incremental sample(s) are below the applicable unrestricted soil volatilization to indoor air criteria, no further sampling or evaluation of the VIAP is necessary for the DU. Samples should be analyzed for all volatile hazardous substances of concern.

2. Random Sampling Strategy – In accordance with EGLE’s [S3TM - Sampling Strategies and Statistics Training Materials for Part 201 Cleanup Criteria](#) (2002), develop a systematic random sampling program. A minimum of nine borings per exposure unit is required. From each boring, a soil sample should be collected from a minimum of two pre-selected or field determined intervals within the urban fill and submitted for laboratory analysis. For large parcels or thicknesses of fill less than 2-feet, a person may propose a different size exposure unit and/or a reduction in the number of borings or samples per exposure unit. Samples should be analyzed for all volatile hazardous substances of concern.

Utilizing the discrete random soil sample results, a demonstration of a dispersed vapor source can be made when:

- The statistical calculations of the range, variance, and standard deviation that are documented in a submittal provided to EGLE support a high degree of variability in the concentration of volatile hazardous substances present in fill, and
- Those data are supported with appropriate laboratory analytical results and figures.

If a vapor source is demonstrated to be dispersed using random soil samples and is not located directly beneath a current or a proposed building, then the contamination dispersed within the urban fill does not pose an unacceptable risk through the VIAP and no further sampling or evaluation of the VIAP is necessary.

Urban Fill less than 4’ bgs Beneath a Proposed Building

If the shallow urban fill will be directly below a proposed building and is shown to contain contaminants in the soil above the applicable unrestricted soil volatilization to indoor air criteria through either discrete random or IS sampling, then any of the following response activities could be conducted:

- a) removal of the urban fill from the building footprint prior to construction, or
- b) conduct sub-slab soil gas sampling after construction of the building as outlined in the section below, or

- c) complete a site-specific evaluation with multiple lines of evidence demonstrating there is not enough contaminant mass present in shallow soils to pose a risk to future receptors through the VIAP.

NOTE: For undeveloped properties, shallow soil gas samples (e.g. collected less than 4 feet bgs) collected over or within a dispersed vapor source prior to the placement of a structure may not be representative of facility conditions once a structure has been constructed.

Urban Fill Exists Beneath a Current Building

The presence of a potential vapor source beneath an existing building, regardless of the thickness of fill, could be evaluated through the installation and sampling of sub-slab soil gas points to determine if the contaminants are randomly dispersed and do not provide sufficient mass to pose an unacceptable risk through the VIAP. The recommended number of sub-slab soil gas point locations based on the square footage of the building are identified in Table 1. Any site-specific approach or reduced number of soil gas sampling locations should be discussed with EGLE prior to implementation.

Table 1 – Building Size and Sampling Locations

Building Size	Sample Density
Less than 10,000 ft ²	Two samples plus one additional sample per every 2,000 ft ² of building over 1,000 ft ²
Greater than 10,000 ft ²	7 + one additional sample per every 2,500 ft ² of building over 10,000 ft ²

The number of sub-slab soil gas point sampling events depends on the hazardous substances and sub-slab sample results. If the sub-slab sample results are all below the applicable unrestricted soil volatilization to indoor air criteria, meet quality assurance and quality control (QA/QC) sampling standards, and do not include any potential acute hazardous substance (see Table 2), only one sampling event is necessary.

If a hazardous substance(s) listed in Table 2 is detected in the sub-slab soil gas sample or is present in the fill material at a soil concentration that exceeds the applicable unrestricted soil volatilization to indoor air criterion, then at least two sampling events three months apart should be conducted. If the sample results are all below the applicable unrestricted soil volatilization to indoor air criteria for vapor for the sample events, it can be concluded that the dispersed contamination does not pose an unacceptable risk through the VIAP and no further sampling or evaluation of the VIAP is necessary.

Table 2 – Hazardous Substances that may be an Acute Vapor Hazard

CAS No.	Hazardous Substance	CAS No.	Hazardous Substance
67641	Acetone	108101	4-Methyl-2-pentanone (MIBK)
98862	Acetophenone	75092	Methylene chloride
7664417	Ammonia	71238	Propyl alcohol*
78933	2-Butanone (MEK)	103651	n-Propylbenzene*
57749	Chlordane	127184	Tetrachloroethylene
95578	2-Chlorophenol	108883	Toluene*
108203	Diisopropyl ether	2303175	Triallate
64175	Ethanol*	71556	1,1,1-Trichloroethane
67561	Methanol*	79016	Trichloroethylene

*NOTE: The compound is aerobically degraded in the vadose zone; therefore, if the results are below applicable unrestricted VIAP criteria and greater than 2% oxygen is present, one sampling event is sufficient for the evaluation of the VIAP.

Urban Fill Lateral to Existing or Proposed Buildings

At some sites, urban fill was or will be excavated for construction and the building foundation is or will be above native material or clean backfill. For these existing or planned structures, it is acceptable to have the urban fill with concentrations of volatile hazardous substances in the soil above the applicable unrestricted soil volatilization to indoor air criteria present laterally to the structure if it is shown to be a dispersed source. No further sampling or evaluation of the VIAP is necessary if the urban fill is solely located outside the footprint of the structure. This condition can be demonstrated in submittals to EGLE by using such documentation as boring logs, cross-sections, geotechnical data, or other lines of evidence obtained from the facility.

Urban Fill Greater Than 4' bgs

The presence of urban fill at depths of 4-feet and greater bgs allows for the construction and sampling of soil gas wells to evaluate the VIAP for a current or proposed building. For this scenario, one soil gas well per quarter acre should be installed across the site or facility at a recommended depth of 5-feet bgs but no shallower than 4-feet bgs. Soil gas wells used to evaluate dispersed contaminants in urban fill should be constructed within the urban fill material.

The facility should be sufficiently characterized to document the subsurface conditions and presence of urban fill, including the determination of where contaminant concentrations are present in fill above the applicable unrestricted soil volatilization to indoor air criterion. Ideally, the soil gas sampling will be biased towards or collocated with the locations where there are known contaminant concentrations above applicable unrestricted soil volatilization to indoor air criteria in the fill. If locations are discovered where contaminant concentrations in soil vapor are greater than the applicable vapor criterion, response actions such as additional soil gas sampling and characterization (more than 1 per quarter acre), mitigation, or remediation may be necessary.

If the soil gas sample results are below the applicable unrestricted soil volatilization to indoor air criteria for vapor and meet all required QA/QC sampling standards, only one sampling event is necessary. If one or more of the hazardous substances listed in Table 2 are detected in the soil gas sample or are present in the fill material at a soil concentration that exceeds the applicable unrestricted soil volatilization to indoor air criterion, at least two soil gas sampling events three months apart should be conducted. If all sample results are below the applicable volatilization to indoor air criteria for vapor, it can be concluded that the contamination present within urban fill is dispersed and does not pose an unacceptable risk through the VIAP and no further sampling or evaluation of the VIAP is necessary.

Approved: 

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Attachment 1 – Tabular Summary of Dispersed Source Demonstrations

Location of Urban Fill	Thickness of Urban Fill	Possible demonstration of dispersed vapor source	Results and Evaluation
Beneath a proposed building	< 4' bgs	- Soil evaluation using IS or discrete random sampling strategy	1) IS: All results < Criteria – No further action 2) Discrete random: All results < Criteria – No further action 3) IS or Discrete random: Any Result > Criteria a) Remove fill from beneath the footprint b) Conduct sub-slab soil gas sampling post construction c) Site specific evaluation or remedy strategy
Beneath a current building	< 4' bgs	- Conduct sub-slab soil gas sampling	1) All results < criteria – no further action after 1 sampling event 2) Acute Hazardous Substances Detected and all results < criteria – one additional sampling event for a total of two.
Solely outside the footprint of current or planned structures.	< 4' bgs	- Verify that the urban fill is a dispersed source through IS, discrete random samples, or other lines of evidence.	No further sampling or evaluation of the VIAP is necessary.
Beneath a current or planned structure	> 4' bgs	- Soil gas evaluation (soil gas wells with screens set no shallower than 4 feet bgs for planned structure footprints or sub-slab points for current structures)	1) All results < criteria – no further action after 1 sampling event 2) Acute Hazardous Substances Detected and all results < criteria – one additional sampling event for a total of two.