

March 31, 2016

## **Division of Remediation Vapor Intrusion Investigation Process and Flowchart**

**Introduction** – The Tennessee Department of Environment and Conservation, Division of Remediation (DOR) developed a vapor intrusion investigation flowchart for DOR project managers and other interested parties. The flowchart provides a general depiction of the anticipated potential stages of a DOR vapor intrusion investigation, from site discovery through various remedial alternatives. This text is intended to provide clarification of the decision process and overall logic flow represented by the flowchart.

*Disclaimer: It is recognized that investigating potentially complete vapor intrusion pathways is by necessity an iterative process, and that it is impossible to capture all the possible variations of a vapor intrusion investigation with a flowchart. Appropriate DOR staff should be consulted if there are any questions regarding a particular program's vapor intrusion investigation requirements.*

**Step 1) Site Discovery** – Sites with potential vapor intrusion pathways can come under the jurisdiction of DOR in varying ways including, but not limited to, complaint response, spill response, and through participation in one of DOR's voluntary or regulatory remedial programs. These are all referred to as "Site Discovery" for the purposes of the flowchart.

**Step 2) Does an Imminent Hazard Exist that Requires Emergency Response?** – If odors or negative physiological effects are reported by inhabitants or occupants of on-site buildings, the building atmosphere should be evaluated for fire and explosive conditions. Explosive conditions posing safety concerns that warrant urgent intervention are reasonably suspected to exist when measured concentrations of vapors in the building, utility conduits, sumps, or other subsurface drains directly connected to the building exceed one-tenth (10%) of the lower explosive limit (LEL). If it is determined that there is potential fire or explosive conditions, immediate evacuation is recommended. The local fire department should be notified of the threat. Once the possibility of an imminent hazard has been discounted or appropriate emergency response has occurred additional investigation can take place.

**Step 3) Evaluate Available Site Data & History** – The investigation of the potential vapor intrusion exposure pathway can proceed by gathering site data from existing documentation. Site historical information should be reviewed and development of the Conceptual Site Model (CSM) should begin. The presence and extent of karst or fractured bedrock features and other potential preferential pathways should be noted.

**Step 4) Is There Evidence of a Release at Site?** – The possibility of a release of vapor forming chemicals, including but not limited to chlorinated volatile organic chemicals (CVOCs) and petroleum hydrocarbons (PHCs), should be assessed. Lists of specific vapor forming chemicals can be found in various sources including the U.S. Environmental Protection Agency (USEPA) Regional Screening Levels table and the USEPA Vapor Intrusion Screening Level (VISL) calculator. If vapor forming chemicals are not present in site media, and there is no evidence or indication (e.g., current or past complaints of odors or physiological effects) of a release at the site, investigation of the vapor intrusion pathway can end.

**Step 5) Has There Been a Release Inside the Building?** - If there is evidence or indication of a release of vapor forming chemicals inside a building, the building should be considered an Existing Building of Concern and a site-specific evaluation should occur (see Step 9a). Otherwise proceed to Step 6.

**Step 6) Collection/Gathering of Screening Data** – Site data should be evaluated for completeness and prepared for a screening evaluation. If critical data gaps are identified, data to fill these gaps can be acquired.

**Step 7) Does the Site Pass a Screening Evaluation?** – For the screening evaluation site, data is compared to appropriate vapor intrusion risk-based screening levels and/or other screening criteria (e.g., vertical separation distances) determined on a program specific basis. If applicable screening criteria are met, investigation of the vapor intrusion pathway can end. If screening criteria are not met, the vapor intrusion investigation process should continue (proceed to Step 8).

**Step 8) Are There Existing Buildings of Concern?** – Any existing building(s) located within critical lateral distances (determined on a program-specific basis) from the edge or boundary of a CVOC or a PHC soil gas or groundwater plume should be considered an “Existing Building of Concern.” If a preferential pathway is suspected to impact a building located beyond critical lateral distances, the pathway should be evaluated as a possible vapor conduit. If the preferential pathway cannot be ruled out through soil gas sampling or other means, the building associated with the suspected preferential pathway should be considered an Existing Building of Concern.

### **Investigations of Existing Buildings of Concern**

**Step 9a) Conduct a Site-Specific Evaluation That May Include Data Collected Indoors** – Where there is an Existing Building of Concern, collection of exterior soil gas near the foundation, sub-slab soil gas, and/or indoor air samples may be appropriate. A site-specific vapor intrusion evaluation should be performed utilizing multiple lines of evidence.

**Step 10a) Does the Site Pass a Site-Specific Evaluation?** – If a site-specific evaluation concludes with acceptable risk results (determined on a program-specific basis), investigation of the vapor intrusion pathway can end. If it does not, proceed to Step 11a.

**Step 11a) Mitigate Indoor Air Exposure, Remediate Subsurface Contamination, Conduct Long Term Monitoring, and Establish Any Necessary Institutional/Engineering Controls** – When a site-specific evaluation indicates that unacceptable vapor intrusion risks may exist to occupants of existing buildings, some possible outcomes include mitigation, remediation, monitoring, and/or the establishment of institutional controls (ICs) or engineering controls (ECs).

### **Investigations of Areas Where There Are No Existing Buildings of Concern**

**Step 9b) Conduct a Site-Specific Evaluation That May Include Use of an Approved Site-Specific Model** – In areas where there is not an Existing Building of Concern but there is a potential for buildings to be constructed in the future, a site-specific vapor intrusion evaluation

focusing on potential future exposure should be performed utilizing multiple lines of evidence. Exterior soil gas/groundwater data and soil characteristics data can be utilized for site-specific modeling (e.g., Johnson and Ettinger (J&E) model) as one line of evidence

(For information on the Johnson and Ettinger model please see [http://www.epa.gov/oswer/riskassessment/airmodel/johnson\\_ettinger.htm](http://www.epa.gov/oswer/riskassessment/airmodel/johnson_ettinger.htm).)

**Step 10b) Does the Site Pass a Site-Specific Evaluation?** – If a site-specific evaluation concludes with acceptable risk results (determined on a program-specific basis), the investigation of the vapor intrusion pathway can end. If it does not, proceed to Step 11b.

**Step 11b) Establish Institutional/Engineering Controls, Remediate Subsurface Contamination, Conduct Long Term Monitoring** – When a site-specific evaluation indicates that unacceptable vapor intrusion risks may exist to occupants of potential future buildings, some possible outcomes include remediation, monitoring, and/or the establishment of ICs or ECs.

**DOR VAPOR INTRUSION INVESTIGATION FLOWCHART**

