DATA QUALITY AND ADEQUACY FACT SHEET

Introduction

Due to the inherent limitations of environmental sampling and analysis methods, including those associated with vapor intrusion (VI) assessments, data are evaluated prior to use to determine whether they are of sufficient quality for the intended use and are consistent with the VI conceptual site model (VI CSM) and project-specific data quality objectives (DQOs) (NJDEP 2014; USEPA 2006). DQOs are typically developed during project planning (i.e., during work plan preparation). Procedures for addressing data quality for laboratory analyses for common chemicals are well established, but project-specific DQOs are needed to set objectives for the overall data collection process and to make sure data collected will meet those objectives, including field measurements (e.g., field-screening methods), field sampling, and site-specific observations relevant to VI assessments.

Some typical DQOs for VI studies that should be addressed are listed below. This list is not complete, as special circumstances at any given site may dictate very specific DQOs.

- Define study goals.
- Identify chemicals of concern and screening levels.
- Choose sampling and analysis methods with appropriate reporting limits.
- Complete pre-sampling building survey (interior sampling).
- Establish appropriate sampling conditions, number of samples, and duration of sampling.
- Collect quality control (QC) samples (e.g., field blanks, duplicates).
- Establish data validation procedures.

A variety of field and laboratory data is collected for VI studies, including chemical concentrations, weather conditions, differential pressure, and a range of site-specific observations. Developing DQOs should be an early step in any data collection activity. Planning tools, such as the U.S. Environmental Protection Agency's (USEPA's) DQO process described below, can be used to help ensure that data of the right quality, type, and amount are collected. Clearly defining project objectives and goals also helps in selecting the appropriate sampling methods and locations.

Even when data relevant to VI is collected prior to considering VI as an exposure pathway (e.g., groundwater data), the quality of the existing data should be reviewed to provide context to any conclusions from the data. The purpose of this fact sheet is to identify data quality and adequacy as an important part of the process and to provide an overview of DQOs and references to further resources. Additional steps to ensure data quality are included in **Chapter 7: Sampling and Analysis** because specific quality requirements may differ according to the investigation activity.

Data Quality Objectives

USEPA has developed guidance for their DQO process to "ensure that when collecting data to characterize environmental processes and conditions, these data are of the appropriate type and quality for their intended use" (USEPA 2006). While this guidance is typically applied to Superfund sites, the concepts are relevant to all data collection activities and can be customized or simplified to an

appropriate level of effort. In addition, a number of states have their own guidance documents that include guidelines on data quality and adequacy (e.g., IDEM 2022).

DQOs should be established before data are collected and reviewed after data collection. DQOs are an integral part of the data evaluation process and should be addressed prior to using data to interpret site conditions. Previously collected data may not comprehensively meet all DQOs outlined for new data, but if the data meet analytical standards (Step 5 below), the existing data can be used to supplement newly collected data to address the problem statement/study questions.

Guidance from the USEPA (2006) organizes the DQOs around seven steps:

1. State the problem.
2. Identify the goals of the study.
3. Identify the information inputs.
4. Define the boundaries of the study.
5. Develop the analytical approach.
6. Specify performance or acceptance criteria.
7. Develop the plan for obtaining the data.

These seven steps are typically addressed within the context of a VI site screening or detailed evaluation, although this formal stepwise process is not always cited. As long as the concepts outlined in these steps are addressed appropriately, the quality of the data collected should meet the intent of this process.

Step 1. State the problem: This is a way of setting the goal for the project. For example, if the problem is a simple screening question, such as "is VI potentially occurring in buildings (current or future)?" the problem statement would be "it is not known if VI is occurring in buildings (current or future)." This problem statement would set a different level of data collection than "the extent of vapor-forming chemicals (VFCs) in soil vapor is not delineated." The VI CSM is an integral part of defining Step 1. Step 1 can be more detailed: "The potential human health risks from VI for buildings within a specific area have not been quantified." They may also focus on specific questions: "The sanitary sewers may be preferential VI pathways." For detailed, comprehensive studies, several problem statements may be needed to cover the full range of issues to be addressed.

Typical problem statements that an investigator may consider include the following:

- The source area of VFCs in groundwater has not been delineated.
- Indoor sources and VI intrusion sources of chemicals are not distinguishable.
- The short-term temporal or seasonal variability of chemicals in indoor air is not known.
- The variability of VI between heating and cooling seasons has not been characterized.
- All buildings where VI might be occurring have not been sampled. This could include buildings near the source release area or the footprint of the groundwater plume, as well as buildings that are served by potentially impacted sewer utilities lines and other preferential pathways (see the **Vapor Intrusion Preferential Pathways Fact Sheet**).

Step 2. Identify the goals of the study. This step establishes the goal for the particular study, which could be a screening evaluation or a comprehensive evaluation of VI and potential human health risks. The goals set in Step 2 will define the types and amount of data that will be needed to address Step 1 (e.g., whether the data already exist or need to be collected). A screening evaluation (is VI potentially occurring?) may need less data than a comprehensive evaluation. When setting goals, it should be recognized that USEPA typically considers reasonable maximum exposure as the applicable representation of potential exposure for the purpose of risk assessment, so data representative of this condition should be collected (e.g., temporal data [heating or cooling seasons, wet or dry seasons, seasonally variable water table conditions] or whether the heating, ventilation, and air conditioning is on or off, etc.).

Step 3. Identify the information inputs. This step summarizes what data are needed to meet the study goals and can include the identification of media to sample (e.g., groundwater, soil vapor, or indoor air), appropriate sampling methods, and the appropriate analytical methods that should be used (e.g., TO-15, TO-15SIM, TO-17; [see **Section 7.10**] to achieve sufficiently low detection limits for indoor air samples for many VFCs). This step is dependent on regulatory requirements appropriate to the site (e.g., does the state require colocated sub-slab soil vapor and indoor air samples or a specific number of samples based on building size) as well as professional judgment. Information inputs also can encompass field observations, including documenting soil types, weather conditions, and other information beyond environmental samples. Existing data should be reviewed to understand whether it is adequate for the intended purpose or additional information is needed.

Step 4. Define the boundaries of the study. This step addresses the geographic and temporal boundaries of the study as well as any constraints that may limit the ability to gather data (e.g., permission from residents). The geographic boundaries should be related to the study goals (Step 2) and may expand or contract in subsequent studies depending on the results. In some cases, the boundaries extend beyond the original source area or "site." Particularly with VI, there are temporal environmental conditions under which VI may be higher than others (e.g., cold weather, barometric pressure variations). These temporal conditions should be considered to address reasonable maximum exposure for the purpose of evaluating human health risk.

Step 5. Develop the analytical approach. This step describes how the data will be analyzed. For example, will the data be combined spatially or with depth to address the study problem or how will indoor air and soil vapor concentrations be evaluated? Will this be a simple screening comparison, involve some modeling, or include a health risk assessment? Ideally, a set of guidelines is used in this step to determine further action (e.g., no action, further sampling, mitigation).

Step 6. Specify performance or acceptance criteria. This step defines the criteria that can be used in statistical hypothesis testing or, more frequently, in an estimate of allowable uncertainty. Typically, in this step the actual data collected in the field are compared to the planned data collection to verify that sufficient samples of good quality were collected. In some circumstances, data usability or data quality reports are required to document that the available data can be used to address the study question. Even if formal reports are not required, the quality of the analytical data should be reviewed. This is the step where the criteria for field and laboratory data quality can be established (e.g., duplicate samples, blank samples). Data quality assessment often considers the parameters of precision, accuracy, representativeness, comparability, completeness, and sensitivity of the data (shortened to PARCCS) and is performed to identify specific QC nonconformances and data adequacy. The data usability evaluation for this step considers the introduction of bias or other effects these QC nonconformances may have on the interpretation and use of the data.

Step 7. Develop the plan for obtaining data. This step documents the process outlined in Steps 1 to 6 as well as the details for sample collection and data analysis. Step 7 is essentially the work plan for collecting the data as outlined in Steps 1 to 6.

Once data are collected, the DQOs are reviewed to assess whether sufficient data have been collected to address the study question(s) (Step 2). Then, data evaluation can proceed. It is not unusual for initial rounds of data collection to result in additional questions, which can lead to new problem statements and sampling activities.

REFERENCES

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