7.9 SOIL VAPOR OR INDOOR AIR SAMPLE EVALUATION

The interpretation of data is a key element in planning the project as the data will drive the decision. When planning an investigation, project planners should consider the likely interpretation of the data to avoid wasting time and resources. In general, the results from a single media (i.e., concentrations of VOCs in groundwater) should not be used as a single line of evidence to rule out a vapor intrusion pathway. A "multiple lines of evidence" approach should be used to evaluate the vapor intrusion pathway due to the variability in subsurface conditions. Lines of evidence to evaluate the completeness of a vapor intrusion pathway may include the site history, the identification of a known or suspected source area, the building chemical use inventory, groundwater, soil vapor, indoor air and outdoor air data, information on building construction, ratio of indoor air and soil vapor results, and others. By using the multiple lines of evidence approach, investigations can assess whether the vapor intrusion pathway is complete and whether elevated levels of contaminants in indoor air are likely due to subsurface vapor intrusion, an indoor source, or a localized outdoor source.

7.9.1 Soil and Groundwater Sample Evaluation

Site specific groundwater and soil analytical data are compared to HDOH environmental action levels (EALs). The Groundwater Action Levels listed in Table C-1a of the EHE document are intended to address vapor intrusion from groundwater into buildings and subsequent impact on indoor air quality. The Soil Action Levels listed in Table C-1b of the EHE document are intended to address vapor intrusion from soil into buildings and the subsequent impact on indoor air quality (HDOH, 2008).

7.9.2 Soil Vapor Sample Evaluation

If analytical data from groundwater or soil samples approach or exceed the action levels listed the EHE document Appendix 1, Tables C-1a and C-1b, respectively (or in the EAL Surfer), additional investigation in the form of collection of soil vapor samples and analysis is recommended. The soil vapor sample analytical results are compared to Shallow Soil Gas Action Levels for evaluation of potential vapor intrusion concerns published in the EHE document (HDOH, 2008, Table C-2 in Appendix 1).

7.9.3 Indoor Air Sample Evaluation

Initially, the site data are compared to typical background concentrations, either provided in indoor air literature or obtained from concurrently collected outdoor air samples, to assess whether an environmental medium may have been contaminated. When conducting a comparison of detected indoor air contaminant concentrations to background, a detected contaminant concentration that is higher than typical background for the contaminant may indicate an atypical, possibly extraneous source of contaminants impacting the air.

The evaluation of indoor air sample data is continued by comparing concentrations of detected contaminants with established HDOH criteria for Indoor Air Action Levels (HDOH, 2008, Table C-3 in Appendix 1).

Further, data from air samples taken in various parts of a building can be reviewed and compared to each other to help identify contaminant concentration gradients or hot spots. For example, if basement or elevator shaft concentrations are elevated above background and there is a decreasing concentration gradient from those areas on up, there is a good chance that the detected concentrations are due to groundwater or soil contamination. However the building should be inspected prior to sampling to eliminate the presence of other indoor sources such as stored chemicals in a basement.

Air concentrations of VOCs can be expressed either as mass per unit volume [e.g., milligrams per cubic meter (mg/m^3)] or as volume of gas per volume of air. [e.g., ppmv]. In the interpretation of data, it is often necessary with VOCs to convert from one type of unit to another to allow for comparisons between toxicity values and background values, or for comparisons between laboratory reported concentrations and EALs. The conversion can be achieved using the Ideal Gas Law equation. The following equation simplifies the Ideal Gas Law equation assuming atmospheric pressure [one atmosphere = 760 millimeters of mercury (mm Hg)] and, unless site specific information indicates otherwise, at 298 Kelvin (K) [i.e., 25 degrees Celsius (˚ C)]:

$$ppmv = \frac{mg/m^3 \times 24.45}{MW}$$

Where:

ppmv = Parts per million by volume

mg/m^3 = Milligrams per cubic meter

MW = Molecular Weight (of a specific chemical)

The HDOH has developed a Vapor Unit Conversion spreadsheet that converts between concentrations (HDOH, 2008), which is available for public use.

After the results of indoor air quality measurements are compared against background data the data will be used in the risk assessment process.

7.9.4 Additional Evaluation

If analytical data from groundwater or soil samples, soil vapor samples, or indoor air samples approach or exceed the action levels listed above, additional evaluation or remedial actions may be warranted. Under most circumstances, and within the limitations described in the EHE document (HDOH, 2008), the presence of a chemical in soil, soil gas, or groundwater at concentrations below the corresponding Tier 1 EALs can be assumed to not pose a significant threat to human health and the environment.

Exceeding the Tier 1 EALs for a specific chemical does not necessarily indicate that the contamination poses significant environmental concerns, only that additional evaluation is warranted (HDOH, 2008). A detailed review of specific hazards can be carried out if time- and cost-beneficial, or contamination that exceeds the EALs can simply be remediated. This can even include the preparation of site-specific human health or ecological risk assessments, although this level of effort will rarely be required for typical sites.