TITLE: **Reasonably Anticipated Complete Exposure Pathways**

DATE EFFECTIVE: 21 October 2011

HISTORY: Update of VA30007.11.001 - Revision was necessary to reflect changes in the NFA form.

KEYWORDS: Reasonably anticipated exposure pathway, point of compliance, land use category, vapor intrusion, pathway assessment, identified area, exposure unit, complete exposure pathway

RULE/ AUTHORITY: OAC 3745-300-07, -08, -09, -11

QUESTION: How do you determine reasonably anticipated complete exposure pathways at VAP properties?

BACKGROUND: The definition of a complete exposure pathway includes "a current or reasonably anticipated exposure pathway determined to be complete after the identification of current and reasonably anticipated property use and receptor populations," as provided in OAC 3745-300-01(A)(25). The data quality objectives (DQOs) provided in OAC 3745-300-07(C) include a requirement to determine identified area(s) that need to be investigated, factoring in current and reasonably anticipated future use of the property, and developing an approach to identify chemical(s) of concern, complete exposure pathways, and current and reasonably anticipated future receptors. OAC 3745-300-07(E)(6) requires the identification of current and reasonably anticipated property uses and receptors.

OAC 3745-300-07(F)(1) requires the determination of both the current and reasonably anticipated complete exposure pathways. If it is determined that any of the exposure pathways on or adjoining the property are not reasonably anticipated to be complete, the Phase II report must include a written justification for the elimination of those pathways from further consideration in accordance with OAC 3745-300-07(F)(1)(c). Because a volunteer is not obligated to determine applicable standards or apply a remedy for incomplete exposure pathways, exposure pathway completeness determination is an important step.

A remedy is needed for all complete exposure pathways determined to exceed applicable standards. Because the remedy must be implemented prior to Ohio EPA issuing the covenant not to sue (CNS), remedy options that address exposure pathways

anticipated to occur after redevelopment can be limited. This is especially true for buildings or construction projects that take place after issuance of the CNS. However, remedies implemented in order to obtain a CNS can be modified, as necessary, to adjust for changes that occur at the property over time after the CNS is issued (e.g., redevelopment). Refer to TGC VA30011.14.003 for guidance on appropriate remedies to address anticipated pathways.

In accordance with OAC 3745-300-07(I)(3), all complete pathways must meet applicable standards or a remedy needs to be implemented. Determining which existing (or current) pathways at a property are complete is typically a straight forward determination. However, determining which future exposure pathways or receptors are "reasonably anticipated" to be complete can be more challenging. This document provides guidance on the determination of "reasonably anticipated complete exposure pathways."

ANSWER: The determination of the reasonably anticipated complete exposure pathways should be done for each Identified Area or Exposure Unit; incomplete pathways in one area may be complete in another. The test of reasonableness should be based on an evaluation of multiple lines of evidence and generally follows three steps:

Step 1 – Establish the Land Use Category: The property's land use category (e.g., residential or commercial/industrial) must be determined because it helps to define the types of receptors expected at the property, sets the point of compliance for direct contact with soil, and determines the applicable standards that can be used at the property. (See 3746.04(B)(1))

Step 2 – Consider Development Plans: Current development, as well as a property's development potential over time, serve important roles when identifying anticipated complete exposure pathways. In some cases, development plans are well defined and known. In other cases, development details may be much less defined. Some properties are vacant and ready for redevelopment without any known end use. Because development plans are not always known in detail, the identification of a reasonably anticipated exposure pathway for potential development is not always easily done. However, it is an important and necessary part of a pathway completeness determination.

In general, development plans fall into one of the following Development Plan Categories:

1. Only the current configuration and use of the property is foreseeable;
2. Future site configuration and associated building designs and property use are known;
3. General plans for development and property use are anticipated, but no specifics are available; or
4. New development is expected or intended, but even general plans are unknown.

If the current property configuration will not change, or if post-CNS development plans are certain, then pathway completeness is limited to the current and/or proposed development plans. That is, reasonably anticipated pathways associated with the planned development/use can be readily identified. However, if development plans are less certain, then the NFA Letter must approach the evaluation of reasonably anticipated pathways somewhat differently, given the uncertainty in development plans. Unknown or uncertain development plans are especially problematic for the vapor intrusion to indoor air pathway because building design and/or location on the property can affect whether applicable standards are met. Refer to Table 1 for guidance on when to consider the vapor intrusion pathway complete.

Step 3 – Consider Property-Specific Criteria: After designation of the land use category and consideration of known or intended development plans, there are "property-specific criteria" that should be assessed to complete the evaluation of reasonably anticipated pathways at the property. Below is a list of criteria for consideration when determining whether or not additional complete exposure pathways exist above and beyond those identified based on development plans.

- The current or planned configuration of the property allows for additional buildings or development, such as building additions, new buildings, outparcels, etc.;
- Development potential of unimproved parcels and whether or not specific areas of the property are needed for parking, green space, etc.;
- Current land uses and/or community development plans for

the property and surrounding areas;

- Physical features of the property and whether or not the features are conducive to buildings, such as the topographic features, water features, flood plain, etc.;
- Zoning, rights-of-way, easements, and the location of railroads or roads and whether or not these allow for buildings on the property or surrounding areas;
- Accessibility to parking, roads, and utility corridors; or
- Potential for re-parceling or sub-parceling of identified areas, exposure units, and/or the property.

Any additional pathways identified based on consideration of the above criteria must be considered reasonably anticipated pathways. If after evaluating these criteria, there are no additional complete pathways identified beyond those based on the land use category and development plans (e.g., Development Plan Category 1 from Step 2 above), then no further consideration of additional pathways can be justified. Written justification in accordance with OAC 3745-300-07(F)(1)(c) is required for all pathways eliminated from consideration.

In practice, there are only a few pathways that need to be evaluated differently based on changes in future development plans. The primary pathway is the vapor intrusion to indoor air pathway, and the primary concern for this pathway is the location, size and configuration of future buildings. Similarly, the anticipated/future construction worker pathway can also have uncertainty, especially when deciding the depth and location of excavations for development or utility trenching. Appendix A includes examples with specific scenarios on how to determine if a pathway is complete or reasonably anticipated.

Specifics for the Vapor Intrusion Pathway: Table 1 includes a decision matrix that can help determine whether the vapor intrusion pathway should be considered complete for existing or reasonably anticipated buildings. Reasonably anticipated buildings may not always have known construction plans, locations, or a known timetable for their construction. It is intended that the following matrix can be applied to an entire property, or only to specific identified areas or exposure units on a property. For instance, a portion of a property with an existing building might continue its existing use, but another area of the property might be planned for development in the future (with or without specific construction

plans). A third area on the property without any current buildings is viewed as an area unlikely for new buildings. The matrix can be used to help determine the approach for independently assessing the three different areas of the property and the identified areas or exposure units.

Table 1: Complete Pathways for Vapor Intrusion Assessment Matrix

	Construction of new buildings is unlikely*	Construction plans for new buildings are known**	Construction plans for new buildings are unknown, but there is potential / desire for future development***
Continued use of existing buildings or post-CNS demolition of existing buildings	Complete pathway exists for existing buildings as configured	Complete pathways exist for both existing buildings and planned buildings	Complete pathways exist for both existing buildings and reasonably anticipated buildings (assume a default building)
Vacant areas without buildings, including areas where buildings were demolished prior to NFA issuance	No complete pathway exists for vapor intrusion pathway	Complete pathways exist for planned buildings	Complete pathways exist for reasonably anticipated buildings (assume a default building)

* The bulleted list included in Step 3 (Property-Specific Criteria) can help determine if construction is unlikely.

** When construction plans are known, vapor intrusion should be evaluated using the dimensions and configuration of the planned buildings (e.g., planned buildings from Development Plan Category 2 described in Step 2 above).

*** A “default building" is defined by the building parameters listed in Tables 4 and 5 of “Sample Collection and Evaluation of Vapor Intrusion to Indoor Air for Remedial Response and Voluntary Action Programs, Ohio EPA, Division of Emergency and Remedial Response, May 2010” http://epa.ohio.gov/portals/30/rules/VI%20guidance.pdf.

Specifics for the Construction / Excavation Worker: The same development determinations used in assessing the vapor intrusion pathway can be used in assessing the construction / excavation worker pathway. If the weight of evidence allows for the conclusion that this pathway is not reasonably anticipated to be complete, then an applicable standard need not be developed. OAC 3745-300-07(F)(1)(c) directs the volunteer to include a written justification for the elimination of those exposure pathways from further consideration. However, if the weight of evidence indicates that the pathway is reasonably anticipated, then a demonstration must be made that applicable standards are met. If the area exceeds the applicable standards, or an applicable standard was not developed, the volunteer must implement a risk mitigation plan or other remedy

in accordance with OAC 3745-300-11. The point of compliance for this pathway can be determined based on the depth of construction of potential buildings and utilities. If contamination in the subsurface is only present at a depth deeper than the anticipated depth of construction, the pathway may be considered incomplete because the contaminated media is present beneath the point of compliance.

SUMMARY: All identified areas or exposure units where complete or reasonably anticipated complete exposure pathways exist must be assessed in accordance with the Phase II rule. OAC 3745-300-07(E)(6) requires the identification of current and reasonably anticipated property uses. OAC 3745-300-07(E)(6) also requires the identification of receptor populations reasonably anticipated to be exposed to chemical(s) of concern on the property, and all off-property receptor populations reasonably anticipated to be exposed to chemical(s) of concern emanating from the property.

The Volunteer needs to collect the necessary information to determine if the environmental media meet or exceed the VAP applicable standards. If a pathway is deemed not to be reasonably anticipated, then an applicable standard need not be developed. OAC 3745-300-07(F)(1)(c) directs the volunteer to include a written justification for the elimination of those exposure pathways from further consideration. If a current or reasonably anticipated pathway is considered complete, then an applicable standard for the environmental media must be developed or a remedy must be implemented to address the pathway. If the area exceeds the applicable standards, the volunteer must implement a remedy in accordance with OAC 3745-300-11.

For voluntary actions on brownfields or developing properties, the placement and/or size of future buildings often determine whether applicable standards for vapor intrusion will be met after a property is developed or redeveloped. Development plans have an important role in determining what is considered complete exposure pathways, but other factors should also be considered in order to ensure all reasonably anticipated exposure pathways are identified. These other factors become increasingly important as the uncertainty in development plans increases. It may be necessary to assume default development scenarios in order to adequately

evaluate reasonably anticipated exposure pathways when known development plans do not exist.

OHIO EPA CONTACT:

For any questions concerning this issue, please contact the VAP central office at (614) 644-2924.

Appendix A
Example Scenarios for Determining Pathway Completeness

The following scenarios assume that source areas are located near or beneath buildings or areas with potential buildings. If a current or reasonably anticipated pathway is considered complete, then an applicable standard for the environmental media must be developed or a remedy must be implemented to address the pathway. If the area exceeds applicable standards, the volunteer must implement a remedy in accordance with OAC 3745-300-11. Guidance on appropriate remedies for addressing anticipated pathways are included in TGC VA30011.11.001.

Scenario 1: A commercial building on property is currently vacant. Reuse of the vacant building is planned post-CNS.

Recommended Approach: The current and reasonably anticipated vapor intrusion pathway is complete. Vapor intrusion is evaluated based on the configuration and layout of the exiting building. The rest of the property is evaluated using Step 3 (Property-Specific Criteria) to determine if additional pathways (i.e., new buildings or new construction activities) are anticipated to be complete. Written justification is provided in the NFA Letter for pathways determined to be incomplete.

Scenario 2: Existing commercial building is vacant and will be demolished once cleanup is complete and the CNS is issued. There are specific plans for a new building once the old one is demolished.

Recommended Approach: The vapor intrusion pathway is complete. The existing building is evaluated for vapor intrusion because it will be on property after issuance of the CNS. If applicable standards are exceeded for the existing building, a remedy is required prior to issuance of the CNS. Vapor intrusion is also evaluated based on known plans for the new building and a remedy will be needed if applicable standards are exceeded. The rest of the property is evaluated using Step 3 (Property-Specific Criteria) to determine if additional pathways (i.e., new buildings or new construction activities) are anticipated to be complete. Written justification is provided in the NFA Letter for pathways determined to be incomplete. Construction worker pathway is evaluated based on planned and reasonably anticipated construction activities considering construction locations and depth of construction activities (including utility work) on the property.

Scenario 3: A vacant building was demolished on the northern half of the property prior to NFA issuance and there are no plans for redevelopment of this area; it will remain as green space. However, a new building is planned for the southern half of the property post-CNS.

Recommended Approach: There is no complete pathway for vapor intrusion for the

northern half of the property. Written justification is provided in the NFA Letter to support this conclusion based on the intent for this part of the property to remain green space. However, the vapor intrusion pathway is complete for the new building and is evaluated based on known plans for the new building. A remedy is needed if applicable standards are exceeded. Construction worker pathway is evaluated based on planned and reasonably anticipated construction activities considering construction locations and depth of construction activities (including utility work) on the property. Landscaping and maintenance issues are evaluated for the green space area.

Scenario 4: Same as scenario 3, however, there is uncertainty about whether the northern half of the property will be developed in the future.

Recommended Approach: The vapor intrusion pathway is complete for the new building that is planned and a potential building that may be built in the future on the northern half of the property. The "Property-Specific Criteria" in Step 3 were used to determine that the northern half of the property may be redeveloped in the future. Therefore, vapor intrusion is evaluated based on known plans for the new building (southern half of property) and a default building located on the northern half of the property. Applicable standards are determined based on the specifics of the new building and a default scenario for the potential building. The construction worker pathway is evaluated following a similar approach to the previous scenarios.

Scenario 5: A manufacturing building is currently in use and plans include a potential new addition to the building or construction of a separate building. New buildings on the rest of the property are not planned, but given that this is an industrial park it is considered a possibility for the future. The property is being marketed as a good place to start or expand a business.

Recommended Approach: The vapor intrusion pathway is complete for both the current building and any potential buildings that may be built. Applicable standards for the existing building are determined using the current building configuration and layout. Default inputs are used to evaluate any potential construction on the rest of the property. Remedial actions are needed if either scenario exceeds applicable standards. The construction worker pathway is evaluated following a similar approach to the previous scenarios.